PROJECT DESCRIPTION

THE JAY-CARDINAL PROJECT

Prepared for: Dominion Diamond Ekati Corporation

Prepared by: Golder Associates Ltd.

October 2013

13-1328-0031

SUMMARY

Dominion Diamond Ekati Corporation is proposing the construction and operation of the Jay-Cardinal Project which is an extension of a large, stable and successful mining operation that has been a foundational element of the Northern economy for 15 years. As such, a Project Description has been prepared to support Dominion Diamond Ekati Corporation's application to the Wek'éezhìi Land and Water Board requesting a land use permit and Class A Water Licence to enable mining of the Jay and Cardinal kimberlite pipes.

The Jay and Cardinal kimberlite pipes are located beneath Lac du Sauvage, to the east of the Ekati Mine's existing Misery site, in the Lac de Gras watershed. Most of the facilities required for supporting and processing ore mined from the Jay and Cardinal kimberlites already exist at the Ekati Mine. No new mining methods are proposed for this Project and the socio-economic benefits of the Ekati Mine will be maintained with Project approval. The following activities will be undertaken to enable mining of the Jay-Cardinal Project:

- quarrying of granite rock for construction of roads and other necessary pads;
- construction of roads, pads, and incidental support buildings;
- construction of dikes and diversion to isolate the portion of Lac du Sauvage containing the Jay and Cardinal kimberlite pipes;
- drawdown of the water level in the isolated portion of Lac du Sauvage to expose the Jay and Cardinal kimberlite pipes for open pit mining;
- fish-out of the main body of Lac du Sauvage;
- mining of the Jay and Cardinal open pits and underground workings;
- placement of waste rock from the Jay and Cardinal developments;
- operational management of incidental runoff water entering the isolated portion of Lac du Sauvage; and
- reclamation of the constructed facilities.

The proposed approach to mining the Jay and Cardinal kimberlite pipes is by isolating an area of Lac du Sauvage behind dikes that divert a majority of the inflows to the north and south of the isolated area. The diversion and drawdown approach provides the greatest opportunity for success as a project that will substantively extend the operating life of the Ekati Mine.

The existing Ekati Mine environmental monitoring, management, and mitigation programs can all be expanded to incorporate the activities proposed for the Jay-Cardinal Project. However, based on the larger scope of the diversion and drawdown activities at Lac du Sauvage as compared to previous developments at the Ekati Mine, and the level of public concern likely to result, an environmental assessment conducted by the Mackenzie Valley Environmental Impact Review Board is considered the appropriate level of regulatory review.

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Mining of the Jay and Cardinal kimberlite pipes represents 10 to 20 years of additional mine life at current ore processing rates, provided that ore production is underway prior to exhaustion of the other known and economically viable kimberlite resources. Dominion Diamond Ekati Corporation's strategy is to secure the immediate future of the Ekati Mine through the Jay-Cardinal Project, and to then progress additional opportunities for a long-term sustainable Northern diamonds business that benefits the people of the North.

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Acronyms and Abbreviations

Acronym	Definition
AANDC	Aboriginal Affairs and Northern Development Canada
AEMP	Aquatic Effects Monitoring Program
amsl	above mean sea level
AQMP	Air Quality Monitoring Program
ASTt	Arctic Small Tool tradition
BHP	BHP Billiton Canada Incorporated
BP	Before Present
CALA	Canadian Association of Laboratory Accreditation
CCME	Canadian Council of Ministers of the Environment
CDA	Canadian Dam Association
COSEWIC	Committee on the Status of Endangered Wildlife in Canada
CPUE	catch-per-unit-effort
CWQG	Canadian Water Quality Guideline
DDEC	Dominion Diamond Ekati Corporation
DFO	Fisheries and Oceans Canada
Dominion	Dominion Diamond Corporation
EA	environmental assessment
EAR	environmental assessment report
EARPGO	Environmental Assessment and Review Process Guidelines Order
EIR	environmental impact report
EIS	environmental impact statement
ELC	Ecological Land Classification
ENR	Environment and Natural Resources [GNWT]
FPK	fine processed kimberlite
GNWT	Government of the Northwest Territories
IBA	Impact Benefit Agreement
ICRP	Interim Closure and Reclamation Plan
IEMA	Independent Environmental Monitoring Agency
ISBN	International Standard Book Number
ISO	International Standards Organization
ISQG	Interim Sediment Quality Guidelines
LLCF	Long Lake Containment Facility
MK	magmatic kimberlite
MVEIRB	Mackenzie Valley Environmental Impact Review Board
MVLWB	Mackenzie Valley Land and Water Board
NOx	nitrogen oxide
NWT	Northwest Territories
NY	New York
ON	Ontario
PAH	polycyclic aromatic hydrocarbons

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Acronym	Definition
PEL	probable effects level
PM	particulate matter
PVK	primary volcaniclastic kimberlite
PWNHC	Prince of Wales Northern Heritage Centre
QA	quality assurance
QC	quality control
RCMP	Royal Canadian Mounted Police
RMR	rock mass rating
RVK	re-sedimented volcaniclastic kimberlite
SEA	Socio-Economic Agreement
SNP	Surveillance Network Program
SOx	oxides of sulphur
SQG	Sediment Quality Guideline
SSWQO	Site-Specific Water Quality Objectives
SWS	Schlumberger Water Services Canada Inc
TDS	total dissolved solids
the Panel	Environmental Assessment Review Panel appointed for the 1996 environmental assessment
TK	Traditional Knowledge
TransK	transitional kimberlite
TSP	total suspended particulate
TSS	total suspended solids
VC	Valued Component
VK	volcaniclastic olivine-rich kimberlite
VOC	volatile organic compound
WEMP	Wildlife Effects Monitoring Program
WLWB	Wek'éezhìi Land and Water Board
WPKMP	Wastewater and Processed Kimberlite Management Plan
WRSA	waste rock storage area
ZOI	zone of influence

Units of Measure

Unit	Definition
%	percent
<	less than
≤	less than or equal to
>	greater than
°C	degrees Celsius
µm	micrometre
µm/sec/m^2	micrometres per second per square metre
µS/cm^c	microSiemens per centimetre corrected for temperature
cells/mL	cells per millilitre

Unit	Definition
cm	centimetre
cpt	carats per tonne
dmt	dry metric tonnes
dw	dry weight
g	gram
Ga	billion years
ha	hectare
km	kilometre
km/h	kilometres per hour
km^2	square kilometre
kW	kiloWatt
m	metre
M	million
m^2	square metre
m^3	cubic metre
m^3/h	cubic metres per hour
m^3/s	cubic metres per second
m^3/y	cubic metres per year
Ma	million years
masl	metres above sea level
mg dw/m^3	milligrams dry weight per cubic metre
mg/kg	milligrams per kilogram
mg/L	milligrams per litre
mg-N/L	milligrams as nitrogen per litre
mg-P/L	milligrams as phosphorus per litre
ML	million litres
mm	millimetre
Mm^3	million cubic metre
Mt	million tonnes
MW	MegaWatt
org/m^2	number of organisms per square metre
org/m^3	number of organisms per cubic metre
t	tonne
tpd	tonnes per day
ug/L	micrograms per litre
V	volt

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1.0 INTRODUCTION

1.1 Purpose

The purpose of this Project Description is to provide information to support Dominion Diamond Ekati Corporation's (DDEC) application to the Wek'éezhìi Land and Water Board (WLWB) requesting a land use permit and Class A Water Licence to enable mining of the Jay and Cardinal kimberlite pipes. The Jay and Cardinal kimberlite pipes are located in Lac du Sauvage to the east of the Ekati Mine's existing Misery site. Most of the facilities required for supporting and processing ore mined from the Jay and Cardinal kimberlites already exist at the Ekati Mine. Because of the substantive use of existing facilities, the Jay-Cardinal Project should be viewed as an extension of the existing Ekati Mine, rather than as a new mining project.

This document provides:

- an overview of the proponent;
- a description of the existing Ekati Mine operations , including those elements directly associated with mining of the Jay and Cardinal kimberlite pipes;
- a description of the alternative approaches for the Jay-Cardinal Project that were evaluated and the rationale for the selected approach;
- a description of the new development and activities required for the Jay-Cardinal Project; and,
- a review of the existing and required regulatory permits and approvals.

1.2 Corporate Overview

Dominion Diamond Corporation (Dominion) is a wholly Canadian-owned and Northwest Territories (NWT) based mining company that mines, processes, and markets Canadian diamonds. Dominion is actively pursuing options to extend its operations and the economic benefits it provides in the NWT.

Dominion is fully committed to maintaining and advancing the principles and practices of sustainable development, while making best use of the resources mined. This commitment includes respect for the natural and social environments, sharing economic benefits, and diligently reducing adverse effects or outcomes resulting from its work. Dominion maintains a high standard of environmental stewardship throughout all phases of its operations. The Ekati Mine meets its environmental protection commitments through a comprehensive management system, which is ISO 14001:2004 certified.

On November 13, 2012, Dominion and its wholly owned subsidiary, Dominion Diamond Holdings Limited, entered into share purchase agreements with BHP Billiton Canada Incorporated (BHP), and various affiliates, to purchase all of BHP's diamond assets, including its controlling interest in the Ekati Mine. The Ekati Mine was acquired from BHP in April 2013 and consists of two joint ventures: the Core Zone and the Buffer Zone joint ventures.

Dominion uses a wholly owned subsidiary, Dominion Diamond Holdings Limited, as the holding entity for the Ekati Mine. The operating entities for the Ekati Mine are two indirectly wholly owned subsidiaries of Dominion Diamond Holdings Limited: DDEC for the Core Zone, and Dominion Diamond Resources

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Corporation for the Buffer Zone. Dominion also owns 40 percent (%) of the Diavik Diamond Mine (also in the Lac de Gras area of the NWT), as a non-operating partner.

Dominion's interest in the Ekati Mine includes 80% of the Core Zone (current operations and other permitted kimberlite pipes) and 58.8% of the Buffer Zone (development and exploration potential). The remaining 20% of the Core Zone is held by geologists Dr. Charles Fipke and Dr. Stewart Blusson, while the remainder of Buffer Zone is divided between Dr. Fipke (10%) and Archon Minerals Limited (31.2%). The Core Zone encompasses 176 mining leases, totalling 173,024 hectares (ha), while the Buffer Zone contains 106 mining leases totalling 89,151.6 ha.

With the completion of ownership transfer in April 2013, Dominion initiated the development of options to extend the operating life of the Ekati Mine beyond the currently scheduled closure in 2019. The Jay-Cardinal Project is a cornerstone of Dominion's vision of building a long-term diamond business in the Canadian North that continues to deliver Northern benefits well into the future.

1.3 Background Information

1.3.1 The Ekati Mine

The Ekati Mine and its surrounding claim block are located approximately 200 kilometres (km) south of the Arctic Circle and 300 km northeast of Yellowknife, NWT (Figure 1.3-1). The mine is at the headwaters of the Coppermine River drainage basin, which flows north to the Arctic Ocean (Figure 1.3-2).

Kimberlite indicator minerals were first discovered in the Lac de Gras area in 1989, and the first diamonds were discovered in the fall of 1991. Baseline environmental data were first collected between 1993 and 1996, with effects monitoring beginning during construction in 1997. The original environmental impact statement (EIS) outlining the predicted environmental effects from the Ekati Mine was submitted in 1996 to an Environmental Assessment Review Panel (the Panel). The Panel was convened under the provisions of the *Environmental Assessment and Review Process Guidelines Order* (EARPGO), SOR/84-467, which was promulgated under the *Canadian Environmental Assessment Act* 1992, to recommend to the Minister of Aboriginal Affairs and Northern Development Canada (AANDC) whether the Ekati Mine should proceed. After public hearings were held by the Panel, approval for the project was granted in November of 1996. The licensing and permitting process was then implemented, the mine was constructed, and production started in October 1998. Operators at the Ekati Mine now have 15 years of continuous open pit mining experience in 6 separate pits, and roughly 8 years of underground mining experience.

Open pit mining commenced in August 1998 at the Panda Pit, and continued through June 2003. Underground production from the Panda pipe began in June 2005 and was completed in 2010 (this pipe is fully depleted and the underground mine decommissioned for closure). The Koala open pit operation commenced in 2003 and was completed in 2007; in the same year, underground production commenced and is currently active. The Koala North underground trial mine was operated from 2003 to 2004; commercial production began in 2010 and is currently active. The Misery open pit operation commenced in 2002 and initially terminated in 2006, while production from the Misery stockpiles continued until 2007. Pre-stripping at Misery for a pushback pit commenced in 2011 and the operation is currently active. The Fox open pit operation commenced in 2005 and the operation is currently active. The Beartooth open pit operation commenced in 2004 and was completed in 2008 (this pipe has been fully depleted); the open

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pit is being used for storage of underground minewater and deposition of fine processed kimberlite. The general arrangement of the Ekati Mine is illustrated in Figure 1.3-3. Currently, the Pigeon pipe is scheduled for development beginning in 2014 while the Sable pipe is not presently scheduled for development. The currently scheduled Ekati Mine operating life extends to 2019.

In 2013, DDEC requested a land use permit and water licence for the development of the Lynx kimberlite pipe, which is located close to the Misery site. This small satellite open pit would require very little new development and would be mined in conjunction with current mining activities at the Misery site. The proposed Lynx Project is not dependent on the Jay-Cardinal Project, and neither is the proposed Jay-Cardinal Project dependent on the Lynx Project.

1.3.2 Jay-Cardinal Project

The Jay and Cardinal kimberlite pipes are located in the southeastern portion of the Ekati Mine property about 25 km from the main facilities and approximately 7 km to the northeast-east of the Misery Pit, in the Lac de Gras watershed (Figure 1.3-4). Mining of the Jay and Cardinal kimberlite pipes represents 10 to 20 years of additional mine life at current ore processing rates, provided that ore production is underway prior to exhaustion of the other known and economically viable kimberlite resources (i.e., 2019).

Mining of the Jay and Cardinal kimberlite pipe will involve the use of a number of existing components of the Ekati Mine:

- Misery site mining infrastructure (e.g., fuel facility, explosives magazines);
- primary roads and transportation infrastructure (e.g., Ekati airstrip, Misery Haul Road);
- Ekati camp and supporting infrastructure;
- process plant; and,
- fine processed kimberlite management facilities (e.g., mined-out Panda and Koala open pits supported by the Long Lake Containment Facility [LLCF]).

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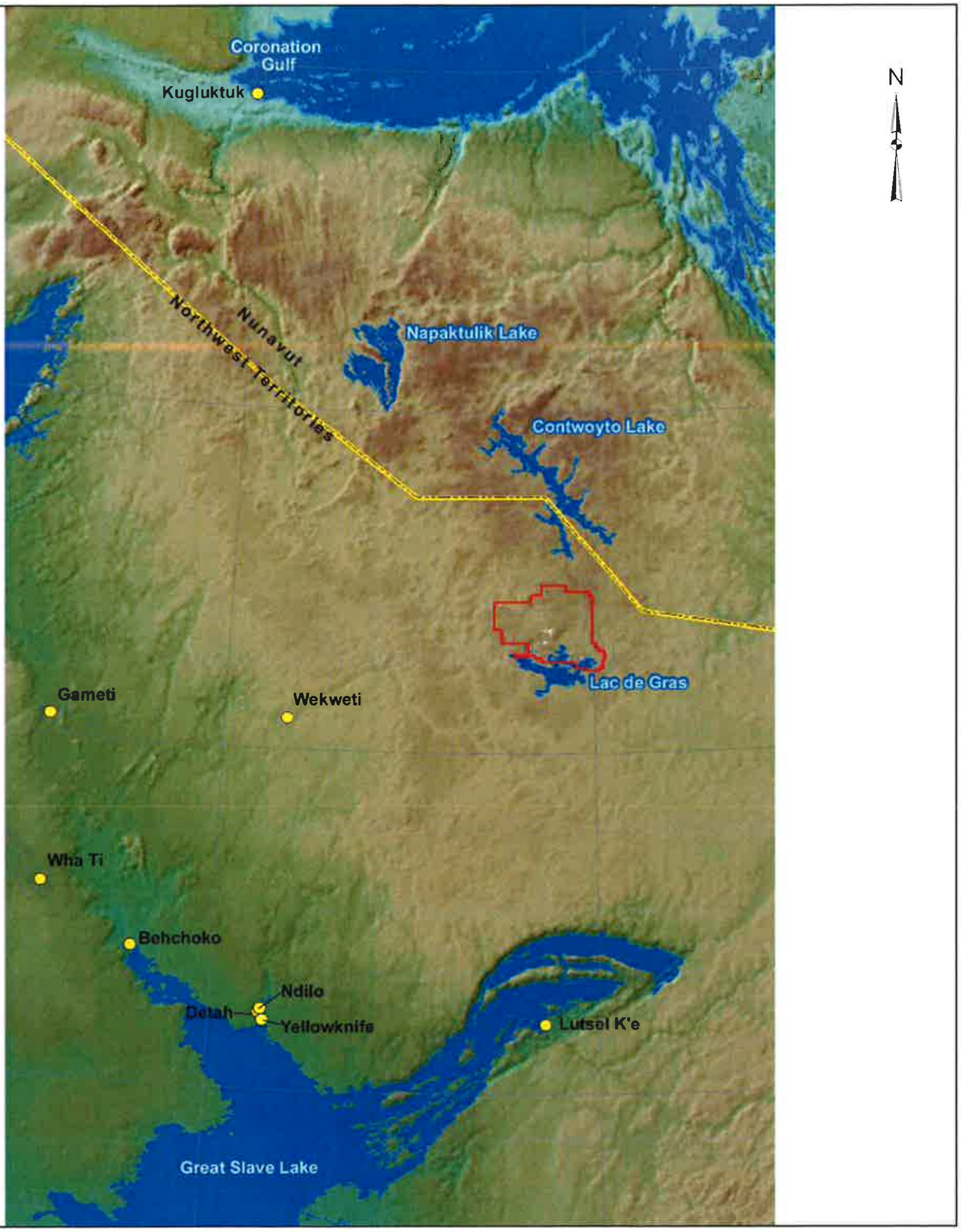


LEGEND

- COMMUNITY
- EKATI CLAIM BLOCK
- LAKE

80 0 80

SCALE 1:4,000,000 KILOMETRES

PROJECT

JAY-CARDINAL PROJECT
LAC DU SAUVAGE,
NORTHWEST TERRITORIES, CANADA

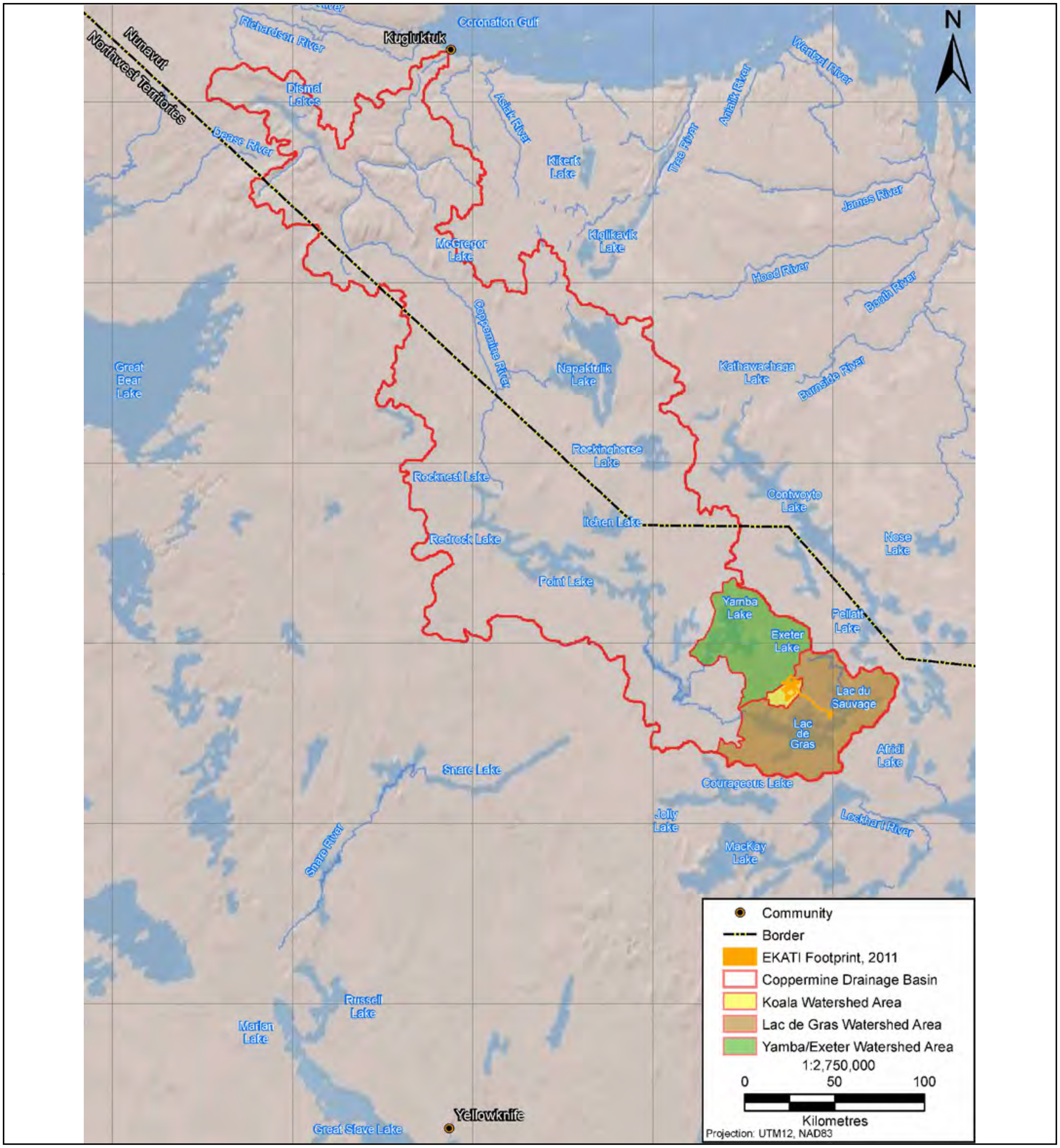
TITLE

LOCATION OF EKATI MINE CLAIM BLOCK

DOMINION DIAMOND

PROJECT		13-1328-0031	FILE No.	
DESIGN	RC	01/10/13	SCALE AS SHOWN	REV 0
GIS	RC	01/10/13		
CHECK	ED	16/10/13	**FIGURE: 1.3-1**	
REVIEW	ED	16/10/13		

G:\CLIENTS\DOMINION\DDEC Jay and Lynx Projects\Figures\13-1328-0031 Diversion Study\2130 - EIR Process\Jay-Cardinal Project Description\mxd\Fig1.3-1_Location_of_Ekati_Claim_Block.mxd



G:\CLIENTS\DOMINION\DDEC Jay and Lynx Projects\Figures\13-1328-0031 Diversion Study\2130 - EIR Process\Jay-Cardinal Project Description\mxd\Fig1.3-2_Coppermine_River_Watershed.mxd

REFERENCE

EKATI DIAMOND MINE DEVELOPMENT DESCRIPTION: SUPPORTING DOCUMENT FOR THE APPLICATION TO THE WEK'ÈEZHÌI LAND AND WATER BOARD FOR RENEWAL OF WATER LICENCE W2009L2-001, APRIL 2012. BHP BILLITON CANADA INC.

PROJECT

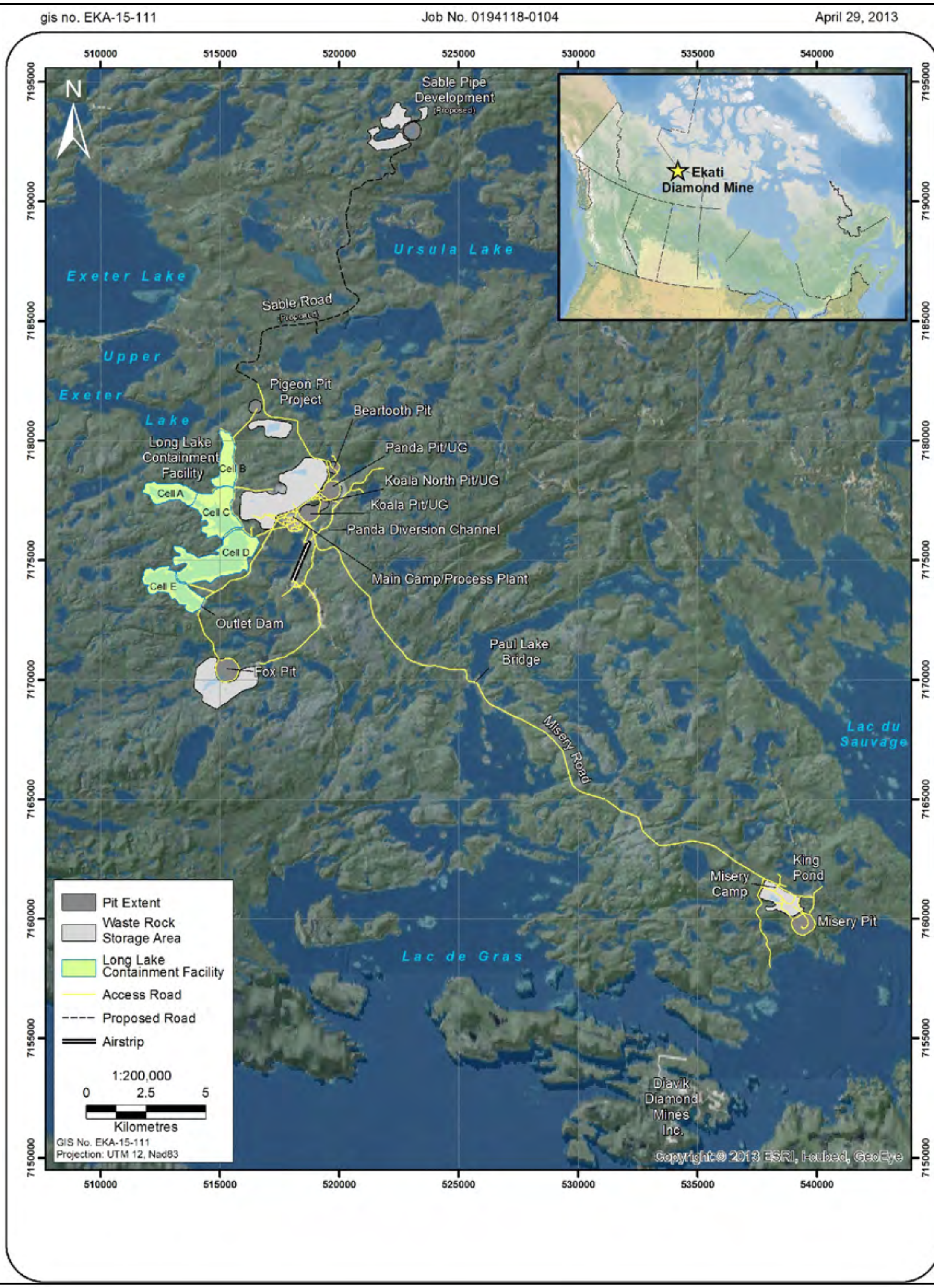
JAY-CARDINAL PROJECT
LAC DU SAUVAGE,
NORTHWEST TERRITORIES, CANADA

TITLE

COPPERMINE RIVER WATERSHED

DOMINION DIAMOND

PROJECT		13-1328-0031	FILE No.	
DESIGN	RC	01/10/13	SCALE AS SHOWN	REV 0
GIS	RC	01/10/13		
CHECK	ED	16/10/13	**FIGURE: 1.3-2**	
REVIEW	ED	16/10/13		



G:\CLIENTS\DOMINION\DDEC Jay and Lynx Projects\Figures\13-1328-0031 Diversion Study\2130 - EIR Process\Jay-Cardinal Project Description\mxd\Fig1.3-3_Ekati_Mine_General_Arrangement.mxd

REFERENCE

EKATI DIAMOND MINE DEVELOPMENT DESCRIPTION: SUPPORTING DOCUMENT FOR THE APPLICATION TO THE WEK'ÈEZHÌI LAND AND WATER BOARD FOR RENEWAL OF WATER LICENCE W2009L2-001, APRIL 2012. BHP BILLITON CANADA INC.

PROJECT

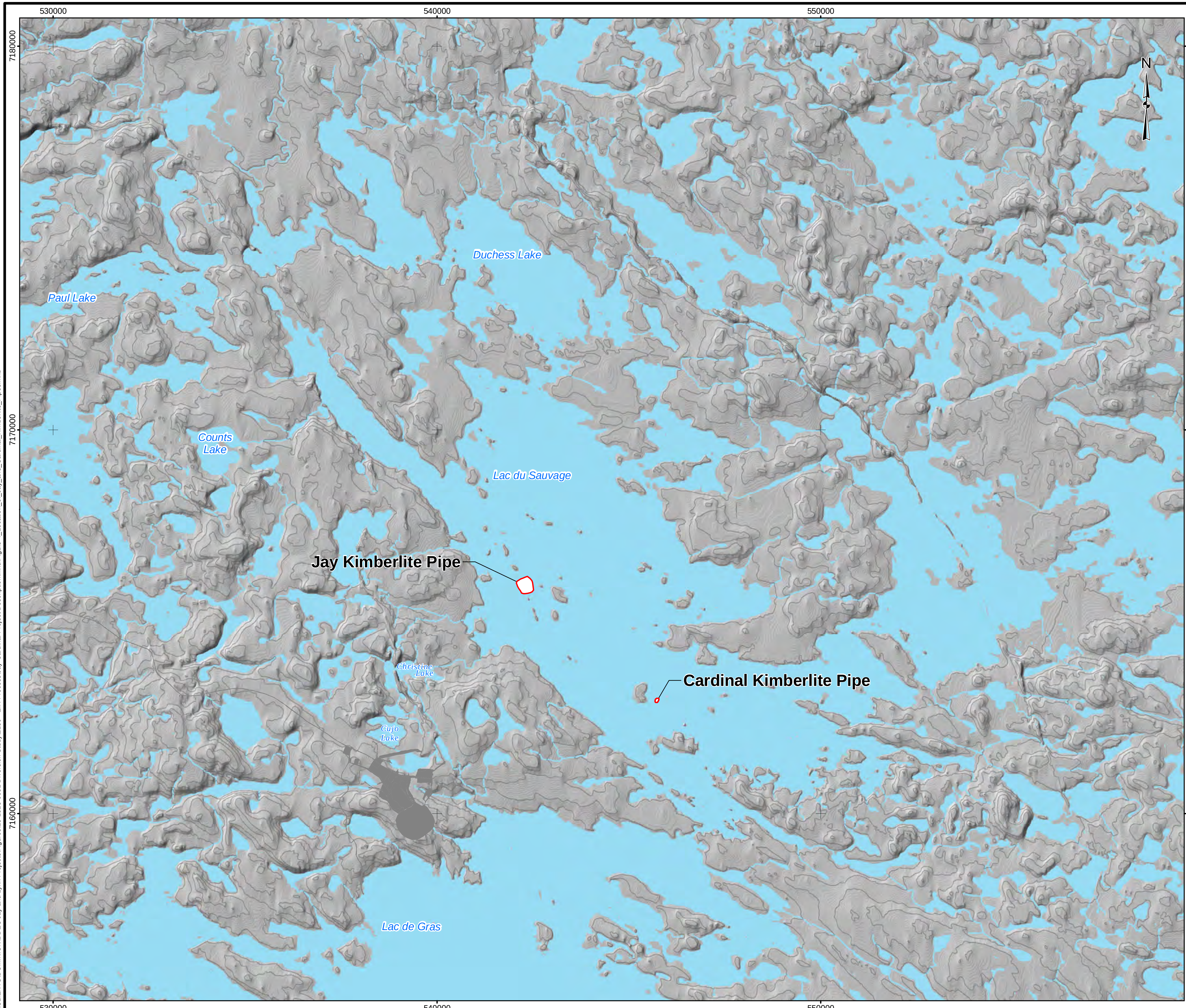
JAY-CARDINAL PROJECT
LAC DU SAUVAGE,
NORTHWEST TERRITORIES, CANADA

TITLE

EKATI MINE GENERAL ARRANGEMENT

DOMINION DIAMOND

PROJECT		13-1328-0031	FILE No.	
DESIGN	RC	01/10/13	SCALE AS SHOWN	REV 0
GIS	RC	01/10/13	**FIGURE: 1.3-3**	
CHECK	ED	01/10/13		
REVIEW	ED	01/10/13		



LEGEND

- KIMBERLITE PIPE
- EKATI MINE FOOTPRINT (MISERY OPERATION)
- 10M CONTOUR
- WATERCOURSE
- WATERBODY

REFERENCE

1:50,000 LAKES AND STREAMS - CANVEC
1:50,000 DEM - GEOBASE
DATUM: NAD83 PROJECTION: UTM ZONE 12N

2 0 2

SCALE 1:100,000 KILOMETRES

PROJECT

JAY-CARDINAL PROJECT
LAC DU SAUVAGE,
NORTHWEST TERRITORIES, CANADA

TITLE

LOCATION OF JAY AND CARDINAL KIMBERLITE PIPES

DOMINION DIAMOND

PROJECT	13-1328-0031		FILE No.
DESIGN	RC	01/10/13	SCALE AS SHOWN REV 0
GIS	RC	01/10/13	
CHECK	ED	16/10/13	FIGURE: 1.3-4
REVIEW	ED	16/10/13	

G:\CLIENTS\DOMINION\DDEC Jay and Lynx Projects\Figures\13-1328-0031 Diversion Study\2130 - EIR Process\Jay-Cardinal Project Description\mxd\Fig1.3-4_Location_of_Jay_and_Cardinal_Kimberlite_Pipes.mxd

The following activities will be undertaken to enable mining of the Jay-Cardinal Project:

- quarrying of granite rock for construction of roads and other necessary pads;
- construction of roads, pads, and incidental support buildings;
- construction of dikes and diversion to isolate the portion of Lac du Sauvage containing the Jay and Cardinal kimberlite pipes;
- drawdown of the water level in the isolated portion of Lac du Sauvage to expose the Jay and Cardinal kimberlite pipes for open pit mining;
- fish-out of the main body of Lac du Sauvage;
- mining of the Jay and Cardinal open pits and underground workings;
- placement of waste rock from the Jay and Cardinal developments;
- operational management of incidental runoff water entering the isolated portion of Lac du Sauvage; and
- reclamation of the constructed facilities.

The areas at the outlet of Lac du Sauvage into Lac de Gras and along the esker on the west side of Lac du Sauvage are known to be important traditional use, cultural, and caribou movement sites. DDEC respects these values and has purposely designed the Jay-Cardinal Project to avoid physical disturbance of the outlet area. DDEC will hold discussions with traditional knowledge holders in order to determine the best road alignment for the necessary road crossing of the esker.

All licences and approvals required to undertake the proposed Project are currently in place with the exception of:

- Class A Water Licence;
- Land Use Permit for the mining area, water diversion system, and access roads;
- Surface Lease;
- Fisheries Authorization under Section 35 of the *Fisheries Act* for activities in Lac du Sauvage; and,
- Exemption under Section 23 of the *Navigable Waters Protection Act* for activities in Lac du Sauvage.

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1.4 Need for the Project

1.4.1 Regional Context

Regionally, diamond mining has been a major contributor to the NWT economy since the 1990s. Mining overall is the largest private sector employer in the NWT and accounts for 29% of the gross domestic product (GNWT 2013). The mining industry creates significant opportunities and revenue for northern businesses and in particular Aboriginal businesses. Currently there are three operating diamond mines in the NWT. The Ekati and Diavik mines provide the majority of the employment and economic benefits because of the open pit operations and larger scale. The Ekati Mine is currently scheduled to close in 2019, and the Diavik Mine has an uncertain future beyond 2019. New mines and the extension of existing mines' life would provide considerable benefits to the future economy of the NWT.

As indicated in the Government of the Northwest Territories (GNWT) Mineral Development Strategy Report (GNWT 2013), the formulation of a Mineral Development Strategy is a priority. The goal of this Strategy is to support sustainable mineral development in the NWT, so that Northerners benefit from mineral development to the greatest extent possible. A three-person panel of outside experts listened to stakeholders in a process of engagement that extended from late January 2013 to early April 2013. This panel heard from 126 individuals representing 65 different organizations. The overwhelming majority of participants supported development of the NWT's mineral resources, in a balanced approach to the economic, social, and environmental outcomes of mining developments. There was a strong emphasis on environmental protection, respect for Aboriginal cultures and lifestyles, and leaving Northerners with a lasting and positive legacy and heritage.

1.4.2 The Future of the Ekati Mine

The mining plan for the Ekati Mine schedules mining of the various kimberlite pipes in a manner that provides a sustainable and stable operation. The rate at which a pipe can be mined and the order in which each pipe can be developed depend on factors unique to each pipe:

- pipe size and geometry;
- physical properties of the kimberlite and its associated processing characteristics;
- kimberlite pipe diamond grade and grade distribution within the kimberlite pipe;
- carat values; and
- location relative to the central process plant.

These pipe factors coupled with operational considerations result in an intricate mine planning process. Typical operational factors include:

- haul truck cycle times;
- equipment fleet size and composition;
- process plant capacity; and
- workforce stability.

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The Jay-Cardinal Project is fundamental to the long-term future of Northern benefits from the Ekati Mine. The Project provides an estimated additional 10 to 20 years of mining, and will provide a stable operating platform for identifying and developing additional sources of kimberlite that could carry the Ekati Mine even further into the future.

1.5 References

GNWT (Government of the Northwest Territories). 2013. Pathways to Mineral Development: Report of the Stakeholders Engagement Panel for the NWT Mineral Development Strategy. Yellowknife, NWT. April 2013.

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2.0 REGULATORY APPROVALS AND AUTHORIZATIONS

2.1 Regulatory Guidelines and Policies Applicable to the Jay–Cardinal Project

This project description and the associated documentation fulfill the requirements for project submissions to the WLWB. The following guidance documents from the Mackenzie Valley Land and Water Board (MVLWB) were referenced in the preparation of this application:

- The Mackenzie Valley Land and Water Board Document Submission Standards (MVLWB 2012a);
- Standards for Geographical Information Systems Submissions (MVLWB 2012b);
- Guide to Completing Land Use Permit Applications (MVLWB 2013a);
- Guide to Completing Water Licence Applications (MVLWB 2003);
- Engagement and Consultation Policy (MVLWB 2013b);
- Engagement Guidelines for Applicants and Holders of Water Licences and Land Use Permits (MVLWB 2013c);
- Water and Effluent Quality Management Policy (MVLWB 2011a);
- Guidelines for Developing a Waste Management Plan (MVLWB 2011b); and
- Draft Guidelines for Adaptive Management (WLWB 2010).

Other supporting documentation used to inform this application includes:

- AANDC Guidelines for Designing and Implementing Aquatic Effects Monitoring Programs for Development Projects in the NWT (Government of Canada 2009);
- Spill Contingency Guidelines (Government of Canada 2007a);
- Mine Site Reclamation Policy (Government of Canada 2002);
- Mine Site Reclamation Policy Guidelines (Government of Canada 2007b);
- Fisheries and Oceans Canada (DFO) Freshwater Intake End-of Pipe Fish Screen Guideline (Government of Canada 1995);
- Fish Screen Design Criteria for Flood and Water Truck Pumps (Government of Canada 2011); and
- Canadian Council of Ministers of the Environment (CCME) Canadian Water Quality Guidelines (CWQG) for the Protection of Aquatic Life–Site Specific Guidance (Government of Canada 2003).

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2.2 Previous Environmental Assessments

Initial applications for what would become the Ekati Diamond Mine (called the NWT Diamonds Project at that time) were reviewed by the Panel between 1994 and 1996 (Table 2.2-1). The Environmental Assessment Review Panel June 1996 Report recommended that the Government of Canada approve the NWT Diamonds Project.

In 1999, BHP Diamonds Inc. applied to the NWT Water Board for an expansion to the existing Ekati Mine. This application was for the inclusion of the Sable, Pigeon, and Beartooth pipes to the north of the existing facilities. Soon thereafter, the *Mackenzie Valley Resource Management Act*, S.C. 1998, c. 25 came into effect, meaning that the environmental assessment (EA) of the project was undertaken by the nascent Mackenzie Valley Environmental Impact Review Board (MVEIRB). In 2001, the MVEIRB's Report of Environmental Assessment on the Proposed Development of Sable, Pigeon, and Beartooth Kimberlite Pipes recommended that the Minister of Indian and Northern Affairs Canada approve the proposed development.

Table 2.2-1 Existing Environmental Assessments for the Ekati Mine Relevant to the Jay–Cardinal Project

Project	Environmental Assessment	Subsequent or Associated Licensing and Permitting	Aspect Relevant to the Jay–Cardinal Project
NWT Diamonds Project	• NWT Diamonds Project Environmental Impact Statement (1995) • the Panel recommendation to approve the NWT Diamonds Project (1996) • Government of Canada Approval (1996)	• Type A Water Licence • Surface Land Leases • Mining Leases • *Fisheries Act* Authorizations • *Navigable Waters Protection Act* Authorizations	• Initial approval for the overall Ekati Operation, which included open-pit and underground development of the Panda, Koala, Fox, Leslie, and Misery kimberlite pipes, process plant, waste rock and water management, camp, airstrip, and on-site roads, deposition of fine processed kimberlite into Cells A-D of Long Lake Containment Facility and into mined out open pits.
Sable, Pigeon, and Beartooth Expansion	• Environmental Assessment Report for Sable, Pigeon, and Beartooth Kimberlite Pipes (April 2000) • MVEIRB's Report of Environmental Assessment on the Proposed Development of Sable, Pigeon, and Beartooth Kimberlite Pipes (February 2001)	• Type A Water Licence • Type A Land Use Permits • Surface Land Leases • Mining Leases • *Fisheries Act* Authorizations • Navigable Waters Protection Act Authorizations	• Open-pit development of Sable, Pigeon, and Beartooth pipes, waste rock and water management, Sable road construction, Ursula granular quarry, fine processed kimberlite deposition into Cells A-D of the Long Lake Containment Facility and Beartooth open pit.

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2.2.1 NWT Diamonds Project (i.e., Ekati Mine)

BHP Diamonds Inc. NWT Diamonds Project underwent an extensive environmental assessment and regulatory process under the *Canadian Environmental Assessment Act* in 1996, prior to the establishment of the *Mackenzie Valley Resource Management Act*. In July 1994, the Minister of AANDC referred the project to the Minister of Environment for public review under the EARPGO. The EARPGO process was mandated by an Order-in-Council from the federal Cabinet. In December 1994, the Panel was appointed for the purpose of assessing the potential for adverse impacts from a segment of the mining industry that was new to Canada, the mining of diamonds from kimberlite.

The short- and long-term environmental and socio-economic effects of the NWT Diamonds Project, were reviewed by the Panel, as well as the proposed development plan. In May 1995, the Panel issued guidelines for the preparation of an EIS. The EIS was then prepared and submitted by BHP Diamonds Inc. in July 1995. The EIS assessed the combined open-pit and underground development of five diamond-bearing kimberlite pipes near Lac de Gras; four located within a few kilometers of each other in the Koala watershed (Panda, Koala, Fox, and Leslie) and a fifth, to the southeast, adjacent to Lac de Gras (Misery). The 1995 EIS also anticipated the future development of additional kimberlite pipes.

In January and February of 1996, extensive public hearings were held in potentially impacted communities identified by the Panel in the western NWT (and present day Nunavut). In June 1996, the Panel concluded that the environmental effects of the proposed Ekati Mine were largely predictable and mitigable. It was concluded by the Panel that monitoring would detect any effects not predicted or those not accurately predicted, allowing them to be addressed through various environmental management plans and an adaptive management strategy.

Concerning future development possibilities at the Ekati Mine, the conclusion of the Panel was:

> *"The cumulative environmental effects of additional development by BHP on the Lac de Gras claim block are unlikely to be significant. It has reached this conclusion for several reasons. First, mining of additional pipes would extend the life of the mine and would not result in development of additional processing capacity. Secondly, tailings would be deposited in mined-out pits and no expansion of the Long lake tailings impoundment or creation of a new impoundment would be required. Thirdly, if additional pits were developed, the Proponent and government would have some years of experience in managing the effects of the Project. Nevertheless, continued monitoring and adaptive management would be required, especially if new pits were located in previously undeveloped watersheds. Finally, the Panel agrees with the Proponent's conclusion that the cumulative socio-economic effects entailed by extending the life of the mine are likely to be positive since extension of the life of the mine would provide economic stability." (excerpt from page 67 of the Environmental Assessment Review Panel June 1996 Report)*

The Panel June 1996 Report was accepted without any changes by the Government of Canada, indicating its acceptance of the conclusion.

2.2.2 Sable, Pigeon, and Beartooth Expansion

In April 1999, after permit and licence applications were submitted by BHP for the Sable, Pigeon, Beartooth Expansion Project, a preliminary screening was initiated by the NWT Water Board. The preliminary screening recommended that the proposed development undergo environmental assessment under the *Mackenzie Valley Resource Management Act*. This conclusion was based on the potential for

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significant adverse impacts on the environment primarily related to the lack of water-related baseline information in the vicinity of the newly proposed developments and the need for a thorough cumulative effects assessment with respect to the existing Ekati Mine and the anticipated Diavik Diamond Mine.

In December 1999, the MVEIRB released its Terms of Reference for the EAR. In June 2000, BHP submitted its EAR to the MVEIRB. No new processes, methods or waste streams were proposed. Extensive public hearings were held in N'Dilo in September 2000 and in February 2001. The MVEIRB concluded that the proposed development should not result in significant adverse effects.

The MVEIRB recommendation to approve the expansion project was accepted by the Minister of the Department of Indian Affairs and Northern Development (now AANDC).

2.3 Jay–Cardinal Project Regulatory Process

With the exception of the Inuvialuit Settlement Region, the regulatory process in the NWT is set out in the *Mackenzie Valley Resource Management Act* (the *Act*). Under the *Act*, the Land and Water Boards of the Mackenzie Valley are responsible for performing the initial review and preliminary screenings of proposed projects and regulating the use of the land and water as well as the deposition of waste within their respective regions. The Ekati Mine is located within the Wek'eezhii settlement area where all development applications are processed by the WLWB. The WLWB objective is to provide for the conservation, development, and use of land and water resources for the optimum benefit to the residents in their settlement areas and the Mackenzie Valley and to all Canadians. Most of the facilities and activities related to mining of the Jay and Cardinal kimberlite pipes have already been subject to environmental assessment and approval. New processing facilities and camp facilities are not required as part of the Jay–Cardinal Project. There are no newly proposed mining methods associated with this application and socio-economic benefits of the mine will be extended with Project approval.

The Jay–Cardinal Project requires the diversion of fresh water around a section of Lac du Sauvage, and drawdown of the water level within the that section of Lac du Sauvage for the duration of mining (see Section 4). This is required to enable development of two open pit mines, Jay and Cardinal, with access roads. This type of development (e.g., diversion of freshwater and lake drawdown or dewatering to expose a kimberlite pipe for mining, in this environment, has been previously assessed within the NWT Diamond Project (1998) and the Sable, Pigeon, and Beartooth Expansion (2002). These engineering activities have been successfully carried out and accepted as successful by regulators over the past 15 years of mining operations at the Ekati Mine. All instruments of environmental management and monitoring currently in use at the Ekati Mine will be expanded to include all aspects of the Jay–Cardinal Project.

For many of the activities associated with the Jay–Cardinal Project, development will occur using the same mitigation measures previously assessed in the above-referenced two environmental assessments. However, based on the larger scope of the diversion and drawdown activities at Lac du Sauvage as compared to previous developments at the Ekati Mine, and the resulting likely level of public concern, an environmental assessment conducted by the MVEIRB is considered the appropriate level of regulatory review.

The initial stage of the environmental assessment process will result in the issuance, by the MVEIRB of, Terms of Reference for the Jay–Cardinal Project. The purpose of the Terms of Reference is to focus the

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environmental assessment on issues related to the project that are most important and relevant to this stage of the permitting process (i.e., with regard to the subsequent detailed regulatory process for issuance of a Water Licence and Land Use Permit(s). A suggested draft Terms of Reference for the Jay–Cardinal Project is provided in Appendix 2A with the aim of facilitating this first stage of MVEIRB's process.

2.4 Jay–Cardinal Regulatory Instruments

The licences and permits that will be required to enable mining of the Jay and Cardinal kimberlite pipes are listed in Table 2.4-1 and described in the subsequent text. DDEC holds the necessary mineral leases that provide the fundamental mineral and mining rights.

2.4.1 Surface Leases

There are currently eight surface leases in place for the existing operations at the Ekati Mine (Figure 2.4-1). These leases do not cover the area around Lac du Sauvage that would be new development for the Jay – Cardinal Project.

One or more new surface lease(s) for the Lac du Sauvage area will be sought in conjunction with this application.

2.4.2 Type A Land Use Permits

The Ekati Mine currently holds three Class A Land Use Permits (Pigeon Pit and associated activities; Sable Pit and associated activities; and Sable Haul Road), which were issued by the WLWB. These cover mining development activities associated with the Sable and Pigeon pits and were issued after the proclamation of the *Mackenzie Valley Resource Management Act*.

A Type A Land Use Permit is required for the area around Lad du Sauvage that is outside of the boundaries of the pre-MVRMA Surface Leases (Figure 2.4-1). The Land Use Permit will include the extraction of waste rock and kimberlite, construction of a water diversion structure, construction of a site access road, and the other activities required for mining of the Jay and Cardinal kimberlite pipes. The present document is in support of DDEC's application for a Land Use Permit.

2.4.3 Type A Water Licence

The Ekati Mine operates under one Class A Water Licence. The purpose of a Class A Water Licence is to enable water use and deposition of waste.

As part of the requirements of the Water Licence, discharge criteria for water to be released into the receiving environment must be met and rock seepage must be monitored.

The present document is in support of DDEC's application for a water licence enabling the development, operation, and reclamation of the Jay–Cardinal Project.

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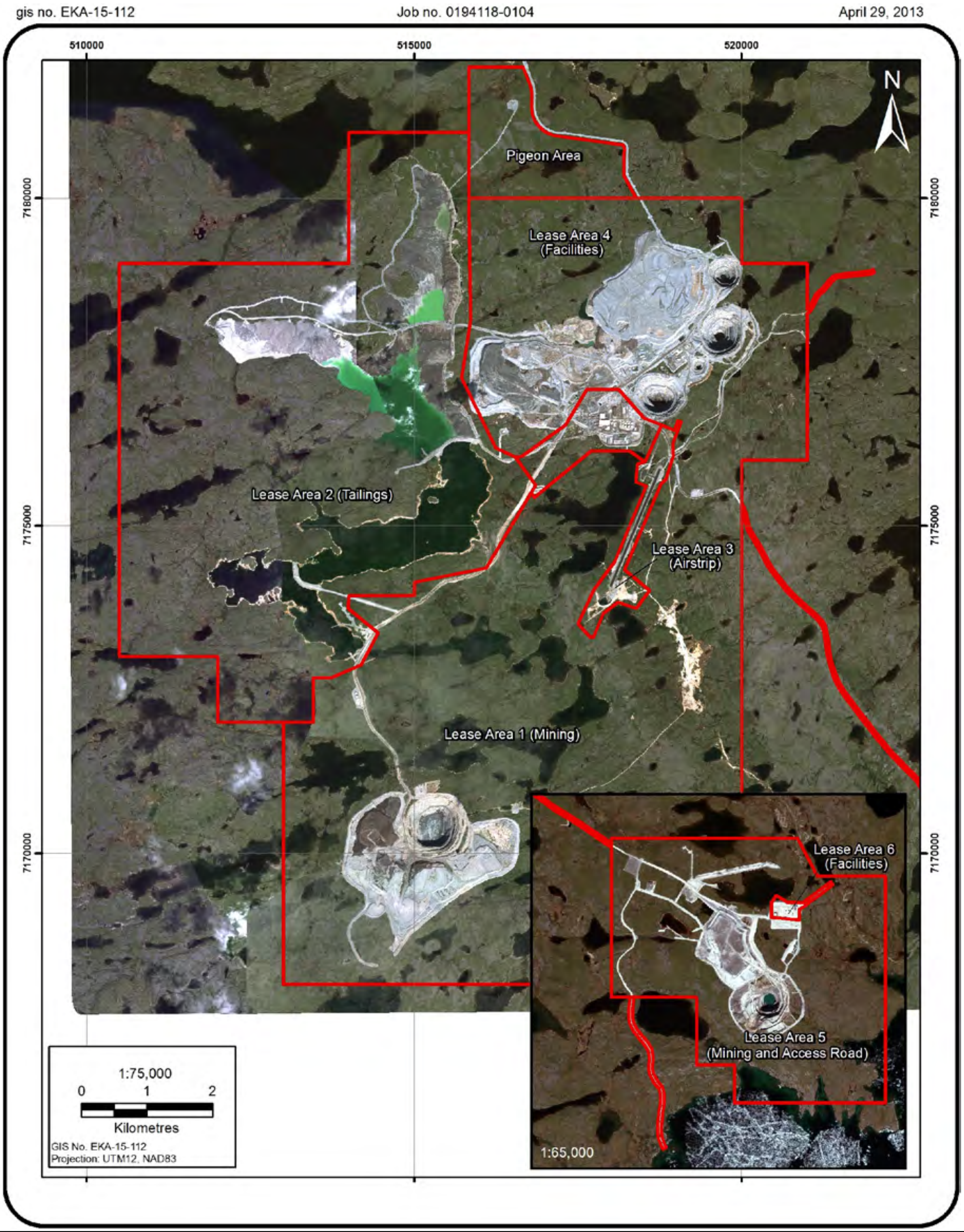

PROJECT

JAY-CARDINAL PROJECT
LAC DU SAUVAGE,
NORTHWEST TERRITORIES, CANADA

TITLE

LOCATION OF EKATI SURFACE LEASES

REFERENCE

EKATI DIAMOND MINE DEVELOPMENT DESCRIPTION: SUPPORTING DOCUMENT FOR THE APPLICATION TO THE WEK'ÈEZHÌI LAND AND WATER BOARD FOR RENEWAL OF WATER LICENCE W2009L2-001, APRIL 2012. BHP BILLITON CANADA INC.

DOMINION DIAMOND

PROJECT		13-1328-0031	FILE No.	
DESIGN	RC	02/10/13	SCALE AS SHOWN	REV 0
GIS	RC	02/10/13	**FIGURE: 2.4-1**	
CHECK	ED	16/10/13		
REVIEW	ED	16/10/13		

Table 2.4-1 Permits, Authorizations, Licences, or Leases Required for the Ekati Mine

Permit, Authorization, Licence, or Lease	Administration	Current Permit, Licence or Lease	Project Components / Activities Included	Relevance to Jay–Cardinal Project
Surface Lease (Crown Land)	AANDC	76D/10-2-2 (Koala, Panda, and Fox mining, and Facilities) (6,023 ha); 76D/10-3-2 (Long Lake Containment Facility) (3.701 ha); 76D/10-4-2 (Airstrip and Facilities) (110 ha); 76D/10-5-2 (Koala Area Facilities) (155 ha); 76D/9-3-2 (Misery Open Pit Mining, Facilities, and Road) (1,144.04 ha); 76D/9-4-2 (Misery Area Facilities) (12 ha); 76D/10-7-2 (Pigeon Open Pit Mining, Facilities, and Road) (324.6 ha); and 76D/15-4-2 (Sable Open Pit Mining and Facilities) (998 ha).	Occupy and use lands required for open pits, process plant, camp, air strip, and site road	A surface lease will be required for the necessary developments in the Lac du Sauvage area beyond the boundaries of the current surface leases.
Type A Land Use Permit	(WLWB	• W2008F0009 (Sable Haul Road) • W2008D0007 (Mining and associated activities on Sable Lease) • W2008D0008 (Mining and associated activities on Pigeon Lease)	• Mining development activities	• A Type A Land Use permit will be required for the Jay-Cardinal Project for the open pits and access roads, runoff and water diversion structures, and other activities at Lac du Sauvage.
Type A Water Licence	(WLWB	• N7L2-1616 – Ekati Mine – Issued: January 1, 1997 by the NWT Water Board – Renewed as MV2003L2-0013: October 4, 2005 by the MVLWB • MV2001L2-0008 - Sable, Pigeon and Beartooth Expansion Project – Issued: August 15, 2002 by the MVLWB – Renewed as W2009L2-0001: August 14, 2009 by the WLWB • MV2003L2-0013 – Ekati Mine (This licence is a renewal of N7L2-1616) – Issued: October 4, 2005 by the MVLWB – Re-issued as W2009L2-0001: August 14, 2009 by the WLWB • W2009L2-0001 – Ekati Mine (This licence is the	• Operation of the Ekati Mine • Mining activities at all established areas • Future mining at the Pigeon and Sable pipes • Various identified water diversions and water uses. • Deposition of processed kimberlite into the Beartooth Pit • Disposal of waste from diamond mining and processing associated with development, operation, and reclamation activities within the Koala, Pigeon, Sable, and Lac du Sauvage watersheds.	• Type A Water Licence to include lake drawdown activities at Lac du Sauvage, and management / disposal of waste.

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Table 2.4-1 Permits, Authorizations, Licences, or Leases Required for the Ekati Mine

Permit, Authorization, Licence, or Lease	Administration	Current Permit, Licence or Lease	Project Components / Activities Included	Relevance to Jay–Cardinal Project
		amalgamation of the renewal of MV2001L2-0008 into MV2003L2-0013) – Issued: August 15, 2009 by the WLWB – Renewed as W2012L2-0001: August 18, 2013 • W2012L2-0001 – Ekati Mine (This licence is a renewal of W2009L2-0001) – Issued: Aug 18, 2013 by the WLWB – Assigned to Dominion: April 2013 – Expiry: Aug 18, 2021		
Fisheries Act Authorization	Fisheries and Oceans Canada (DFO)	• Fisheries Authorization SCA96021 – Ekati • Fisheries Authorization SC00028 – King Pond – Cujo Stream • Fisheries Authorization SC01111 – Desperation Pond – Carrie Stream • Fisheries Authorization SC99037– Sable, Pigeon and Beartooth	• Loss of lake and stream habitat caused by construction and operation of the Koala, Panda, Misery, Fox and Leslie mine pits • Loss of fish habitat caused by the use of King Pond as a settling facility for the Misery pit operations • Loss of fish habitat associated with the construction of a dike across Desperation-Carrier Stream and for the use of Desperation Pond for waste rock storage and water management • Loss of fish habitat caused by the development of the Beartooth Pit and by the construction of Sable and Pigeon pits	• A Fisheries Authorization will be required for the drawdown of Lac du Sauvage, construction and operation of the Jay and Cardinal pits.
Navigable Waters Protection Act Authorization	Transport Canada	• 8200-T-12313.1 Original Ekati water works • 8200-97-6112 Sable, Pigeon, Beartooth water works	• Construction of water intakes, water diversion, dewatering of lakes, processed kimberlite disposal, discharge/outfalls, dams/dykes, spillway discharge channel, water crossings and compensation structures associated with construction and operation of the mine and its infrastructure	• An exemption under Section 23 of the Navigable Waters Protection Act is required for Dominion to drawdown water levels in Lac du Sauvage.

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2.4.1 *Fisheries Act* Authorizations

The existing Fisheries Authorizations for the Ekati Mine were received under the previously in-force *Fisheries Act* (pre-2012) which specifically indicated the requirement for authorizations for the harmful Alteration, Disruption or Destruction of Fish Habitat unless such impacts had been authorized by DFO.

A *Fisheries Act* (2012) authorization under the revised *Act* is needed when impacts to fish and fish habitat are expected. The Fisheries and Oceans' Proponents Guide to Information Requirements for Review under the Fish Habitat Protection Provisions of the *Fisheries Act* outlines the information required to provide for adequate protection of fish and fish habitat.

The Ekati Mine currently operates under four *Fisheries Act* Authorizations issued by DFO. The purpose of the authorizations is to provide approval for work that will result in the Harmful Alteration, Disruption, or Destruction of fish habitat (as per the requirements of the previous version of the *Act*).

The Jay–Cardinal Project will result in effects to fish and fish habitat through the diversion and drawdown of Lac du Sauvage. A Fisheries Authorization under the *Fisheries Act* (2012) is being sought in conjunction with this application to provide for activities within Lac du Sauvage.

2.4.2 *Navigable Waters Protection Act* Authorization

Navigable Waters Protection Act authorizations are granted to allow for the construction of the mine and its infrastructure (i.e., water intakes, water diversion, dewatering of lakes, processed kimberlite disposal, discharge/outfalls, dams/dykes, spillway discharge channel, water crossings and compensation structures) in the Lac de Gras area. The principle objective of the *Navigable Waters Protection Act* is to protect the public right of navigation by prohibiting the building or placement of any "work" in, upon, over, under, through, or across a navigable water without the authorization of the Minister of Transport.

The Ekati Mine already holds two authorizations, one for the original water works and one for Sable, Pigeon, and Bear tooth–diversions, outfalls, dewatering and other related activities (Table 2.4-1).

An exemption under Section 23 of the *Navigable Waters Protection Act* that would enable drawdown of the water level in Lac du Sauvage is being sought in conjunction with this application.

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3.0 HUMAN AND BIOPHYSICAL ENVIRONMENT

3.1 Overview

The Ekati Mine area and its surrounding claim block are located approximately 200 km south of the Arctic Circle and 300 km northeast of Yellowknife in the NWT, Canada (Figure 1.3-1). The mine is located within the headwaters of the Coppermine River drainage basin, which flows north to the Arctic Ocean (Figure 1.3-2).

The Ekati Mine is located in the Canadian subarctic, and cold winter conditions predominate with approximately five months of spring/summer/fall weather each year when daytime temperatures are above freezing. Winters are long and extremely cold with daily temperatures that often fall below -30 degrees Celsius (°C). Annual precipitation is low.

The Ekati Mine and its surrounding claim block cover 2.663 square kilometres (km^2). Mine development only has occurred in 0.77% of the claim block (3,002 hectares [ha] or 30.2 km^2). The topography is flat with local surface relief rising up to 20 metres (m). The local terrain is characterized by boulder fields, tundra, and wetlands. There are more than 8,000 lakes with interconnecting streams in the area. It is an area of continuous permafrost overlain by an active layer (i.e., thawing during the summer and refreezing during the winter).

The lakes and streams of the area are characterized by clear, soft, low-nutrient waters typical of northern aquatic environments. Most nutrients in the soil in permafrost areas are not accessible to flowing water. Low temperatures in the active layer result in extremely low rates of organic matter decomposition and nutrient release. Hence, surface waters are very low in nutrients and in aquatic plant production. The biological productivity and biomass of plants and animals in the streams and lakes are low compared to streams and lakes in southern Canada; these waterbodies are cold, nutrient poor, and covered with up to 2 m of ice for nine months of the year (Pienitz et al. 1997).

The terrestrial vegetation is composed of species adapted to freezing temperatures, low nutrients, and localized areas of drought and standing water. The area is predominately wildlife habitat, with limited human use, mainly for hunting.

The Ekati claim block is within the Traditional lands of five groups of Aboriginal peoples: the Tłı̨chǫ, the Yellowknives, the Chipewyan, the Inuit and the Métis (EAP 1996). Small family groups followed the caribou migration pattern throughout the winter, and fished in lakes during the summer. Archaeological studies have shown that human use of the Lac de Gras area dates back to 3,000 years before present time (BP).

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3.2 Traditional Aboriginal Land Use

3.2.1 Traditional Land Use

People have lived and travelled across the North since the end of the last ice age, at least 10,000 years BP. The earliest inhabitants of the central District of the Mackenzie (Paleo-Indians or the Northern Plano tradition) are known to have lived in the region approximately 7,000 years BP. The tool assemblage associated with this population resembles that of early Aboriginal hunters of the northern plains, such as the Chipewyan (Wright 1981). Until about 3,500 years ago, the climate was warmer and animal populations were large and well established. Paleo-Indian hunters from the northern plains might have moved north following the caribou migration beyond the treeline and through the tundra of the barrenlands. Paleo-Indian sites in the NWT have been found in association with major caribou crossings that also provide fishing (Wright 1981). These Paleo-Indian sites have been found mainly to the east of Great Slave and Great Bear Lakes (Noble 1981).The nearest known Paleo-Indian sites to the Ekati Mine area are found more than 160 km northeast at Rawalpindi Lake (Rescan 2006).

The earliest cultural remains identified in the Ekati Mine area are from the Paleo-Eskimo or Arctic Small Tool tradition (ASTt). The ASTt people likely migrated from Siberia at approximately 4,000 BP. Most ASTt people sites in the barrenlands date from between 3,500 to 2,600 BP (Gordon 1996). This coincides with a cooling trend noted by the retreat of the treeline and a southern shift in populations around 4,000 to 3,000 BP (Maxwell 1980). The ASTt is characterized by spears, harpoons, stone burins, and microblades, often inset into bone or antler. Arctic Small Tool tradition sites have been identified on the Lac du Sauvage esker, at the Lac de Gras–Lac du Sauvage narrows, and at the outlet of Lac de Gras. The ASTt people probably fished and hunted caribou that were crossing the narrows and stayed close to sources of water (Rescan 2006).

The Taltheilei tool tradition is found throughout the Athabasca, Great Slave Lake, and north to the Lac de Gras regions. This assemblage is representative of early use and occupation of the land by the ancestral Athabaskan or Subarctic Dené (Noble 1981). It is less distinct than the ASTt and contains large shale and quartzite lanceolates, bifacial knives, sandstone whetstones, and circular scrapers. The continuity of this assemblage for over 2,000 years that, in some respects continues today supporting the Dené assertions that they have been living in the region “since time immemorial” (Rescan 2006). A small number of Taltheilei sites have been identified on inland eskers within the Ekati Mine area. It is highly probable that sites without diagnostic artifacts also can be attributed to the Taltheilei ancestors of the Chipewyan, Yellowknives, and Tłı̨chǫ (Rescan 2006).

Evidence of more recent, traditional use of the Lac de Gras region has been identified through physical remains, oral traditions, and the accounts of early European travellers. Prior to European contact, the Lac de Gras area was utilized by Dené groups such as the Tłı̨chǫ, Yellowknives, and Chipewyan. Their traditional land use patterns focused on the seasonal movements of harvestable wildlife (Helm 1981).

The Copper Inuit from the north also hunted, trapped, and travelled as far south as the Lac de Gras area. The big game animals harvested included barren ground (*Rangifer tarandus groenlandicus*) and woodland caribou (*Rangifer tarandus caribou*), moose (*Alces alces*), and, less commonly, musk ox (*Ovibos moschatus*) and wood bison (*Bison bison athabascae*). The Dené followed the migrating caribou into the tundra in the summer and fall, and then continued hunting and trapping in the barrens throughout the winter. Bow and arrow, spears, deadfall, snares, clubs, and, more recently, rifles, have been used to hunt big and small game (Smith and Rogers 1981). Small fur-bearing animals were taken regularly, with hare being an important winter food resource; grouse and ptarmigan were taken when big game was scarce. Dried meat and fish were the main sources of food in the winter.

Aboriginal people used nets, spears, or hook and line to harvest fish. Fish were an important food resource that was seasonally abundant during spawning runs. Waterfowl and their eggs provided a substantial component of the diet on a seasonal basis. Waterfowl were taken using bow and arrows tipped with blunt points or by being driven into nets (Smith and Rogers 1981). With the exception of the seasonal collection of berries, the diet of the Subarctic Dené did not include many vegetal foods. However, plants were used for medicine, dwellings, canoes, snowshoes, sleds, weaponry, and domestic items (Rescan 2006).

European iron has been available since 1750 and direct trading was occurring throughout most of the NWT by 1800. Changes in technology vary depending on location. Helm (1981) suggested that technology remained characteristically aboriginal until the twentieth century. However, Noble (1981) noted that early historical period (from 1770 to 1840) was marked by a reduction in aboriginal tools, at least from northern Great Slave Lake to the lower Coppermine River.

In 1890, Warburton Pike travelled with a Chipewyan Métis, King Beaulieu, to MacKay Lake and Lac de Gras to hunt musk ox. Pike's descriptions of traditional hunting methods mirror the accounts given by modern Dené through traditional knowledge (TK). At one time, Pike and Beaulieu were storm-bound on a promontory in Lac de Gras. This point has since been referred to as Pointe de Misère and it is the location and the source of the name of Ekati Mine's Misery Pit (Rescan 2006). In his journal, Pike (1892) reports that Lac du Sauvage was named by Beauleau for the Inuit that he had met there in the past.

Dené groups shared a similar loose social organization and were highly mobile, reflecting the seasonal distribution of the region's resources. Shelters were easily transportable conical, skin-covered, tipi-like structures or temporary rectangular pole and brush-covered structures. The Dené travelled along rivers and lakes with canoes during the warmer months and used snowshoes, dogsleds, and toboggans during the winter months (Smith and Rogers 1981).

The western interior of the Barrenlands was inhabited periodically by the Copper Inuit. The pre-contact origins of the Copper Inuit originate in the Thule Tradition, which spread across the central and eastern arctic approximately 750 BP (McGhee 2009). Traditionally the Thule are known for their bone, antler, and ground stone slate technologies; they are not known for chipped or flaked stone working, although the use of quartzite and chipping or flaking technology is more common on the Barrenlands (Linnamae and Clark 1976). Cooler temperatures during the Little Ice Age (from around 1350 to 1850 Anno Domini) and the access to European trade could have motivated the Thule to move from the traditional costal hunting grounds to the Barrenlands where they could fish and hunt caribou. Tent rings, caches, hunting blinds, and Inuksuk are common features that remain after their occupation. Inuit had a hunting technology that included kakavik (three-pronged fishing tool), kayak, bow and arrow, fishing weirs, spears, and harpoons (Maxwell 1985).

With the arrival of fur trade posts in the region in the late 1700s, conflict developed between the Tłı̨chǫ and the Yellowknives (who had better access to trade goods) (Gillespie 1981). Resolution of this conflict was achieved in the latter part of the nineteenth century. The establishment of the fur trade posts slowly changed the migratory patterns of the Dené so that they could provide caribou, and later furs, to the posts

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located around Great Slave Lake. Following the destruction of the plains buffalo and a decline in the number of caribou around the 1880s, the Inuit, Dené, and Métis shifted focus to the trade of musk ox, which were hunted to the northeast of Great Slave Lake. The trade of musk ox ended in the early 1900s and fur trapping became a main part of the economy for the Dené, Métis, and Inuit (Helm 1981). Until the 1950s, the Inuit at an outpost at Pellatt Lake fished and hunted caribou, providing food and clothing to coastal populations. Use of the area has declined since the closing of fur trade posts, however, such use continues near Lac de Gras and MacKay Lake (Rescan 2006).

In 1900, the Geological Survey of Canada began recording mineral observations in the NWT. Modern mining began to develop throughout the North beginning with the Eldorado Mine at Port Radium in the early 1930s. Commodities such as uranium, radium, silver, and copper were mined around Great Bear Lake. Gold was discovered in the Yellowknife area around the same time and drill programs began in the 1940s. After the 1940s, mining operations expanded to include other mines such as Colomac, Pine Point, Tundra, Lupin, and Prairie Creek. Mining became a mainstay of the growing Northern population (GNWT Industry, Tourism and Investment 2008).

In the 1970s, diamond-bearing kimberlite was discovered in the high Arctic but was not considered economically viable. In 1991, diamonds were recovered from drill cores from the Point Lake kimberlite pipe near Lac de Gras resulting in the largest staking rush in Canadian history. Today, the Diavik and Ekati Mines operate in the Lac de Gras region. The exploration and development associated with these operations, including winter roads, are the main land use activities currently occurring in the area. The other operating diamond mine in the NWT is Snap Lake, with Gahcho Kué in development.

The Inuit, Dené, and Métis maintain connections with the region and continue to carry out traditional land use activities near Lac de Gras (Rescan, 2006).

3.2.2 Archaeology

The main archaeological site types anticipated to be located in the general Ekati Mine area are prehistoric camp/hunting sites (e.g., tent rings and hunting blinds), station and hunting sites (e.g., caches, hearths, and marker sites), lithic scatters, and isolated artifact find locations. Burials potentially are present in the mine area and some have been identified by the Tłıçhǫ at Exeter Lake (Chocolate and Legat 2000).

Areas of moderate- to high-archaeological potential are well-drained, elevated landforms suitable for habitation. These include areas adjacent to important lakes, rivers, and drainages, and topographic features such as rock outcrops and eskers. In contrast, low, poorly drained areas are generally considered to have low archaeological potential. Low-lying areas were used as winter travel corridors in some regions, but little to no archaeological evidence is present to confirm this past use.

Topographic features, which may influence the location of campsites and hunting sites, include sources of fresh water, suitable ground surfaces campsites, and suitable building material. Most are close to food resources. Campsites and hunting sites often are found along the shorelines of lakes and creeks, which were important water sources, and modes of travel for the pre-contact and contemporary groups. Non-habitation sites associated with land use activities such as resource or subsistence activities, while less restricted tend to follow a pattern.

Landforms with the highest archaeological potential are:

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- shore lines of culturally valuable fish-bearing lakes;
- river banks and lakeshores, river or lake confluences, or paleo terraces;
- hill crests;
- uplands hills and ridges, eskers, and moraines;
- nearby non-food resources such as lithic raw material sources;
- topographic features that channel animal migration, specifically caribou; and
- seasonal travel routes (eskers or valleys).

The proposed Project is located north and east of the existing Ekati camp. In response to exploration activity in the area, many of the elevated landforms near Lac de Gras and Lac de Sauvage were examined during the summer between 1994 and 1997 as well as in 2001 (Bussey 1995, 1996,1997, 1998, 2002).

In total, there are 200 archaeological sites recorded within the Ekati Mine claim block, and 78 within the Regional Study Area for archaeology (Figure 3.2-1). There are 29 recorded archaeological sites within the proposed Jay-Cardinal Project footprint, the Local Study Area for archaeology (GNWT no date). Proposed and active fieldwork will determine whether there are additional sites previously not recorded; a heritage Management Plan will be developed for all sites within the proposed Jay-Cardinal Project.

Archaeological Impact Assessments are necessary for the Jay-Cardinal Project, through which mitigation, preservation and protection of known artifacts or heritage resources will be identified. The *Archaeological Sites Regulations* outline the importance of the identification, protection, and conservation of archaeology sites. The Ekati standard for the protection of archaeological and heritage resources that may be encountered and identified during field operations will apply to the Jay-Cardinal Project.

The 2013 archaeological baseline program focussed on archaeological assessments of lakeshores of Paul, E1[1], and Duchess Lake, and the north arm of Lac du Sauvage. Proposed locations of Project infrastructure with high archaeological potential were also assessed (Figure 3.2-1). The location of previously recorded sites was confirmed when possible. Previously unrecorded sites were documented according to the standards outlined by the Prince of Wales Northern Heritage Centre (PWNHC). The assessment of areas of proposed disturbance without recorded archaeological sites will enable the development of a mitigation plan and communicate this plan to communities as part of the PWNHC consultation process.

[1] E1 is an unofficial lake name.

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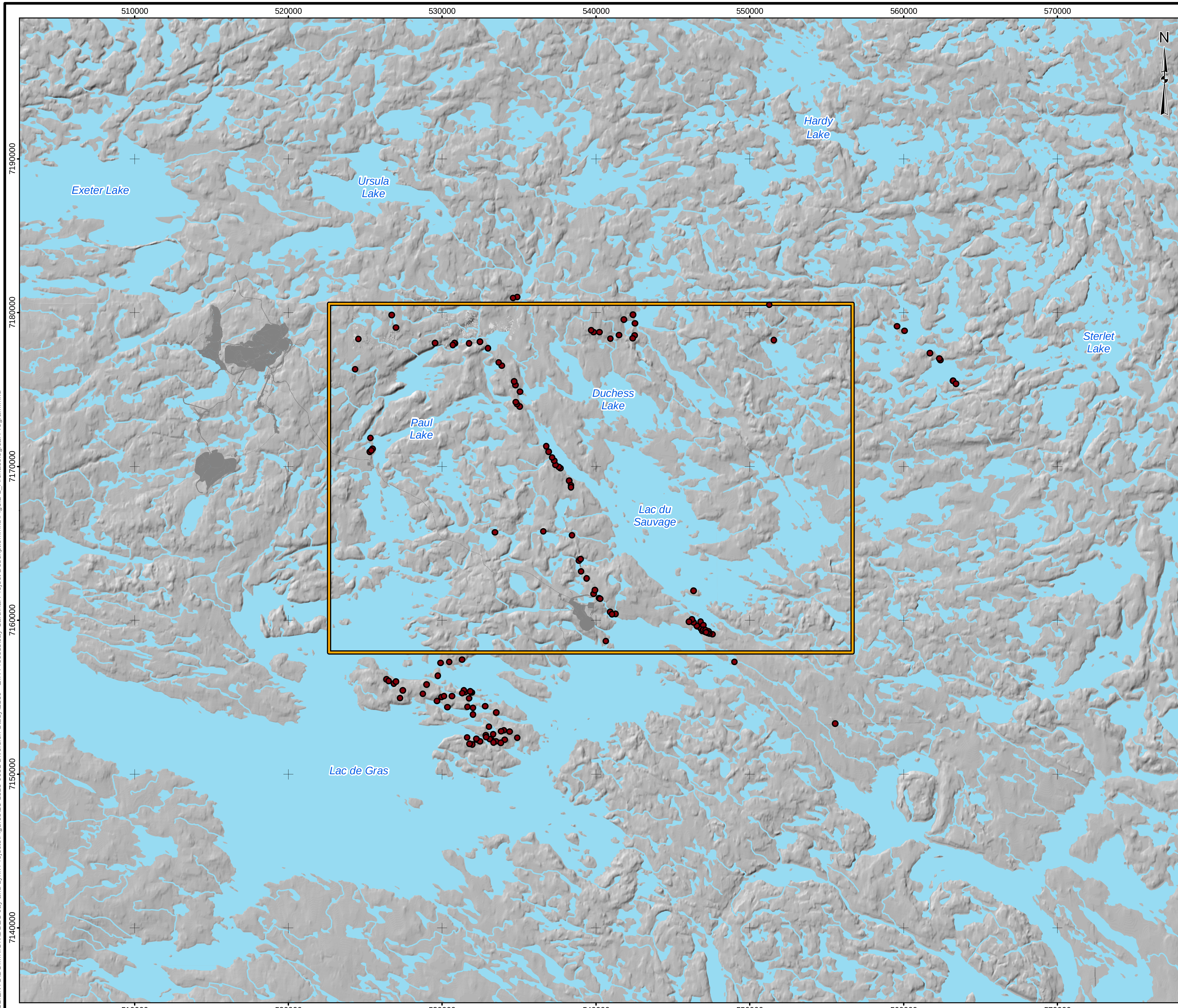

LEGEND

- EKATI MINE FOOTPRINT
- WATERCOURSE
- WATERBODY
- ARCHAEOLOGICAL SITE
- REGIONAL STUDY AREA

REFERENCE

ARCHAEOLOGICAL SITE DATA PROVIDED BY THE PRINCE OF WALES NORTHERN HERITAGE CENTRE; © GOVERNMENT OF THE NORTHWEST TERRITORIES, EDUCATION, CULTURE AND EMPLOYMENT
1:250,000 WATER - NTDB
1:50,000 DEM - GEOBASE
DATUM: NAD83 PROJECTION: UTM ZONE 12N

5 0 5

SCALE 1:250,000 KILOMETRES

PROJECT

JAY-CARDINAL PROJECT
LAC DU SAUVAGE,
NORTHWEST TERRITORIES, CANADA

TITLE

2013 TERRESTRIAL BASELINE: ARCHAEOLOGICAL PROGRAM

DOMINION DIAMOND

PROJECT		13-1328-0031	FILE No.	
DESIGN	JR	09/10/13	SCALE AS SHOWN	REV 0
GIS	ANK	09/10/13		
CHECK	ED	16/10/13	FIGURE: 3.2-1	
REVIEW	ED	16/10/13		

G:\CLIENTS\DOMINION\DDEC Jay and Lynx Projects\Figures\13-1328-0031 Diversion Study\2130 - EIR Process\Jay-Cardinal Project Description\mxd\Fig3.2-1_Archaeological Program.mxd

3.2.3 Traditional Knowledge

Major wildlife trails are located around and through Lac de Gras and Lac du Sauvage. People camped in areas where caribou, fish, and water were available such as at the Lac du Sauvage Outlet Narrows, on small bays along the shore, and on islands with channels where swift currents kept the water open in winter. Travellers would walk along eskers, which were often used for gravesites. Elders discouraged the use of eskers for camping and recommended places behind high points that provided protection from the wind. The type of shelters used at campsites depended on the purpose and duration of the stay. Because the Dené took their supplies with them, rings of tipi stones often are the only remaining evidence of the campsite (Weledeh Yellowknives Dené 1997). Yellowknives Dené Elders have observed a historic lowering of the water levels in the Ekati Mine area and have demonstrated how this changes the location of the campsites in relation to the existing shorelines. A recommendation from the 1997 Ekati Traditional Knowledge study (Weledeh Yellowknives Dené 1997) was that archaeologists check for ancestral evidence of former campsites inland from existing shorelines.

Traditional Tłı̨chǫ trails to the Ekati Mine from Tłı̨chǫ territory have been mapped. The traditional names provide important information about the environment and resources along traditional routes. The Tłı̨chǫ identify open, sparse areas with a variety of vegetation as the preferred habitat for campsites. Different forms of vegetation could be used for different purposes such as starting fires and protecting meat. The Tłı̨chǫ identify the preferred habitat for hunting caribou and obtaining other resources such as berries, medicine, and mending fibres. Some traditional use sites have been destroyed by mining activities and the Tłı̨chǫ worry that changes because of development will continue to affect the value of their resources and their cultural connection with the region (Chocolate and Legat 2000).

Copper Inuit, who lived near Lac de Gras, harvested caribou, seal, grizzly bear (*Ursus arctos* ssp.), fish, waterfowl, wolves (*Canis lupus*), wolverine (*Gulo gulo*), musk ox, and moose from around the Coppermine River and Contwoyto Lake in the spring and summer (Sadownik and Harris 1995). There were many Inuit campsites at Lac de Gras. The Dené and Inuit camped at the narrows of large lakes where the Inuit would capture and spear fish. Inuit elders recall men carving in higher areas, away from where they camped around the Ekati Mine area. They suggest that the remains from those activities in the area are similar to those found within the Ekati Mine area. The Inuit have helped to distinguish between the remains of Dené and Inuit campsites by describing the Dené camps as circular and Inuit camps as rectangular. As children, inland Inuit remember meeting Dené while hunting and trapping at large winter camps, such as at Tahikyoak (Contwoyto Lake), Kaomaogaktok (Rockinghorse Lake), and Lac de Gras. The Inuit and Dené crossed trails, especially in the winter, when the Dené were traveling to the north and Inuit were trapping to the south. These visits were occasions for celebrations and for trading. Major items exchanged were dogs, harnesses, food, furs, and tools such as snow knives (Banci and Hanks 2006). During a TK study of the area, Inuit participants expressed concern about the effect of mine development on the changing migration path, the health of the caribou, and on the quality of water in the Coppermine River. They also expressed their opinions that archaeological sites should be left undisturbed if possible (EAP 1996).

Métis voyageurs arrived in the Mackenzie Valley with the first wave of European fur traders in the late eighteenth century. The Métis often set up trading posts and accompanied explorers and scientists into the barrenlands. The Métis became important participants in the geologic exploration of the North while living and teaching a traditional lifestyle (Bohnet 1995). Metis involved in TK studies for the Ekati Mine

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area have indicated that all archaeological sites and traditional use values should be protected even though the area has not been used regularly for quite some time (EAP 1996).

The Ekati Mine has a strong history of supporting community-based TK projects that extends back the mid-1990s. The Ekati Mine currently supports a number of multi-year community-based projects:

- TK studies in support of the 1995 EIS for the Ekati Mine (completed);
- support of the West Kitikmeot Slave Study (completed);
- support of the Naonaiyaotit Traditional Knowledge Project with the Hamlet of Kugluktuk and Kitikmeot Inuit Association (current);
- support of the Tłı̨chǫ Government for preservation and digitization of older, analogue TK records (current);
- support of the Goyatiko Language Society (Yellowknives Dené First Nation) for preservation and digitization of older, analogue TK records (current);
- support of the Łutselk'e Dené First Nation for preservation and digitization of older, analogue TK records, and for development of a community-based database interface (current); and
- support of the North Slave Metis Alliance for heritage research and database compilation (current).

The Ekati Mine also conducts Ekati-based TK and community engagement programs related to the environmental monitoring programs:

- youth and Elder participation in fish sampling and assessment programs for the Aquatic Effects Monitoring Program (every three years);
- five to seven day youth and Elder visits for caribou monitoring as part of the Wildlife Effects Monitoring Program (annual);
- community participants conducting wolverine and grizzly bear DNA field programs as part of the Wildlife Effects Monitoring Program (varying schedules);
- group workshops to demonstrate and discuss air quality, dust monitoring, or other specific topics of interest (annual);
- Caribou and Roads program with Kugluktuk Elders group as part of the Wildlife Effects Monitoring Program (annual to 2008); and
- vegetation for closure planning workshops with youth and Elders (2013).

3.3 Local Communities

The Ekati Mine operates under Impact Benefit Agreements (IBAs) with the following signatories:

- Łutselk'e Dené First Nation;
- Yellowknives Dené First Nation;
- Tłı̨chǫ First Nation (Dogrib Treaty 11 Council);
- Akaitcho Treaty 8;

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- Hamlet of Kugluktuk;
- Kitikmeot Inuit Association; and
- North Slave Metis Alliance.

The Tłįchǫ reside primarily in the communities of Behchokǫ̀ (formerly Rae-Edzo), Gamètì (formerly Rae Lakes), Whatì (formerly Lac La Martre), and Wekweètì (formerly Snare Lake), while many Yellowknives and Chipewyan Dené reside in the communities of Detah, N'Dilo, and Łutselk'e. Copper Inuit reside primarily in the Hamlet of Kugluktuk. Wekweètì, with a population of 141 (GNWT Bureau of Statistics 2012), is the closest community to the Ekati Mine at approximately 150 km west of the mine site (Figure 1.3-1).

The contemporary economies of northern communities are characterised by both traditional (e.g., hunting, trapping, and fishing) and wage-based components (e.g., employment in resource extraction, government services, and other service industries). The land, water, and the resources therein, are of spiritual and cultural importance to Aboriginal peoples in the region.

The Ekati Mine also operates under a Socio-economic Agreement (SEA) with the GNWT. In addition to Yellowknife, the Agreement identifies "fly-point" communities for employment opportunities: Cambridge Bay, Inuvik, Fort Resolution, Fort Smith, Deline, Norman Wells, Fort Simpson, and Hay River.

3.4 Socio-Economic Setting

3.4.1 Demographics, Employment and Economy

As of 2009[2], nearly half (46%) of the NWT population (43,349) resides in Yellowknife (19,752). The remaining 54% (23,597) live in small communities throughout the NWT. The combined population of the communities[3] near Ekati (smaller communities) is 23,458.

Just over half (51%) of the NWT population is Aboriginal. Most of the Aboriginal population resides in the small communities within the NWT. Twenty three percent (2,596) of the Yellowknife population is Aboriginal, while in the smaller communities, Aboriginal people represent the majority (92% to 98%, depending on community). There is some in-migration to NWT but the territory also experiences out-migration, primarily due to the high cost of living. The Jay–Cardinal Project is predicted to delay out-migration from the predicted closure of Ekati and the future closure of Diavik. Detailed demographic information by community is presented in Table 3.4-1.

In 2009, Canada's unemployment rate was 8.3% and its labour force participation rate is 66.8%. At the same time, the unemployment rate in the NWT was 10.3% and the participation rate was 75.1%. Yellowknife had a comparatively lower unemployment rate of 5.6% with a high labour force participation rate of 84.5%. In other smaller communities, unemployment rates were high (14.5% to 28.2%).

[2] 2009 is the most recent year for which comparable (i.e., between population and other socio-economic features) is available.

[3] Yellowknife, Behchokǫ̀, Detah, Gameti, Łutselk'e, N'Dilo, Wekweètì and Whatì.

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Table 3.4-1 Select Demographic Characteristics of Communities near the Jay–Cardinal Project

Socio-Economic Parameter		NWT	Yellowknife	Behchokǫ̀	Detah	Gameti	Łutselk'e	Wekweeti	Whati
Population (2012)	Total	43,349	19,752	2,174	260	320	292	141	519
	Aboriginal (%)	*22,065 (51)*	*4,596 (23)*	*2,042 (94)*	*255 (98)*	*298 (93)*	*268 (92)*	*138 (98)*	*507 (98)*
Average Annual Growth (2001-2012) (%)		0.5	1.3	1.9	1.9	0.9	-1.8	0.5	0.4
Population (2009)		43,673	19,874	2,056	256	292	312	145	493
Population Aged 15 and Over (2009)[a]		33,730	15,775	1,374	182	214	243	81	360
Participation Rate (2009)		75.1	84.5	48.5	68.1	64.0	47.3	67.9	59.4
Unemployment Rate (2009)		10.3	5.6	22.7	28.2	24.1	27.8	14.5	27.1
Potential Available Labour Supply (2009)		4,847	1,209	507	46	53	87	20	85
% Available Labour Supply without High School Diploma (2009)		55.9	36.1	75.5	80.4	83.0	70.1	60.0	60.0
% Population with High School Diploma (2009)		69.3	83.8	33.9	31.9	32.2	31.3	42.0	33.6

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Despite the low unemployment rate in Yellowknife, the potential available labour force with a high school diploma is high (nearly 800 people) in relation to the labour force requirements of a mine. The combined potential available labour force in the smaller communities near the Project is similar (nearly 800 people); however the majority of this cohort does not possess a high school diploma[4]. This is a barrier to employment in the mining industry, as many mining occupations require that employees have at minimum a secondary school diploma or equivalent.

The mining and oil and gas extractive sectors are the largest economic drivers in the NWT, accounting for approximately one third of the total territorial Gross Domestic Product[5]. Government services (e.g., health care, education, administration, and policing and emergency response) also play a large role in the territorial economy.

3.4.2 Infrastructure, Services and Tourism

Transportation in the NWT consists of a network of regional and local airports, all-weather roads, winter roads, and ferry crossings. The Deh Cho Bridge connects Yellowknife and the North Slave Region with the rest of the country by road, while the Yellowknife airport acts as a major hub for air transportation in the region. Five all-weather access roads service the North and South Slave region. Some of the smaller communities are only accessible by winter road, or by air.

Northwestel provides telephone and television services to the NWT, Bell Mobility and Ice Wireless provide cellular services. The Northwest Territories Power Corporation provides electricity in the NWT, while the individual communities provide water, sewage and waste services.

Medical services are available in all communities to varying degrees. Stanton Territorial Hospital in Yellowknife provides most medical services in the region. Behchokǫ̀ and Yellowknife have ambulance services, while other communities are serviced by air ambulance or Medevac. The RCMP provides protective services in the region, and the Yellowknife Fire Department provides emergency response services (e.g., fire control, rescue, hazardous material response).

There are a variety of recreation opportunities in the NWT, including fishing, camping, canoeing, and hiking. Most communities also have an arena, community hall, and playground. Tourism in the territory is largely based on the wilderness experience, with tourists visiting for canoeing, guided sightseeing, outfitting and other outdoor recreational activities.

3.5 Local Industrial Developments

3.5.1 Diavik Mine

The Diavik Diamond mine (in operation since 2002) is built on East Island, a small island near the east end of Lac de Gras (Figure 3.5-1). At the end of 2011, the total physical development at Diavik encompassed 971 ha (9.71 km^2). There are three diamond-bearing kimberlite pipes under development: A154 South, A154 North, and A418.

[4] Diploma possession rates between 20% and 40% amongst the potential available labour force.

[5] As of 2009.

LEGEND

- WINTER ROAD - YEARLY CONSTRUCTION
- WINTER ROAD - ON-DEMAND CONSTRUCTION
- ALL-WEATHER ROAD
- CAMP
- EKATI MINE FOOTPRINT
- 10M CONTOUR
- WATERCOURSE
- WATERBODY

REFERENCE

1:50,000 STREAMS, LAKES AND WINTER ROAD - CANVEC
1:50,000 DEM - GEOBASE
CAMP LOCATIONS - AURORA GEOSCIENCES
DATUM: NAD83 PROJECTION: UTM ZONE 12N

3 0 3

SCALE 1:150,000 KILOMETRES

PROJECT

JAY-CARDINAL PROJECT
LAC DU SAUVAGE,
NORTHWEST TERRITORIES, CANADA

TITLE

LOCAL DEVELOPMENTS

DOMINION DIAMOND

PROJECT		13-1328-0031	FILE No.	
DESIGN	RC	01/10/13	SCALE AS SHOWN	REV 0
GIS	RC	01/10/13		
CHECK	ED	16/10/13	FIGURE: 3.5-1	
REVIEW	ED	16/10/13		

Open pit mining of these pipes has concluded and they are currently mined from underground. The main camp at the Diavik Mine contains accommodations, dining rooms, offices, water and sewage treatment plants, a waste facility, maintenance shops, a power plant, boiler plant, Arctic corridors, communications system, and an airstrip. The mine infrastructure includes a process plant.

3.5.2 Existing Ekati Mine

The physical development at the Ekati Mine encompasses 3,002 ha (30.02 km^2) (Figure 3.5-1).

Construction at the Ekati Mine began in 1997 with the erection of a 375-room accommodation complex and associated infrastructure (e.g., power, heat, water, sewage treatment, and communication systems) north of Kodiak Lake. This infrastructure was complete and operational by April 1997, at which time the old camp was retained as overflow housing until its closure in 1999. Construction of the truck shop, power generation facility, coarse kimberlite storage building, process plant, and mail fuel storage area continued through late 1997 to early 1998. The mine was officially opened on October 14, 1998.

The Panda Pit was the first pit to be developed at the Ekati Mine. Waste rock removal began in 1997 and mining of kimberlite began in 1998. In 1997 and 1998, waste rock (granite) from Panda Pit was used to construct roads, dikes, dams, building foundation pads, and miscellaneous projects around the site. In 1997, the Panda Diversion Channel was completed. In 1999, a 29 km road was built to link Misery Road to the Tibbitt-to-Contwoyto Winter Road that extends from Yellowknife.

The Panda Pit was closed in 2003. Underground mining began in 2005 and ended in 2010. Waste rock and coarse kimberlite reject from the underground mine were transported to the Panda/Koala waste rock storage area (WRSA). Decommissioning of the Panda underground workings for closure is complete.

Waste rock removal for the Koala Pit and Koala North Pit began in 2000 and 2001, respectively. The underground test mine at Koala North began in 2001 and ended in 2002. Kimberlite production from the Koala Pit began in 2003 and ended in 2005. The Koala Underground operation began in 2004, with kimberlite production beginning in 2007. Koala North underground was operated between 2009 and 2011 and the waste rock and kimberlite reject were transported to the Panda/Koala WRSA. Underground mining in the Koala and Koala North kimberlite pipes is on-going.

Excavation of the Fox Pit began in 2001 and kimberlite production began in 2005. Waste rock was transported to the Fox WRSA. The Nero-Nema Bridge was built in the winter of 2001/2002, extending the Fox Road from the main camp to the Fox Pit. Open pit mining in the Fox kimberlite pipe is on-going.

Waste rock removal from the Misery Pit and the construction of the road and camp for the Misery site began in 1999. Kimberlite production in the Misery Pit began in 2001. Kimberlite production was suspended in April 2005 and stockpiled kimberlite was trucked to the process plant until 2007. Construction activities at Misery camp were initiated in 2011, and the camp re-opened in early 2012 to mine the deeper portions of the Misery pipe with a pushback of the original open pit. Construction of the Misery WRSA recommenced in 2012 to complete the final open pit.

Beartooth Pit construction started in 2003 and kimberlite production began in 2005. Open pit mining of the Beartooth kimberlite pipe was completed in April 2009, after which time the pit was integrated into the mine water management system as a mine water retention pond and, in 2012, as a fine processed kimberlite deposition location.

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In 2010, a test pit was excavated at the Pigeon kimberlite pipe to collect a bulk sample for process testing. Development of the Pigeon open pit is anticipated to commence in 2014.

3.5.3 Tibbitt to Contwoyto Winter Road

The Tibbitt to Contwoyto winter road (approximately 600 km) in the barrenlands of the North provides seasonal road access to the Diavik and Ekati mines. The Diavik Mine is located at kilometre 360 along the road, while the Ekati Mine is located at kilometer 400. Approximately 80% of the road consists of frozen lakes and ponds, connected by short overland portages.

Fuel, large equipment, and heavy consumables are freighted to site on the winter road. Ekati Mine freight typically varies up to 4,000 trucks per year. The logistics of planning and expediting the delivery of freight required for a full year of operation by the winter road over an approximately two-month period is critical to mining operations.

The ice road is built by a joint venture of mining companies (Diavik Diamond Mines Inc., Dominion, and De Beers Canada Inc.) operating in the area and is shared by many users (i.e., exploration companies, tourism outfitters, and Aboriginal hunters of the region). This seasonal winter road is open for eight to nine weeks each year (i.e., from February to the beginning of April, depending on weather and the season's load requirements), and must be re-constructed each year to service mines in the area. Occasionally, the ice road is extended by others north from Lac de Gras to Contwoyto Lake.

The road is capable of withstanding high levels of traffic. During peak usage years in the 2000s, over 10,000 truckloads per year were safely transported to the mine sites.

There are three seasonal maintenance/staging camps along the road. The most northerly is the Lac de Gras camp, located on the south shore of Lac de Gras (Figure 3.5-1).

3.5.4 Outfitter Camps

There are currently, seven fishing and/or hunting operators licensed within the vicinity of the Ekati Mine site (Northwest Territories Tourism 2013). These operators (Arctic Safaris, Aurora Caribou Camp, Aylmer Lake Lodge, Bathurst Arctic Services, Mackay Lake Lodge/True North Safaris, Warburton Bay Lodge, and Peterson's Point Lake Lodge) are located between 50 and 150 km of the Ekati claim block. Currently, no outfitting or guiding activities are taking place within the surface lease areas or mineral claim block area held by the Ekati Mine.

In the recent past, a single outfitter camp was operated on Lac de Gras (Figure 3.5-1) near the Diavik Traditional Knowledge Camp. The Lac de Gras camp is located on the southern shore of Lac de Gras approximately 3 km southeast of the Lac du Sauvage outflow (Figure 3.5-1). It was purchased by John Andre of Shoshone Wilderness Adventures in 1999. Shoshone provided fall barren-ground caribou hunts and fishing from 1999 until 2010. The same company owns an outfitting camp at Courageous Lake; the total number of hunters who used each site annually is unknown. Hunting activity at the Lac de Gras camp was first limited in 2007, when the GNWT reduced the number of sport hunting tags following concerns about declining numbers of the Bathurst caribou herd (The Hunting Report 2007). The camp closed in 2010 following emergency management measures implemented by the GNWT (The Hunting Report 2010; ENR 2013).

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3.6 Atmospheric Environment

The Ekati Mine area is located in the Arctic Climatic Region, where summers are generally short and cool, and winters are long and extremely cold. The mean monthly temperatures ranges from -31.2°C (January) to 10.2°C (July), with a mean monthly temperature of -12°C. Precipitation is sparse, averaging 307 millimetres (mm), and consists of relatively equal amounts of rain and snow. Snow may occur in any month of the year; however, the snow cover exists for about seven months, between October and April. The site is generally windy with velocities averaging 20 kilometres per hour (km/hr) on typical days. Available daylight ranges from a minimum of four hours per day in December to a maximum of 22 hours in June.

The Ekati Mine Air Quality Monitoring Program (AQMP) provides for the on-going collection and annual reporting of information about the effects of mine activities on air quality. The AQMP provides for annual monitoring and reporting of road dust and air quality at the Ekati Mine site, and for a three-year program for regional monitoring and reporting on air quality, snow quality, and lichen. The AQMP is provided to and reviewed by Aboriginal communities, government agencies and the Independent Environmental Monitoring Agency (IEMA) through report submissions, group workshops, and individual meetings. The AQMP can be refined or amended as necessary and appropriate and can be readily expanded to incorporate the Jay-Cardinal Program.

3.7 Geology

Environmental Setting

A regional geology map of the Lac de Gras area is included as Figure 3.7-1. The Ekati Mine area is underlain by the Slave Structural Province, one of several Archean cratons (i.e., the nucleus around with the North American continent evolved). The Slave Province is a granite-greenstone terrane that grew by tectonic accretion.

Rock types within the Slave Province can be assigned to three broad lithostratigraphic groups: metasedimentary schists, migmatites, and various syntectonic and post-tectonic intrusive complexes.

The metasediments represent a metamorphosed greywacke sequence and are widespread in the central and southern portions of the Ekati claim block. Typically, the metasediments are fine-grained with a high proportion of sheet silicates and generally foliated. Sulphide minerals are present at trace concentrations, but occasionally at concentrations of up to 2% at the centimeter scale. Locally, up to 5% sulphides are observed on a centimeter scale.

The metasediments are intruded by voluminous neo-Archean granitoids. Syntectonic (2.64 to 2.60 billion years [Ga]) tonalites and granodiorites occur predominantly in the central and northern portions of the property, while post-tectonic (2.59 to 2.58 Ga) granites (two-mica granite and biotite granite) form large plutons in the eastern and northeastern portions of the Ekati Mine area. The granodiorites are generally white to grey in colour, medium to coarse-grained, and weakly foliated to massive, locally containing rounded biotite-rich mafic xenoliths ranging from 10 to 150 mm in size and rare cubic pyrite grains (up to 2 mm). The granodiorite has an average modal composition of 40% quartz, 45% feldspar, and 15% biotite. In weakly altered zones, 1% to 3% epidote may be present. The two-mica granite contains fine to coarse-grained quartz, potassium feldspar, and plagioclase, with 3% to 15% biotite and muscovite.

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Tourmaline laths up to 0.5 centimetres (cm) by 3.5 cm have been observed. Pegmatite phases are common. Sulphide minerals are rarely observed, and then only in trace amounts.

The western part of the Ekati Mine area is dominated by migmatites, which reflects the melting of metasediments due to widespread granite intrusion and associated heat input.

Five major Proterozoic diabase dike swarms (ages varying from 2.23 to 1.27 Ga) intrude the Archean rocks. The dikes are a few centimetres to more than 30 m wide and classified as magnetic and non-magnetic. Generally, they are near vertical with sharp or fractured contacts of variable orientation. Magnetic dikes are very dark grey to black, fine-grained, and contain magnetite and traces of pyrite, chalcopyrite, with lesser amounts of pyrrhotite. Sulphide mineral concentrations of up to 2% are rarely observed and only over widths of a few centimetres. Non-magnetic dikes have very similar overall composition to magnetic dikes except that they lack abundant magnetite.

The Ekati Mine kimberlite intrusions are Tertiary in age ranging from 45 to 75 Ma [million years]). Erosion of the kimberlite pipes resulted in surface depressions, many of which became permanent, shallow lakes that typically have several metres of silty sand sediments deposited on the lakebed.

The Wisconsinan Laurentide ice-sheet deposited glacial till, glaciofluvial eskers, and kames in the Lac de Gras area. Three directions of glacial flow have been recognized: early flow to the southwest, followed by flow to the west, and finally by flow to the northwest.

On the upland areas, the surface is either exposed bedrock or covered with a thin layer (up to 5 m thick) of Quaternary sediments of silty sand, gravel, boulders, and organic matter.

The geological setting regarding specific project components (e.g., waste rock, kimberlite, and pit wall geochemistry, and rock mass rating) are provided Section 4.5.

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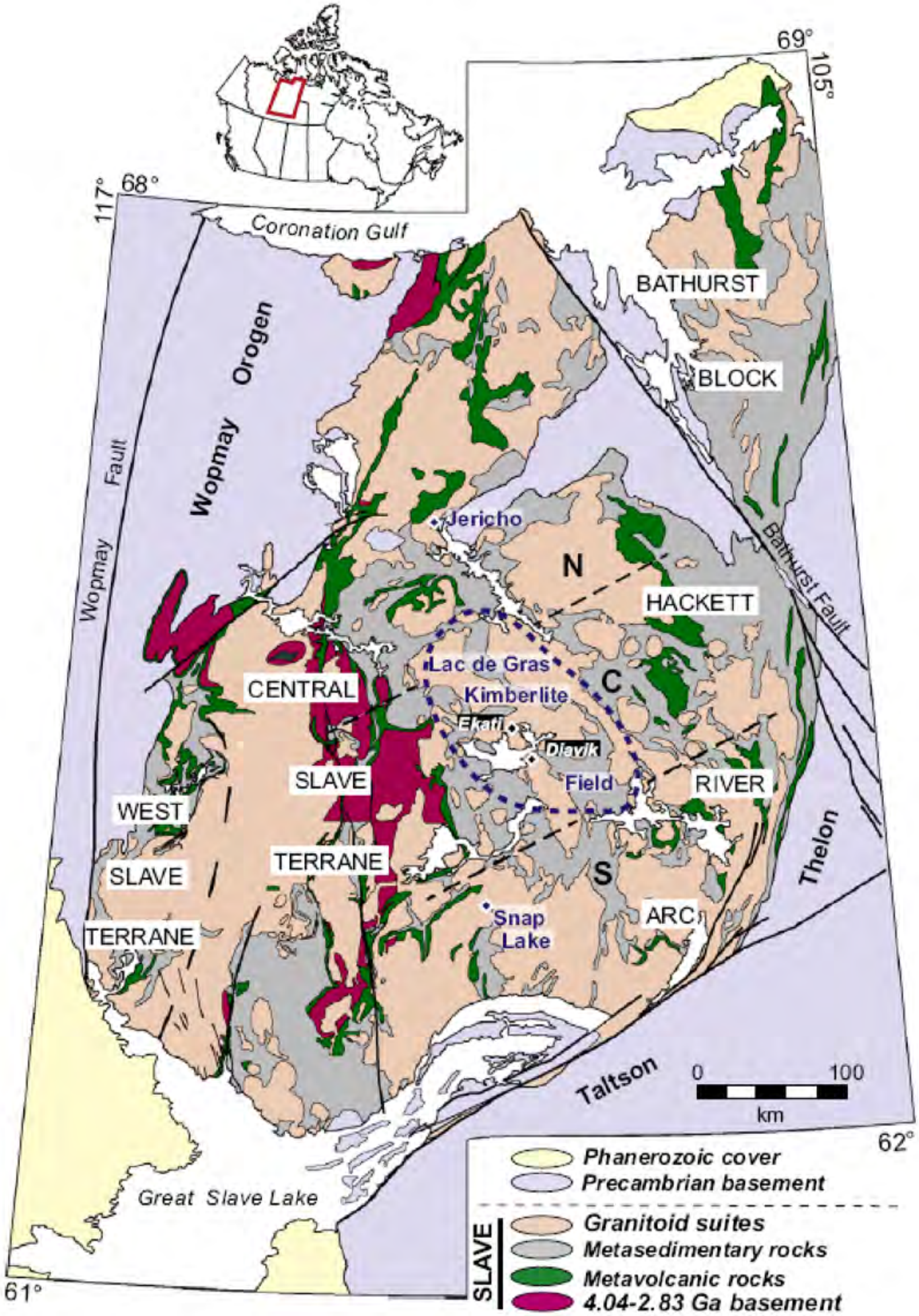

G:\CLIENTS\DOMINION\DDEC Jay and Lynx Projects\Figures\13-1328-0031 Diversion Study\2130 - EIR Process\Jay-Cardinal Project Description\mxd\Fig3.7-1_Regional_Geology.mxd

REFERENCE

EKATI DIAMOND MINE NORTHWEST TERRITORIES, CANADA: NI 43-101 TECHNICAL REPORT. PREPARED BY M. HEIMERSSON AND J.A. CARLSON ON BEHALF OF DOMINION DIAMOND CORPORATION.

PROJECT

JAY-CARDINAL PROJECT
LAC DU SAUVAGE,
NORTHWEST TERRITORIES, CANADA

TITLE

REGIONAL GEOLOGY

DOMINION DIAMOND

PROJECT		13-1328-0031	FILE No.	
DESIGN	RC	01/10/13	SCALE AS SHOWN	REV 0
GIS	RC	01/10/13	**FIGURE: 3.7-1**	
CHECK	ED	16/10/13		
REVIEW	ED	16/10/13		

3.8 Hydrogeology

Environmental Setting

Continuous permafrost (i.e., soil or rock that is continuously below 0°C for two or more years) is present within the region to a depth typically in the order of 350 m below ground surface. This has been established through a number of drill investigations and observations over the life of the Ekati Mine.

Permafrost occurs as a result of cold climates and can be inhibited or prevented from occurring by a ground insulating layer, such as a lake, a glacier or even a building. In the case of a lake, if the lake has a certain size and has existed for at a long period of time, there is often no permafrost below the lake and the border between permafrost and no permafrost tends to run subvertically from the shore line down.

Unfrozen ground beneath lakes is referred to as a talik. The depth of a talik underlying small lakes such as Beartooth Lake (at the Ekati Mine) is minimal. Thus the Beartooth open pit was excavated in permafrost, which prevented groundwater interactions with the open pit. Large lakes, such as Lac du Sauvage, may have a talik zone that extends through to the base of permafrost, which is referred to as a ‘through talik’. In this deep groundwater regime and in the deeper depths of a through-talik, deep-seated ancient groundwater is found within the bedrock fractures (connate water that was trapped in pores in the rock when the rock was formed). This “fossil water” is highly saline as a result of stagnation within the granite rock. The salinity of the groundwater typically increases with depth.

Water movement though unfrozen ground in the Ekati Mine area is largely controlled by geological structures such as fault zones or fractures. The ground itself, though unfrozen, is predominantly granite rock which has an extremely low hydraulic transmissivity. In the case of a through talik, deep groundwater is not under pressure and thus is not pushes upwards into the overlying lake, as evidenced by the extremely low concentrations in surface water of ions such as chloride that are characteristically elevated in the deep groundwater. Site-specific experience in the Panda and Koala underground workings, which are located in sub-permafrost, unfrozen ground, is that chloride-rich, deep groundwater is encountered in fracture zones intersected by the underground workings; however the quantities are relatively small and there is very little evident pressure, the fault zones rather draining by gravity to the lowest point.

The genesis of kimberlite pipes can result in enhanced permeable zones (fractured rock zones associated with faults and other geological discontinuities) that radiate out from the pipes and can provide pathways for groundwater flow thereby increasing groundwater inflow to open pits and underground workings.

3.9 Aquatic Environment

In 2006, an aquatic baseline study was completed for the Jay-Cardinal Project area in anticipation of possible future mining activities. Aquatic components were sampled from three lakes (Lac du Sauvage, Christine Lake, and Ursula Lake) and two streams (Stream A and Stream B) (refer to Figure 2.1-1 in Appendix 3A: 2006 Jay Pipe Aquatic Baseline Report; Rescan 2007). The aquatic components sampled included: bathymetry, hydrology, water quality, sediment quality, limnology, phytoplankton, zooplankton, benthos, fish habitat, and fish communities (Appendix 3A: 2006 Jay Pipe Aquatic Baseline Report; Rescan 2007).

To supplement the existing aquatic baseline data, an extensive baseline field program was undertaken in 2013. The 2013 baseline program continued examination of aquatic components, the study area was extended to encompass additional lakes and streams surrounding Lac du Sauvage (e.g., Duchess Lake,

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Paul Lake, and Counts Lake) (Figure 3.9-1), as well as some unnamed lakes and streams in the study area for some components. Sampling intensity was also increased within Lac du Sauvage (Figure 3.9-2 and Figure 3.9-3). Technical reports on the 2013 baseline program will be available in the future.

The Ekati Mine Aquatic Effects Monitoring Program (AEMP) provides for the on-going collection and annual reporting of information about the effects of mine activities on the aquatic environment. The AEMP overlaps with the baseline data collection study area (e.g., Counts Lake and the Christine-Lac du Sauvage Stream have monitoring stations in them); these available data will also be incorporated into the baseline reports, as appropriate. The AEMP is provided to and reviewed by the WLWB, Aboriginal communities, government agencies and the IEMA through report submissions, group workshops and individual meetings. The WLWB leads a scheduled three-year review of the AEMP. The AEMP is refined and amended as necessary and appropriate, and can be readily expanded to incorporate the Jay-Cardinal Project.

The Ekati Mine Surveillance Network Program (SNP) provides for the on-going collection and monthly reporting of information about water quality at the Ekati Mine and at the effluent discharge locations. The SNP overlaps with the baseline data collection study area (e.g., Cujo Lake and the Christine-Lac du Sauvage Stream have SNP monitoring stations in them); these data will also be incorporated into the baseline reports, as appropriate. The SNP data are provided to and reviewed by the WLWB, Aboriginal communities, government agencies and the IEMA through report submissions, group workshops, and individual meetings. The SNP is refined and amended as necessary and appropriate, and can be readily expanded to incorporate the Jay-Cardinal Project.

3.9.1 Lakes and Surface Hydrology

Environmental Setting

The Jay-Cardinal Project is situated in an Arctic Climatic Region, at an altitude of approximately 465 m above mean sea level (amsl) (ranging from 400 to 500 amsl). The topography is generally flat and the area is typical Arctic tundra, consisting predominately of flat, wet or swampy, terrain with little vegetation. The landscape consists of numerous lakes interspersed among boulder fields, eskers, and bedrock outcrops. Many lake outlets consist of short boulder garden channels, with large relative roughness (ratio of boulder size to flow depth), which may limit fish passage between some lakes.

The Jay-Cardinal Project area is located primarily in the Lac du Sauvage basin, which has a drainage area of 1,496 km^2 and is the largest single tributary to Lac de Gras, which has a drainage area of 3,559 km^2 at its outlet. The Lac de Gras drainage basin is located at the headwaters of the Coppermine River drainage basin. Lac de Gras discharges water west into the Coppermine River, which flows north into the Arctic Ocean at the Hamlet of Kugluktuk. More than 200 small tributary streams, many of which are ephemeral (i.e., flow intermittently) discharge directly into Lac de Gras.

Lac du Sauvage has a surface area of approximately 109.1 km^2; Lac de Gras has a surface area of 572 km^2. Lac du Sauvage has 11 tributary sub-basins, ranging in drainage area from 6.5 to 449 km^2, and a local contributing drainage area of 145 km^2. Its drainage area is approximately 31.5% open water and 68.5% land surface. Lac du Sauvage has a volume of approximately 575 million cubic metres (Mm^3), and a maximum depth of 35 m (Figure 3.9-4).

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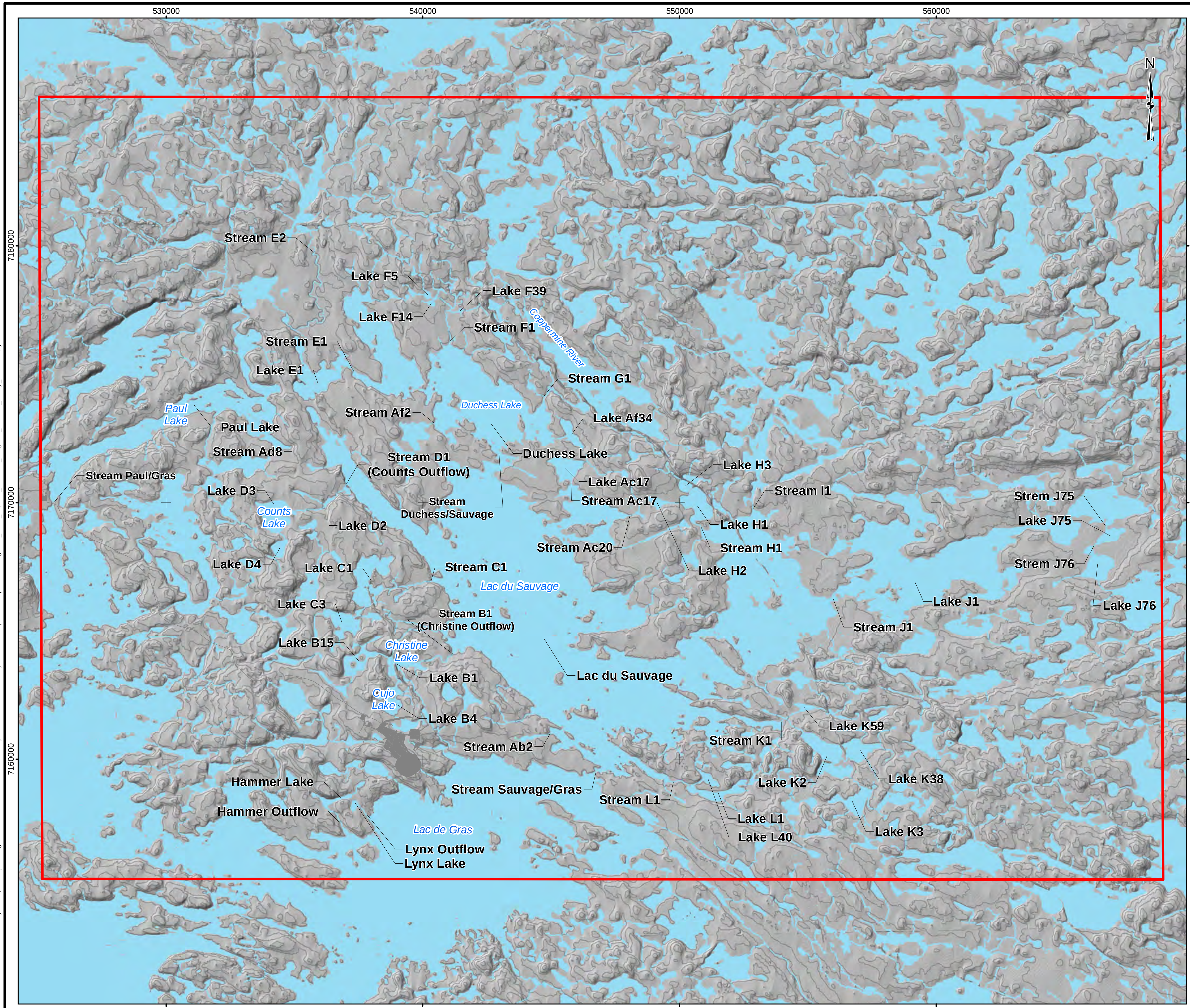

LEGEND

- AQUATIC BASELINE GENERAL STUDY AREA
- EKATI MINE FOOTPRINT (MISERY OPERATION)
- 10M CONTOUR
- WATERCOURSE
- WATERBODY

REFERENCE

1:50,000 LAKES AND STREAMS - CANVEC
1:50,000 DEM - GEOBASE
DATUM: NAD83 PROJECTION: UTM ZONE 12N

3 0 3
SCALE 1:150,000 KILOMETRES

PROJECT
JAY-CARDINAL PROJECT
LAC DU SAUVAGE,
NORTHWEST TERRITORIES, CANADA

TITLE
2013 AQUATIC BASELINE PROGRAM: GENERAL STUDY AREA

DOMINION DIAMOND

PROJECT		13-1328-0031	FILE No.	
DESIGN	RC	01/10/13	SCALE AS SHOWN	REV 0
GIS	RC	01/10/13		
CHECK	ED	16/10/13	**FIGURE: 3.9-1**	
REVIEW	ED	16/10/13		

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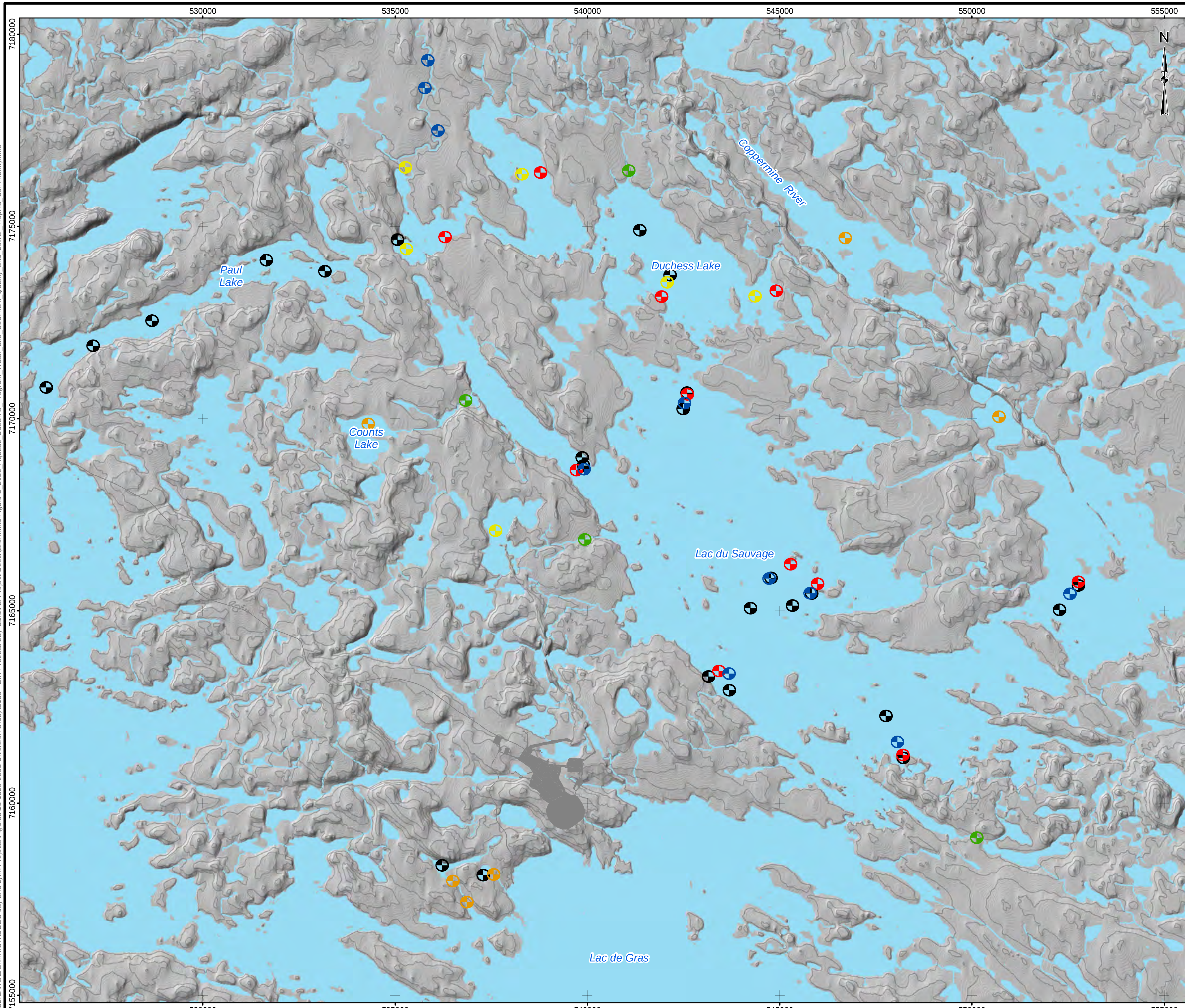

LEGEND

- WATER SAMPLE
- WATER AND FULL SEDIMENT SAMPLE
- WATER, BENTHICS, AND FULL SEDIMENT SAMPLE
- BENTHICS (TOC/PSA) AND SEDIMENT SAMPLE
- BENTHICS SAMPLE
- WATER, PLANKTON, BENTHICS, AND FULL SEDIMENT SAMPLE
- EKATI MINE FOOTPRINT (MISERY OPERATION)
- 10M CONTOUR
- WATERCOURSE
- WATERBODY

REFERENCE

1:50,000 WATER - CANVEC
1:50,000 DEM - GEOBASE
DATUM: NAD83 PROJECTION: UTM ZONE 12N

2 0 2
SCALE 1:100,000 KILOMETRES

PROJECT
JAY-CARDINAL PROJECT
LAC DU SAUVAGE,
NORTHWEST TERRITORIES, CANADA

TITLE
2013 AQUATIC BASELINE PROGRAM: WATER AND SEDIMENT QUALITY AND LOWER TROPHIC COMMUNITY

DOMINION DIAMOND

PROJECT		13-1328-0031	FILE No.	
DESIGN	RC	12/10/13	SCALE AS SHOWN	REV 0
GIS	RC	12/10/13		
CHECK	ED	16/10/13	**FIGURE: 3.9-2**	
REVIEW	ED	16/10/13		

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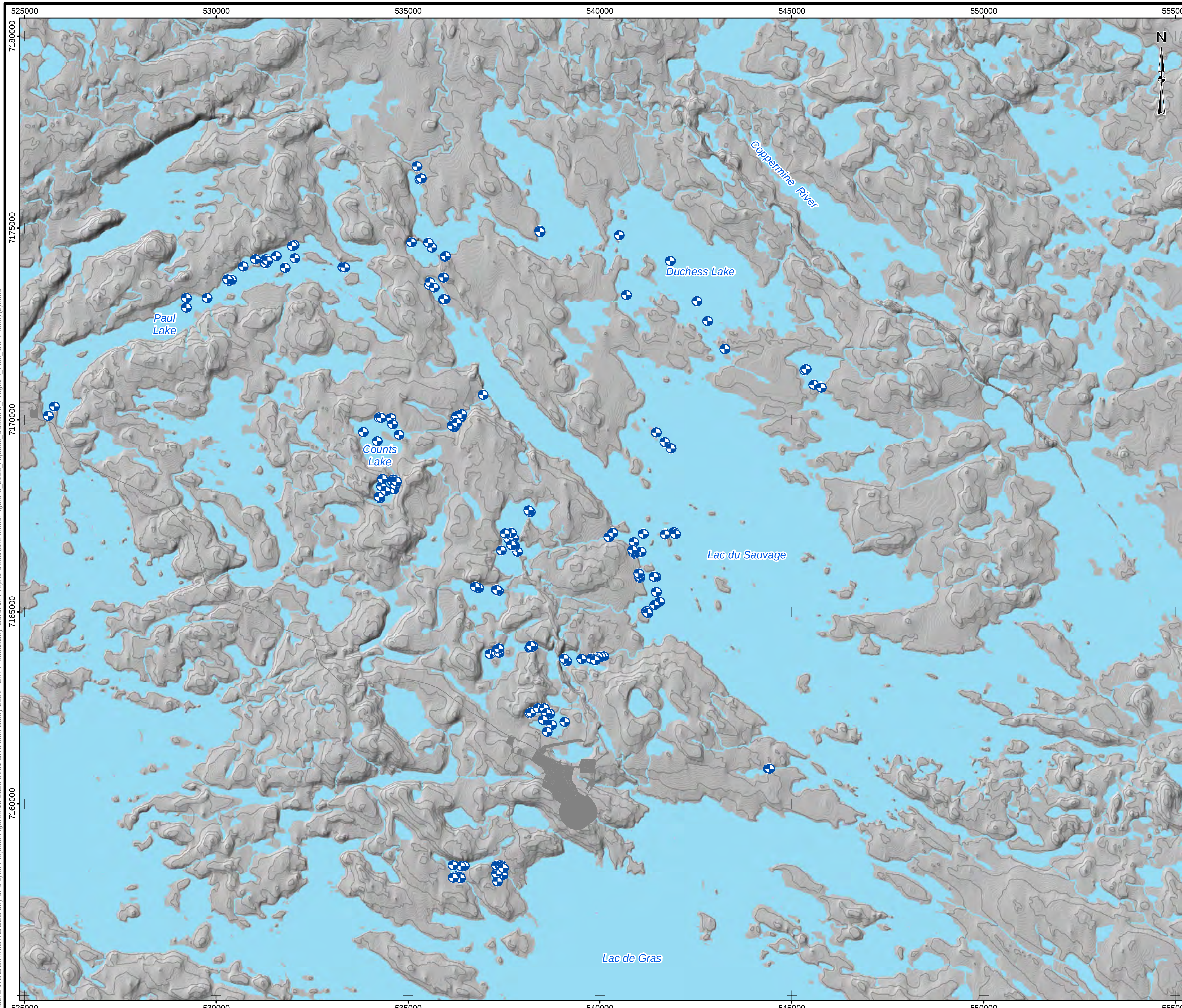

LEGEND

- FISHING LOCATION
- EKATI MINE FOOTPRINT (MISERY OPERATION)
- 10M CONTOUR
- WATERCOURSE
- WATERBODY

REFERENCE

1:50,000 WATER - CANVEC
1:50,000 DEM - GEOBASE
DATUM: NAD83 PROJECTION: UTM ZONE 12N

2 0 2
SCALE 1:100,000 KILOMETRES

PROJECT
JAY-CARDINAL PROJECT
LAC DU SAUVAGE,
NORTHWEST TERRITORIES, CANADA

TITLE
2013 AQUATIC BASELINE PROGRAM: FISH COMMUNITY

DOMINION DIAMOND

PROJECT		13-1328-0031	FILE No.
DESIGN	RC	12/10/13	SCALE AS SHOWN REV 0
GIS	RC	12/10/13	
CHECK	ED	16/10/13	**FIGURE: 3.9-3**
REVIEW	ED	16/10/13	

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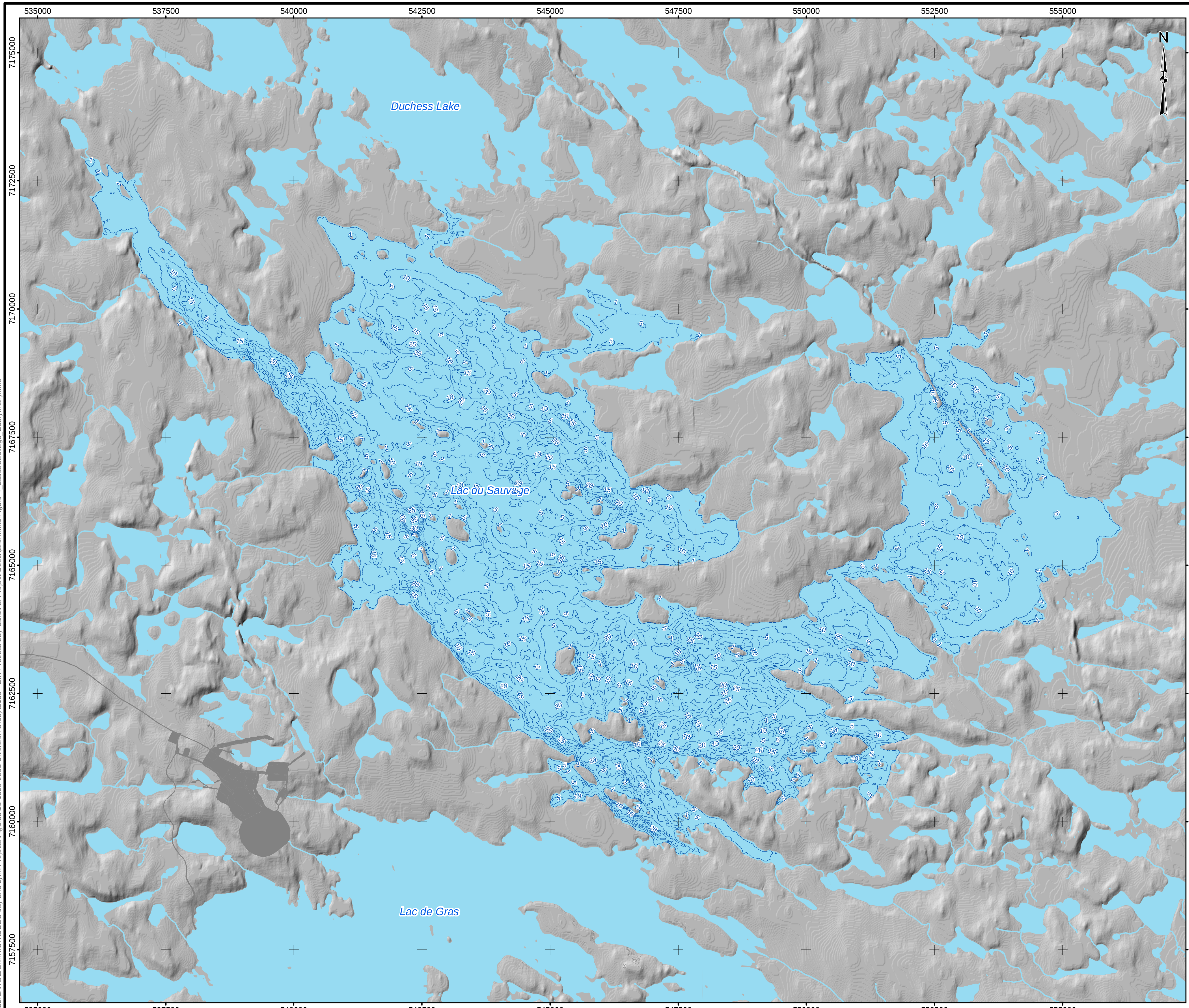

LEGEND

- EKATI MINE FOOTPRINT (MISERY OPERATION)
- WATERCOURSE
- WATERBODY
- BATHYMETRY CONTOUR (5 METRE INTERVAL)

REFERENCE

1:50,000 WATER - CANVEC
1:50,000 DEM - GEOBASE
DATUM: NAD83 PROJECTION: UTM ZONE 12N

1.5 0 1.5
SCALE 1:75,000 KILOMETRES

PROJECT
JAY-CARDINAL PROJECT
LAC DU SAUVAGE,
NORTHWEST TERRITORIES, CANADA

TITLE
LAC DU SAUVAGE BATHYMETRY

DOMINION DIAMOND

PROJECT		13-1328-0031	FILE No.
DESIGN	ANK	10/10/13	SCALE AS SHOWN REV 0
GIS	ANK	10/10/13	
CHECK	ED	16/10/13	FIGURE: 3.9-4
REVIEW	ED	16/10/13	

G:\CLIENTS\DOMINION\DDEC Jay and Lynx Projects\Figures\13-1328-0031 Diversion Study\2130 - EIR Process\Jay-Cardinal Project Description\mxd\Fig3.9-4_LacduSauvage_Bathymetry.mxd

Preliminary water balance estimates for the Lac du Sauvage basin indicate a mean annual water yield of 175 mm, which is equivalent to a water volume of 259 Mm^3 or a mean annual discharge of 7.3 cubic metres per second (m^3/s). This compares to an estimated mean annual discharge of 20.2 m^3/s at the Lac de Gras outlet (Golder 2008). Stream flow is highest at snowmelt in the spring and declines steeply over the summer. Flows typically increase slightly in September in response to autumn rains. Freeze-up occurs in early October and most streams in the barrenlands freeze completely to the streambed during winter, so fish overwinter in lakes. The presence or absence of lakes for overwintering habitat is a key determinant for the distribution of fish and fish habitat.

Lac du Sauvage and tributary lake shorelines include bedrock outcrops, eskers and low relief, and vegetated areas. Erosion sensitivity to changes in water surface elevation regimes will depend on soil and vegetation types, slopes and fetch lengths relative to dominant wind directions.

2013 Baseline Studies

To assist with the 2013 baseline study data collection, the Lac du Sauvage Watershed sub-basins were identified and a nomenclature system was developed to identify the number of lakes and connecting channels within the 11 sub-basins. Sub-basins are identified with capital letters (i.e., A, B, C) (Figure 3.9-5), sub-sub-basins are identified by lower case letters (i.e., Aa, Ab, Ac). (Figure 3.9-6), and lakes are designated by the basin letter followed by the lake number (i.e., L1, L2, L3).

Hydrological studies performed in 2013 include acquisition of Light Detection and Ranging data and high resolution orthophotos for the entire Lac du Sauvage basin. Field studies in the summer and autumn of 2013 included an overall basin reconnaissance, continuous measurements of water surface elevations at 6 lake outflows, manual discharge and water level measurements at those and additional lake outflows, and bathymetric surveys at key lake outlet channels to provide input data for a basin-wide water balance model.

Continuous water level gauges were installed at six lake outflows (Lakes A1, E1, E10, G1, I1 and Lac du Sauvage) between mid-August and late September to measure water levels and allow discharges to be derived on the basis of preliminary stage-discharge rating curves (Figure 3.9-7). Benchmarks were established at these stations to allow them to be used as long-term hydrometric stations. Additional detailed surveys, including benchmark installation, discharge and water surface elevation measurements, and cross-sectional surveys, were performed at approximately 40 additional lake outlets. Smaller lakes were observed by aerial reconnaissance. These surveys will provide input data to the basin water balance model.

Data collection in 2013 also included bathymetric surveys at Lac du Sauvage, Duchess Lake, Paul Lake and Lake E1. Shoreline surveys were performed at these lakes to validate digital data to provide a basis for shoreline erosion modeling.

The 2013 program also identified historical data from Lac du Sauvage tributaries (Cujo Outflow and Counts Outflow) and the Lac de Gras Outflow, which will be used in the hydrology effects assessment.

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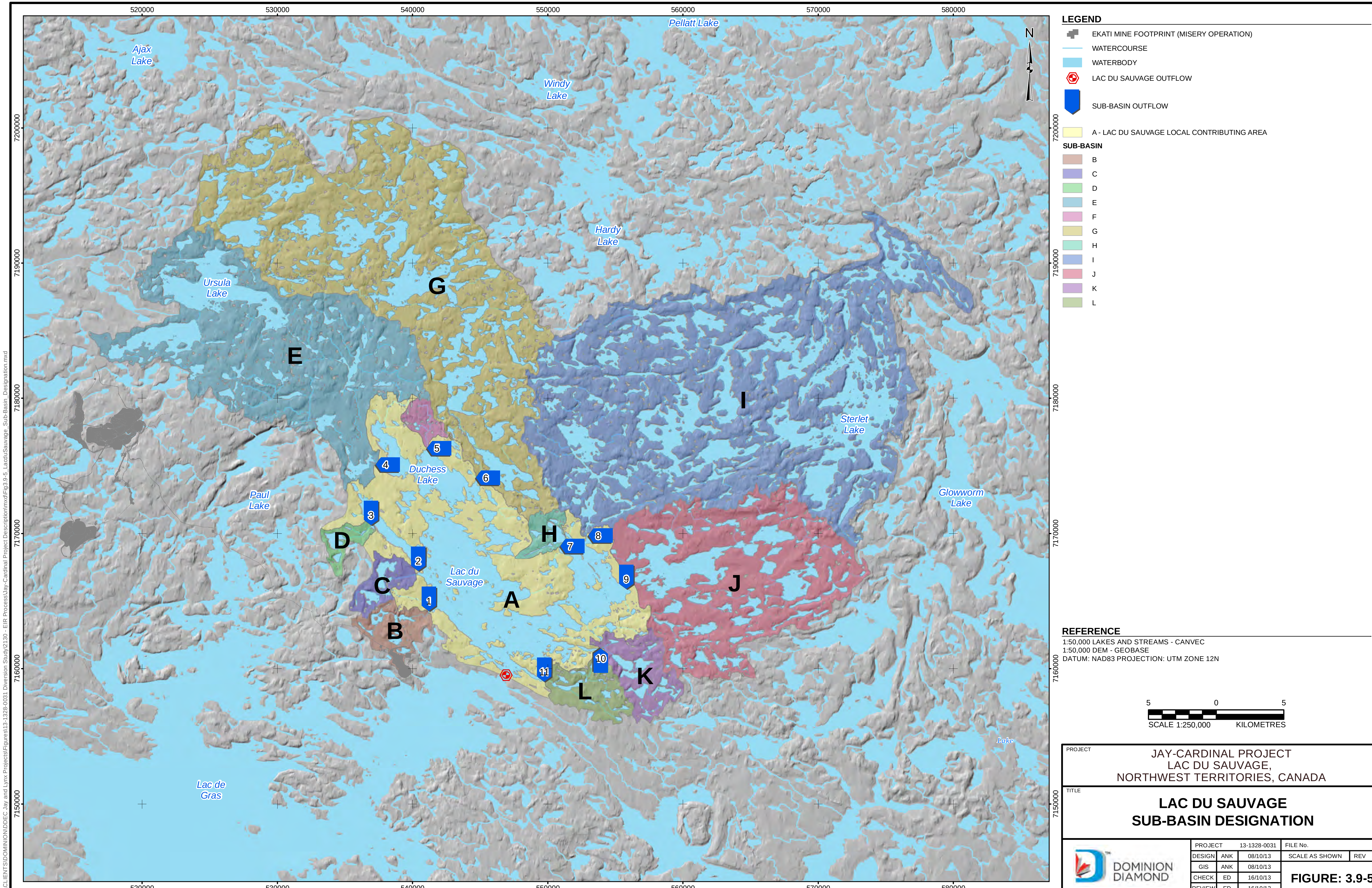

Pellatt Lake
Ajax Lake
Windy Lake
Hardy Lake
Ursula Lake
G
E
I
Sterlet Lake
Duchess Lake
Paul Lake
Glowworm Lake
D
H
C
Lac du Sauvage
A
J
B
K
L
Lac de Gras
1
2
3
4
5
6
7
8
9
10
11
N
LEGEND
EKATI MINE FOOTPRINT (MISERY OPERATION)
WATERCOURSE
WATERBODY
LAC DU SAUVAGE OUTFLOW
SUB-BASIN OUTFLOW
A - LAC DU SAUVAGE LOCAL CONTRIBUTING AREA
SUB-BASIN
B
C
D
E
F
G
H
I
J
K
L
REFERENCE
1:50,000 LAKES AND STREAMS - CANVEC
1:50,000 DEM - GEOBASE
DATUM: NAD83 PROJECTION: UTM ZONE 12N
5 0 5
SCALE 1:250,000 KILOMETRES
PROJECT
JAY-CARDINAL PROJECT
LAC DU SAUVAGE,
NORTHWEST TERRITORIES, CANADA
TITLE
LAC DU SAUVAGE
SUB-BASIN DESIGNATION
DOMINION DIAMOND
PROJECT 13-1328-0031 FILE No.
DESIGN ANK 08/10/13 SCALE AS SHOWN REV 0
GIS ANK 08/10/13
CHECK ED 16/10/13
REVIEW ED 16/10/13
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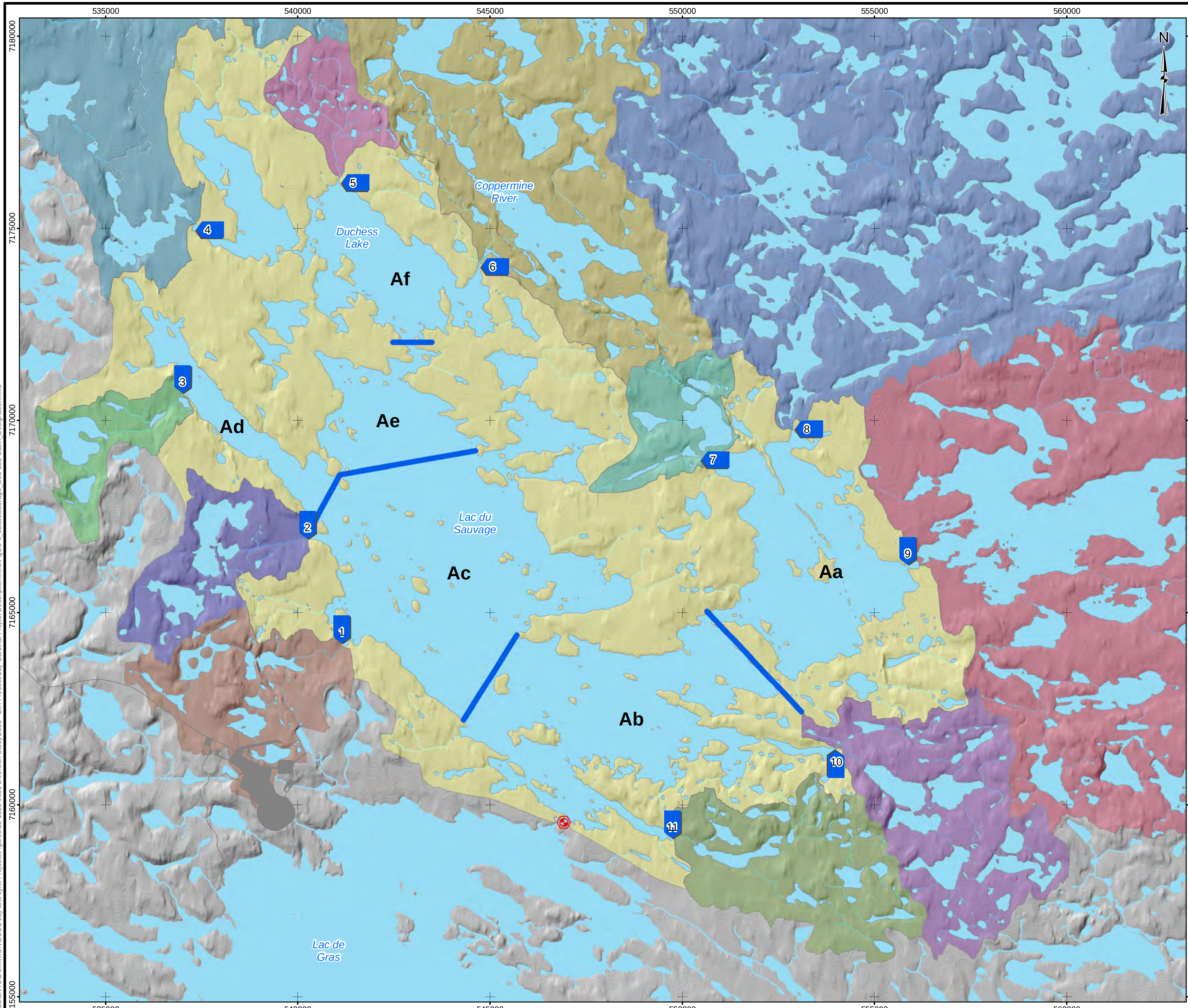
FIGURE: 3.9-5



LEGEND

- EKATI MINE FOOTPRINT (MISERY OPERATION)
- WATERCOURSE
- WATERBODY
- LAC DU SAUVAGE OUTFLOW
- SUB-BASIN OUTFLOW
- A - LAC DU SAUVAGE LOCAL CONTRIBUTING AREA

SUB-BASIN

- B
- C
- D
- E
- F
- G
- H
- I
- J
- K
- L

REFERENCE

1:50,000 LAKES AND STREAMS - CANVEC
1:50,000 DEM - GEOBASE
DATUM: NAD83 PROJECTION: UTM ZONE 12N

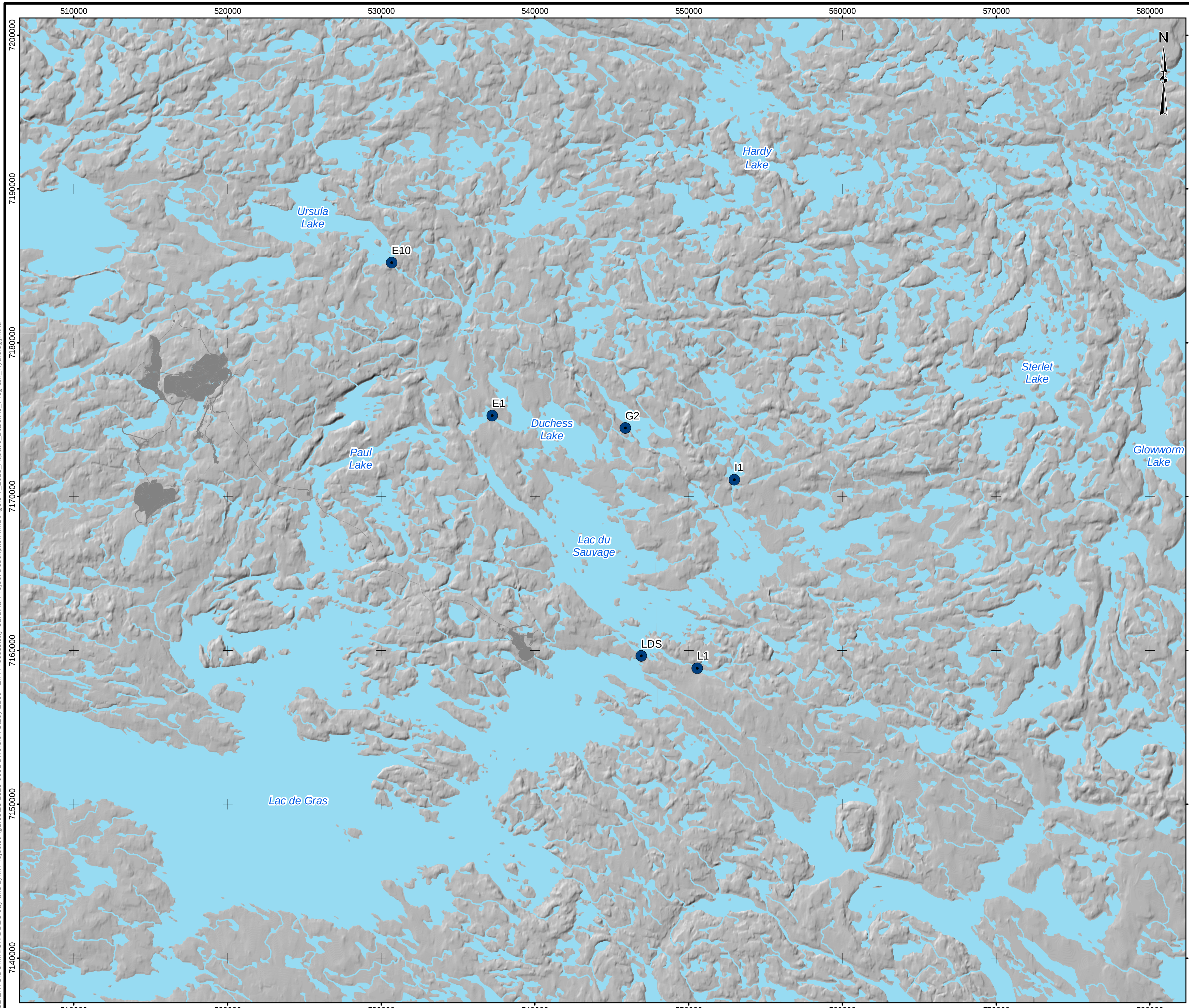
2 0 2
SCALE 1:100,000 KILOMETRES

PROJECT
JAY-CARDINAL PROJECT
LAC DU SAUVAGE,
NORTHWEST TERRITORIES, CANADA

TITLE
LAC DU SAUVAGE
SUB-SUB-BASIN DESIGNATION

DOMINION DIAMOND

PROJECT		13-1328-0031	FILE No.	
DESIGN	ANK	08/10/13	SCALE AS SHOWN	REV 0
GIS	ANK	08/10/13	**FIGURE: 3.9-6**	
CHECK	ED	16/10/13		
REVIEW	ED	16/10/13		



LEGEND

- HYDROLOGY SURVEY LOCATION
- EKATI MINE FOOTPRINT
- WATERCOURSE
- WATERBODY

REFERENCE

1:250,000 WATER - NTDB
1:50,000 DEM - GEOBASE
DATUM: NAD83 PROJECTION: UTM ZONE 12N

5 0 5
SCALE 1:250,000 KILOMETRES

PROJECT
JAY-CARDINAL PROJECT
LAC DU SAUVAGE,
NORTHWEST TERRITORIES, CANADA

TITLE
2013 AQUATIC BASELINE PROGRAM : HYDROLOGY

DOMINION DIAMOND

PROJECT		13-1328-0031	FILE No.
DESIGN			SCALE AS SHOWN REV 0
GIS	LMR	17/10/13	
CHECK	ED	16/10/13	FIGURE: 3.9-7
REVIEW	ED	16/10/13	

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Water Quality

2006 Baseline Summary – Lac du Sauvage

For context, baseline water chemistry data are often compared to CWQG. The CWQG are based upon the most current toxicological data available and are published by the CCME (2012). These guidelines provide conservative protection to aquatic life from anthropogenic stressors, such as a chemical inputs or physical changes (pH, temperature). Concentrations or levels of stressors below CWQGs indicate that adverse effects will not occur. Concentrations or levels of stressors above CWQGs indicate that adverse effects may occur, but there is no certainty that they will occur due in part to the conservative nature of the CWQGs. In addition, particularly in Northern and mineralized areas, inorganic substances such as metals may be naturally elevated above CWQGs and organisms will have adapted to these higher concentrations. Thus, exceedances of CWQGs require further investigation prior to any management actions.

Following CCME guidance, the Ekati Mine has developed six site-specific water quality objectives (SSWQOs), which supersede their respective generic guidelines: chloride (hardness-based), molybdenum, nitrate (hardness-based), potassium, sulphate (hardness-based), and vanadium. These SSWQOs have all undergone internal and third party technical peer review, and are now incorporated into the current Water Licence for the Ekati Mine. As such, these SSWQOs apply to the Jay-Cardinal Project.

Water in Lac du Sauvage was generally well oxygenated, clear, and slightly acidic based on the 2006 baseline study (Rescan 2007). Water quality is typical of oligotrophic or nutrient poor lakes in the region. Dissolved oxygen concentrations near the surface ranged between 8 and 11 milligrams per litre (mg/L) during the open-water season and between 15 and 18 mg/L during the ice-covered season. Water column depth profiles showed dissolved oxygen and thermal stratification during the ice-covered season in all three lakes. Dissolved oxygen profiles showed stratification during the open-water period when dissolved oxygen concentrations fell naturally below the CCME lower bound CWQG for the protection of aquatic life (6.5 mg/L). The Secchi depth ranged between 4 and 8 m (when measured) and was greater than the water column depth at nearly half of the stations during the open-water season. The mean pH ranged from 6.14 to 7.73 in 2006 and all open-water pH values were within the CCME guideline of 6.5 to 9.0.

Total dissolved solids concentrations ranged from 4.9 mg/L to 8.5 mg/L in 2006. Total ammonia concentrations ranged from below the detection limit of 0.005 milligrams as nitrogen per litre (mg-N/L) to 0.039 mg-N/L and were below the CCME guideline. Concentrations of nitrate and nitrite were generally near of below detection limits and well below CCME guidelines. The maximum nitrate concentration was 0.07 mg-N/L. Total phosphorous concentrations were generally low and ranged from 0.0042 to 0.0155 milligrams as phosphorus per litre (mg-P/L).

Concentrations of total metals were generally low and below CCME CWQG and SSWQO. Total aluminum concentrations ranged between 0.002 and 0.019 mg/L. Concentrations of total arsenic ranged between 0.00025 and 0.00034 mg/L; mean concentrations of total copper were approximately 0.00075 mg/L. Total molybdenum concentrations were generally below detection (0.00005 mg/L) with only a single mean concentration in Lac du Sauvage (0.00026 mg/L) exceeding the detection limit. Total nickel and zinc concentrations were low, with maximum concentrations of 0.00053 and 0.0073 mg/L, respectively.

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2013 Baseline Program

To supplement the existing aquatic baseline data, an extensive water quality baseline program was undertaken in 2013 (Figure 3.9-2). Sampling stations and data collection are summarized in Table 3.9-2 and sample collection is detailed in this subsection.

Limnology measurements were taken at 50 cm below the surface water at all water quality stations. For all lakes, a water column profile was completed with measurements taken at 0.5 m intervals if the maximum depth was less than 6 m and at 1 m intervals if the maximum depth was greater than 6 m. Parameters measured were: temperature (°C), dissolved oxygen (mg/L and% saturation), specific conductivity correct to 25°C (µS/cm^{c}), pH, total depth (m), and Secchi depth (m).

If the water column was fully mixed at the time of sampling, a single sample was collected from the middle of the water column; however, if the water column was stratified (a notable temperature and dissolved oxygen (DO) gradient), one sample was taken 1 m from the surface of the lake and another was taken 1 m from the bottom of the water column. A Kemmerer sampler was used to collect the water samples. Appropriate container and preservation protocols were followed and the water samples were submitted to a Canadian Association of Laboratory Accreditation (CALA) certified analytical laboratory for chemical analyses.

Lac du Sauvage and the Lac du Sauvage Outlet to Lac de Gras

In 2013, 14 water quality stations were established within Lac du Sauvage (Figure 3.9-2); water quality and limnology data were collected at each station. Seven water quality stations were located in 10 to 15 m of water, referred to as deep stations (Aa-1, Ab-1, Ac-1, Ac-4, Ac-7, Ad-1, and Ae-1); another seven stations were located in 3 to 5 m of water, referred to as shallow stations (Aa-2, Ab-2, Ac-2, Ac-5, Ac-8, Ad-2, and Ae-2). In addition to the water sample and limnology data collection at the deep and shallow stations, sediment samples were collected for particle size characterization and chemical analysis, and zooplankton, phytoplankton, and benthic invertebrate samples were collected for community composition analysis.

In addition to the Lac du Sauvage water quality stations, one water quality station was established within the Lac du Sauvage outlet (Ab-S1) within flowing water at least 0.3 m deep. At this stream sampling station, sediment samples were collected for particle size characterization and chemical analyses and benthic invertebrate samples were collected for community composition analyses.

Watershed E

Watershed E is located north of the northwest extension of Lac du Sauvage (Figure 3.9-1) and contains Lake E1 and Stream ES2. In 2013, two water quality stations were established within Lake E1. At the deep station (E-L1-1; Figure 3.9-2), sediment samples were collected for particle size characterization and chemical analyses; zooplankton, phytoplankton, and benthic invertebrate samples were collected for community analyses. At the shallow station (E-L1-2), sediment samples were collected for particle size characterization and chemical analysis and benthic invertebrate samples were collected for community composition analysis. Within Stream ES2, one water quality sampling station was established in flowing water at least 0.3 m deep (E-S2). Sediment samples were so collected for particle size characterization and chemical analyses and benthic invertebrate samples were collected for community composition analyses.

Watershed G

Watershed G is located to the east of Duchess Lake and contains Lake G2 and Stream G1 (Figure 3.9-1). In 2013, a water quality station (G-L2) was established at the centre of the lake (Figure 3.9-2).

Duchess Lake

Duchess Lake is located north of Lac du Sauvage (Figure 3.9-1). In 2013, five water quality stations were established within Duchess Lake (Figure 3.9-2). At two deep stations (Af-1 and Af-7), sediment samples were collected for particle size characterization and chemical analyses; zooplankton, phytoplankton, and benthic invertebrates samples were collected for community composition analyses. At another deep station (Af-10) and two shallow stations (Af-2 and Af-4), sediment samples were collected for particle size characterization and chemical analyses and benthic invertebrate samples were collected for community composition analyses.

Paul Lake

Paul Lake is located northwest of Lac du Sauvage (Figure 3.9-1). In 2013, five water quality stations were established within Paul Lake (Figure 3.9-2). All stations established in Paul Lake were deep stations (PL-1, PL-2, PL-3, PL-4, and PL-5). At each station, sediment samples were collected for particle size characterization and chemical analyses; zooplankton, phytoplankton, and benthic invertebrate samples were collected for community composition analyses.

Watershed D

Watershed D is located to the west of the north extension of Lac du Sauvage, and contains Lake D3 (Figure 3.9-1), which is also known as Counts Lake, and Stream D1, which is also known as Counts Outflow. Counts Lake is sampled as a reference lake as part of the Ekati site's AEMP. For the AEMP, limnology, water chemistry, and phytoplankton, zooplankton, benthic invertebrate, and fish community composition data are collected annually, while sediment chemistry data are collected every three years. In 2013, the water quality station (D-L3) at the centre of Counts Lake was sampled (Figure 3.9-2).

Counts Outflow has an established station, which is sampled as part of the Ekati site's AEMP, where hydrology, limnology, water chemistry, and benthic invertebrate community composition data are collected annually. In 2013, the water quality station (D-S1) within Stream D1 (i.e., Counts Outflow) was sampled (Figure 3.9-2); sediment samples were also collected for particle size characterization and chemical analyses.

Watershed C

Watershed C is located to the west of Lac du Sauvage and contains Lake C1 and Stream C1 (the outflow of Lake C1 into Lac du Sauvage) (Figure 3.9-1). In 2013, the water quality station C-L1 at the centre of Lake C1 was sampled (Figure 3.9-2); sediment samples were also collected for particle size characterization and chemical analyses, and benthic invertebrate samples were collected for community composition analyses. At the stream sampling station (C-S1), sediment samples were collected for particle size characterization and chemical analyses.

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Watersheds F, H, I, J, K, and L

Watersheds F, H, I, J, K, and L are located from the south to north tips of Lac du Sauvage, running along the east side of the lake (Figure 3.9-1). Within five of the watersheds (all except Watershed H) an outlet stream to Lac du Sauvage was identified (Stream F1, Stream J1, Stream K1, and Stream L1, respectively). In 2013, a water quality station within each stream was established in flowing water at least 0.3 m deep (F-S1, I-S1, J-S1, KS-1, and LS-1, respectively) (Figure 3.9-2). At the stream sampling stations F-S1 and L-S1, sediment samples were also collected for particle size characterization and chemical analysis. Additional sediment and benthic community sampling was planned for these streams, however, substrate composition was not compatible with sampling methods, i.e., sedimentary substrate was not present. In the sixth watershed, Watershed H, a lake water quality station (H-L1) was established in the centre of Lake H1.

Table 3.9-2 Summary of 2013 Aquatic Baseline Sample Collection

Station	Water Quality	Sediment Characterization	Sediment Chemistry	Zooplankton and Phytoplankton Community	Benthic Invertebrate Community
Lac du Sauvage					
Aa-1	X	X	X	X	X
Aa-2	X	X	X		X
Aa-6		X			X
Ab-1	X	X	X	X	X
Ab-2	X	X	X		X
Ab-6		X			X
Ac-1	X	X	X	X	X
Ac-2	X	X	X		X
Ac-4	X	X	X	X	X
Ac-5	X	X	X		X
Ac-7	X	X	X	X	X
Ac-8	X	X	X		X
Ac-10		X			X
Ac-11		X			X
Ac-12		X			X
Ad-1	X	X	X	X	X
Ad-2	X	X	X		X
Ad-4		X			X
Ae-1	X	X	X	X	X
Ae-2	X	X	X		X
Ae-6		X			X
Ae-7		X			X
Ab-S1	X	X	X		X
Watershed E					
E-L1-1	X	X	X	X	X
E-L1-2	X	X	X		X
E-S2	X	X	X		X
E-S2-3		X			X
E-S2-4		X			X
E-S2-5		X			X

Table 3.9-2 Summary of 2013 Aquatic Baseline Sample Collection

Station	Water Quality	Sediment Characterization	Sediment Chemistry	Zooplankton and Phytoplankton Community	Benthic Invertebrate Community
Watershed G					
G-L2	X				
G-S1	X	X	X		X
Duchess Lake					
Af-1	X	X	X	X	X
Af-2	X	X	X		X
Af-4	X	X	X		X
Af-7	X	X	X	X	X
Af-10	X	X	X		X
Paul Lake					
PL-1	X	X	X	X	X
P1-2	X	X	X	X	X
PL-3	X	X	X	X	X
PL-4	X	X	X	X	X
PL-5	X	X	X	X	X
Watershed C					
C-L1	X	X	X		X
C-S1	X	X	X		X
Watershed D					
D-L3	X				
D-S1	X	X	X		
Watershed F					
F-S1	X	X	X		
Watershed H					
H-L1	X				
Watershed I					
I-S1	X				
Watershed J					
J-S1	X				
Watershed K					
K-S1	X				
Watershed L					
L-S1	X	X	X		X

X = sample collection executed in 2013.

3.9.2 Sediment Quality

2006 Baseline Summary

Sediments in Lac du Sauvage are generally dominated by clay and silts (from particles less than 4 micrometres [µm] to between 4 µm and 0.063 mm; Rescan 2007). Two of five shoreline stations in Lac du Sauvage contained gravel; one shoreline station had a rocky substrate.

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Sediment chemistry data are compared to CCME (2012) Sediment Quality Guidelines (SQG) for the protection of aquatic life. These SQGs generally provide two values, the Interim Sediment Quality Guideline (ISQG) and the Probable Effect Level (PEL). Concentrations below the ISQG indicate that adverse effects will not occur; concentrations above PEL indicate that adverse effects may occur, but there is no certainty that they will occur due in part to the conservative nature of the SQGs. In Northern and mineralized areas, inorganic substances such as metals may be naturally elevated above SQGs and organisms will have adapted to these higher concentrations. Thus, exceedances of SQGs require further investigation prior to any management actions.

From the 2006 baseline report (Rescan 2007), total organic carbon in Lac du Sauvage sediments ranged between 0.35 and 3.16 milligrams per kilogram dry weight (mg/kg dw). Available phosphorous concentrations ranged from 1.0 to 178 mg/kg dw and were variable among stations and between replicates. Total nitrogen concentrations ranged from <0.1% to 0.30%. Total arsenic concentrations in sediments ranged from less than the detection limit (5 mg/kg dw) to 563 mg/kg dw and frequently exceeded the PEL of 17 mg/kg. Total copper concentrations ranged from 8.2 to 41 mg/kg dw and were higher in Christine and Ursula Lakes. Total molybdenum concentrations were generally near of below the detection limit of 4 mg/kg dw; the maximum concentration was 13.4 mg/kg dw. Concentrations of total nickel ranged between 17 to 69 mg/kg and concentrations of total zinc ranged between 36 and 94 mg/kg (above the ISQG of 123 mg/kg, but below the PEL of 315 mg/kg).

2013 Baseline Program

To supplement the existing aquatic baseline data, an extensive sediment quality baseline program was undertaken in 2013 (Figure 3.9-2). Sampling stations and data collected are summarized in Table 3.9-2, and detailed below. As outlined in Subsection 3.9.2.2, sediment samples were collected at all of the water quality stations, except for G-L1, D-L3, H-L1, I-S1, J-S1, and K-S1.

Sediment and benthic invertebrate sampling was completed within the same field program. Limnology measurements were taken at 50 cm below the surface of the water at all sampling stations. For all lakes a water column profile was completed, with measurements taken at 0.5 m intervals if the maximum depth was less than 6 m and at 1.0 m intervals if the maximum depth was greater than 6 m. Parameters measured were: temperature (°C), dissolved oxygen (mg/L and% saturation), specific conductivity correct to 25°C (µS/cm^c), pH, total depth (m), and, Secchi depth (m).

At lake stations, sediment was collected from the upper 5 cm horizon using a pre-cleaned Ekman grab sampler. For metals (including metalloids and non-metals), particle size, organic matter, and nutrient analyses, a wet weight sample of 1,500 grams (g) was required. For particle size and total organic carbon analyses, a wet weight sample of 450 g was required. At minimum, three grab samples were collected and composited (at some locations, due to substrate composition, additional samples were required to obtain enough material). At erosional stream stations, where insufficient sediment occurs for an Ekman grab sampler, erosional substrate was collected using a plastic spoon or gloved hand. Appropriate quality assurance / quality control (QA/QC) including container and preservation protocols were followed and the sediment samples were submitted to the CALA certified analytical laboratory for analyses.

Lac du Sauvage and the Lac du Sauvage Outlet to Lac de Gras

In addition to the water quality stations in Lac du Sauvage, eight additional sediment sampling stations were established (Figure 3.9-2). These stations were located in 6 to 8 m of water and are mid-depth

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stations (Aa-6, Ab-6, Ac-10, Ac-11, Ac-12, Ad-4, Ae-6, and Ae-7). At these mid-depth stations, sediment samples were collected for particle size analysis and benthic invertebrate samples were collected for community composition analyses.

Watershed E

In addition to station E-S2 in Stream ES2, three stream sampling stations (E-S2-3, E-S2-4, and E-S2-5) were established (Figure 3.9-2). Sediment samples were collected for particle size characterization and benthic invertebrate samples were collected for community composition analyses.

3.9.3 Lower Trophic Levels

2006 Baseline Summary

Lower trophic levels, phytoplankton, zooplankton and benthic invertebrates form the base of the food web in a lake, and provide food for fish.

Phytoplankton are small, often microscopic, plants that live in the water column of lakes and make their food through primary production. In other words, through photosynthesis they use light energy from the sun as fuel for their activities. Mean phytoplankton biomasses (as chlorophyll *a*) for 12 stations in Lac du Sauvage in 2006 were 0.41, 0.35, and 0.98 micrograms per litre (ug/L) in July, August, and September, respectively (Rescan 2007). Mean phytoplankton abundances were 591, 877, and 691 cells per millilitre (cells/mL) for the same respective months.

The most abundant phytoplankton taxonomic groups observed in the 2006 sampling (Rescan 2007) were cyanophytes, chrysophytes and chlorophytes. In July, the Lac du Sauvage benthic invertebrate community was dominated by cyanophytes. Chlorophytes and diatoms (phylum Bacillariophyceae) were well represented at all stations, comprising 14% to 33% and 4% to 23% of the phytoplankton assemblages, respectively. By August, the proportions of chrysophytes had decreased while cyanophytes had increased, with most stations dominated by cyanophytes. Chlorophyte and diatom proportions remained high. By September, chrysophyte proportions decreased further, comprising only 3 to 10% of the taxonomic assemblages. Cyanophyte and chlorophyte proportions increased, and all stations were dominated by cyanophytes. Other groups found in smaller proportions (<10%) throughout the open-water season were cryptophytes, pyrrhophytes, and unidentified flagellates. Euglenophytes were only found in a proportion >1% at a station in Lac du Sauvage. In 2006, the mean Shannon diversity index for phytoplankton ranged from 1.68 to 2.55 (Rescan 2007). The mean Simpson diversity index ranged from 0.62 to 0.84 and the mean number of phytoplankton genera present at a site ranged from 36 to 53.

Zooplankton are small, often microscopic, animals that live in the water column and mainly feed on primary producers (phytoplankton). Based on the 2006 baseline data (Rescan 2007), the mean zooplankton biomass in Lac du Savage for 12 stations was 107, 142, and 171 milligrams dry weight per cubic metre (mg dw/m^3) in July, August, and September, respectively. Mean zooplankton abundances were 49,113, 44,381, and 38,602 organisms per cubic metre (org/m^3) for the same respective months.

Zooplankton communities in all of the stations sampled in 2006 were dominated by rotifers, calanoid copepods, and cyclopoid copepods. The dominant groups at stations in Lac du Sauvage varied and included rotifers, calanoid copepods, and cyclopoid copepods. Cladocerans were present at some stations but was always in very small proportions (≤ 10%). The mean Shannon Diversity indices ranged from 0.70 to 1.36 (Rescan 2007). The mean Simpson diversity index ranged from 0.40 to 0.70, and the average number of zooplankton genera present at a site ranged from 6 to 9.

Benthic invertebrates are organisms living at, in, or in association with the bottom (benthic) substrate of lakes, ponds, and streams. Benthic invertebrates form an important link in the food web, often being a source of food for both large and small fish. Twelve lake stations were sampled in Lac du Sauvage for benthic invertebrates in 2006, with three sites sampled per station. Mean benthic invertebrate density in Lac du Sauvage in August 2006 ranged from 504 to 11,926 organisms per square metre (org/m^2) for lake samples (Rescan 2007). Dipterans were generally the dominant group, comprising 20% to 78% of the community. Two stations in Lac du Sauvage had coelenterates as the dominant taxa (52% and 65%, respectively). Coelenterates were found in large proportions at many stations, comprising 2% to 65% of the community. Molluscs were found in the benthic invertebrate communities at all stations, comprising 2% to 34% of the community. Other groups present in smaller proportions (<10%) were oligochaetes, cladocerans, arachnids, nematodes, copepods, hemipterans, trichopterans, and ostracods. The mean Shannon dipteran diversity index ranged from 0.58 to 1.71. The mean Simpson dipteran diversity index ranged from 0.37 to 0.78. The mean number of dipteran genera at a station ranged from two to nine.

Nine shoreline stations were sampled for benthic invertebrates in Lac du Sauvage in 2006 (Rescan 2007). Four stations were in littoral habitats (just offshore) with three sites per station; five stations were in boulder habitats (along the perimeter of the lake) with five sites per station. In the littoral habitat, mean densities ranged from 607 to 3,496 org/m^2. In the littoral habitat, dipterans were the dominant group, comprising 47 to 58% of the community. Molluscs were also well represented, comprising 10 to 32% of the community. Nematodes were found at all stations in proportions of 6% to 18%. Other groups that were observed in smaller proportions (<10%) were oligochaetes, cladocerans, copepods, arachnids, and trichopterans. The mean Shannon diversity index for dipterans ranged from 0.50 to 2.03. The mean Simpson diversity index for dipterans ranged from 0.32 to 0.84. The mean number of dipteran genera at a station ranged from two to 10.

In the boulder habitat, mean densities ranged from 414 to 3,360 org/m^2. Dipterans were generally the dominant group comprising 48% to 85% of the community. One station was dominated by cladocerans (50%). Cladocerans made up only 2% to 5% of the community in the other stations. Oligochaetes were found at all stations, comprising 6% to 24% of the benthic invertebrate community. Other groups found in smaller proportions (<10%) were coelenterates, nematodes, tardigrades, copepods, plecopterans, and hemipterans. The mean Shannon diversity index for dipterans ranged from 0.06 to 0.24. The mean Simpson diversity indices for dipterans ranged from 0.02 to 0.12. The mean number of dipteran genera at a site ranged from two to three.

2013 Baseline Program

To supplement the existing aquatic baseline data, an extensive lower trophic levels baseline program was undertaken in 2013 (Figure 3.9-1 and Figure 3.9-2). Sampling stations and data collection are summarized in Table 3.9-2, and detailed below. As outlined in Section 3.9.2.2, zooplankton, phytoplankton, and benthic invertebrate samples were collected for all of the deep water quality stations within Lac du Sauvage, Duchess Lake, Paul Lake, and Lake E1. Benthic invertebrates samples were also collected at all shallow water quality sampling stations, mid-depth sediment sampling stations, and at the three sediment sampling stations established in Stream E2. In addition, 11 additional littoral benthic invertebrate sampling stations were established within Lac du Sauvage, Duchess Lake, and Lake E1.

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Phytoplankton and zooplankton collections occurred in conjunction with water quality sampling, while benthic invertebrate sampling occurred in conjunction with sediment sampling. Zooplankton and phytoplankton samples were collected to obtain a taxonomic inventory. Phytoplankton samples were also collected to analyze for chlorophyll *a* and nutrient concentrations. LI-COR light (micrometre per second per square metre [$\mu m/sec/m^2$]) profiles were taken.

Three replicate (i.e., not composited and maintained in separate containers) zooplankton samples were collected, 1 m above the substrate via a vertical tow method using a 12" diameter, 80 µm mesh net. Two samples will be analyzed for the 2013 baseline study, while the third will be archived. Phytoplankton samples, chlorophyll *a*, and nutrient samples were collected via a pre-cleaned composite water sample at 2 m intervals within the euphotic zone of the water column. If water depth was sufficient, water was collected at the surface, and then in 2 m intervals until the sampling depth reached twice the Secchi depth. If water depth was not sufficient, water was collected at 2 m intervals until 2 m off the bottom of the lake. Appropriate QA/QC including container and preservation protocols were followed and the samples were submitted for analyses.

For benthic invertebrates sampling, five Ekman grab samples were collected and sieved separately with 250 µm mesh (samples were not composited). At erosional sampling sites, five Surber samples were collected (250 µm). At littoral sampling sites (i.e., water depth less than or equal to 1 m), a composite sample was collected consisting of three kicknet samples (500 µm) completed within areas of gravel/cobble/boulder substrate (3 m long area for 30 seconds). Appropriate QA/QC including container and preservation protocols were followed and the samples were submitted for analyses.

Lac du Sauvage, Duchess Lake, and Lake E1

At littoral sampling sites (i.e., water depth less than or equal to 1 m) within Lac du Sauvage (Aa-3, Ab-3, Ac-3, Ac-6, Ac-9, Ad-3, and Ae-3), Duchess Lake (Af-3, Af-6, and Af-12) and Lake E1 (E-L1-3) (Figure 3.9-2), kicknet littoral sampling stations were established in areas with appropriate habitat and sampled during 2013.

3.9.4 Fish and Fish Habitat

2006 Baseline Summary

During the 2006 sampling effort in Lac du Sauvage (refer to Figure 2.10-1 in Appendix 3A: 2006 Jay Pipe Aquatic Baseline Report; Rescan 2007), Lake Trout (*Salvelinus namaycush*), Lake Whitefish (*Coregonus clupeaformis*), Round Whitefish (*Prosopium cylindraceum*), and Burbot (*Lota lota*) were captured (Rescan 2007). Sixty-seven gillnet sets, for a total large-bodied fishing effort of 69.3 hours, were completed in Lac du Sauvage over the 10 day sampling period, capturing a total of 87 fish. Furthermore, 47 minnow traps were set, for a total fishing effort of 65.7 days. Gillnet catch was dominated by Lake Trout (59%), followed by Lake Whitefish (29%), and Round Whitefish (12%). Three juvenile Burbot were captured in minnow traps.

For gillnetting, the mean total catch-per-unit-effort (CPUE) for Lac du Sauvage was 32 fish per 100 square metre of net in 24 hours (fish/100 m^2/24 h). The CPUE was higher for Lake Trout (18.76 fish/100 m^2/24 h) than Lake Whitefish (8.97) and Round Whitefish (4.05). Minnow trap CPUE for Burbot in Lac du Sauvage was 0.03 fish per 24 hours.

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Lake Trout captured in Lac du Sauvage averaged 564 mm in fork length and 2,119 g in weight, with an average age of 15 years. Based on the 2006 sampling, the Lake Trout population appeared to be dominated by relatively small adult fish; communities dominated by older fish are commonplace in Arctic lakes where recruitment is limited (Rescan 2007). Stomach contents analysis indicated that Lake Trout in Lac du Sauvage relied heavily on fish for their food, with fish composing 74% of the stomach contents by weight.

Lake Whitefish captured in Lac du Sauvage averaged 459 mm in fork length and 1,307 g in weight, with an average age of 11 years. Lake Whitefish diet was dominated by Cladocera (zooplankton) which is consistent with their pelagic nature. The Round Whitefish averaged 319 mm in fork length and 366 g in weight, with an average age of 9 years. Round Whitefish in Lac du Sauvage were benthic in nature, primarily feeding on benthic organisms.

In 2006, a localized fish habitat assessment was completed within the area of Lac du Sauvage overlying the Jay kimberlite pipe (refer to Figures 2.10-2a to 2.1-2d in Appendix 3A: 2006 Jay Pipe Aquatic Baseline Report; Rescan 2007). The majority of the littoral area assessed was dominated by boulder (53%), followed by cobble (27%), gravel (11%), bedrock (6%), and fines (3%). Emergent and submergent vegetation was found in the shoreline areas, providing rearing and feeding habitat for larval and juvenile fish. Shoal transect surveys indicated that the substrate on shoal areas was composed of boulder, cobble, and gravel.

From the data collected in 2006, Lac du Sauvage was found to contain suitable shoreline spawning habitat for Lake Trout, Lake Whitefish, and Round Whitefish, as well as providing rearing habitat for these three species as well as Burbot. The habitat supports an adequate diversity and abundance of lower trophic organisms to support the fish populations present in the lake.

2013 Baseline Program

To supplement the existing aquatic baseline data, a spatially extensive fish population and fish habitat survey and hydroacoustic surveys were undertaken in 2013. The program focused on Lac du Sauvage and other lakes and streams expected to be affected by the proposed Project (Figure 3.9-3).

The hydroacoustic surveys were performed over two surveys periods for all basins in Lac du Sauvage. Surveys were completed during the night along transects positioned across the entire lake with additional effort in the Ac basin (Figure 3.9-6) of Lac du Sauvage during the day. Spatial and temporal coverage of Lac du Sauvage was undertaken to generate reliable estimates of fish density and productivity, as well as to generate information on substrate hardness and roughness. Detailed assessments of substrate were completed at targeted shallow and deep water locations using Eckman grabs, an underwater (Aquaview) camera, along with the Biosonics hydroacoustic echosounder. These data will provide ground-truthed information for substrate typing of the entire area of Lac du Sauvage

Short-duration gill nets were also set in Lac du Sauvage and the Ac basin to sample high density fish locations and to verify the species and sizes of fish detected by Biosonics. Standard fish inventory methods were applied to all study lakes and streams in the study area to target both small and large-bodied fish species. Sampling methods involved short duration sets (i.e., about 2-3 hours soaking) and overnight sets of index gill nets and minnow traps, angling (opportunistic) and backpack electrofishing of lake shorelines and streams. The effort and sampling methods differed among waterbodies, with

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generally more effort performed on larger waterbodies. Data included sampling effort (for later calculation of catch per unit effort), species identification, size (fork length), mass, and ageing structures (for future ageing of fish). The combined fish sampling methods will provide quantitative baseline descriptions of relative abundance and species life history for valued components.

All study waterbodies were visually assessed by aerial reconnaissance and then photographed and geo-referenced so that an extensive catalogue of images could be developed for desktop habitat mapping. In addition, standard fish habitat assessments were conducted at each waterbody, and included surveys of bathymetry, shoreline and stream substrates, in situ water quality and side-scan imaging of substrates (for Ac and Ae basins of Lac du Sauvage). Many of the small streams in the study area were dry or had low flows with no defined streambed or bank (i.e., were ephemeral).

Duchess Lake

Fish sampling involved short duration sets and overnight sets of index gill nets and minnow traps, and shoreline backpack electrofishing.

Lac du Sauvage

Fish sampling involved short duration sets and overnight sets of index gill nets and minnow traps, and backpack electrofishing of shorelines, with a focus on the Ac and Ae basins of Lac du Sauvage in 2013. Angling was also conducted as part of the hydroacoustic study in the Ac basin.

Paul Lake

Fish sampling involved short duration sets and overnight sets of index gill nets and minnow traps.

Watershed A

Fish sampling involved short duration sets of minnow traps and backpack electrofishing of shorelines in Lakes Ab2, Ac17, and Ad8. Short duration sets of index gill nets were deployed in lakes Ac17 and Ad8. Streams Ab2, Ac 17 and Ad8 were not fished because of no-to-minimal flows present at the time of sampling (i.e., stream habitats were deemed of low-quality).

Watershed B

Fish sampling involved short duration sets of index gill nets and minnow trapping, and backpack electrofishing of shorelines in Lakes B1, B4, and B15. Backpack electrofishing was performed in Streams B1 and B15.

Watershed C

Fish sampling involved short duration sets of index gill nets and minnow traps, angling (opportunistic), and backpack electrofishing in Lakes C1 and C3. Backpack electrofishing was performed in Streams C1 and C3.

Watershed D

Fish sampling involved short duration sets of gill nets and minnow traps, and backpack electrofishing of shorelines in Lakes D2, D3, and D4. Backpack electrofishing was performed in Stream D1.

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Watershed E

Fish sampling involved short duration sets of gill nets and minnow traps, and backpack electrofishing of the shoreline in Lake E1. Backpack electrofishing and minnow trapping were performed in the lower reach of Stream E2. Stream E1 was characterized as a fish-bearing stream during aerial reconnaissance of that stream but was not sampled for fish due to the presence of a nearby active wolf den

3.10 Terrestrial Environment

The terrestrial vegetation community around the Ekati Mine is composed of species adapted to freezing temperatures, low nutrients, and localized drought and standing water. Despite the harsh climate, the area supports many species of mammals and birds. Most of these mammals and birds are migratory, moving onto the barrenlands in spring and summer and migrating south as winter approaches (e.g., caribou, wolves, hawks, peregrine falcon [*Falco peregrinus*], owls, geese, ducks, loons, gulls, and sparrows). Others are non-migratory (e.g., grizzly bear, wolverine, Arctic fox [*Vulpes lagopus*], red fox [Vulpes vulpes], Arctic hare [*Lepus arcticus*], squirrel, lemming [*Lemmus lemmus*], vole, mice, ptarmigan, raven [*Corvus* spp], and gyrfalcon [*Falco rusticolus*]). Although uncommon, musk ox have been observed on the northeast side of the claim block.

The topography across the property is generally flat with local surface relief rising up to 20 m, a terrain elevation ranging up to 100 m in total relief over the region. The most distinctive physical features of the landscape are eskers, which are sinuous ridges of granular material deposited by glaciers. Eskers are an important wildlife habitat and have cultural importance.

Bedrock generally outcrops at surface over the Ekati Mine area or is partially overlain by a thin (less than or equal to 5 m thick) veneer of Quaternary sediments consisting mainly of silt, gravel, sand, and organic matter. The overburden is thicker in areas of esker occurrence.

3.10.1 Soils

Environmental Setting

The Ekati Mine is within the continuous permafrost zone, where a layer of permanently frozen subsoil and rock is generally 300 m deep and overlain by a 1 to 2 m active layer that thaws during summer (Heimersson and Carlson 2013). Talik zones occur beneath water bodies and, depending on the thermal storage capacity of the lake, may fully penetrate the permafrost horizon.

Glacial till is the dominant surficial material in the area. Soils in the area are predominantly of the Cryosolic order. These soils form where permafrost occurs within 1 to 2 m of the ground surface. The Cryosols in the claim block are characterized by cryoturbation (i.e., horizons or layers that have been disrupted, mixed, or broken by freeze-thaw activity).

2013 Baseline Program

A baseline soils programs was completed in 2013. Utilizing a combination of aerial reconnaissance and field survey, the soil and terrain was characterized in the Lac du Sauvage area. A total of 43 investigation sites were surveyed at various slope positions along transects, in order to characterize the soil and terrain in the Ekati claim block (Figure 3.10-1). Soil samples were collected, using appropriate QA/QC, from each distinct soil horizon at 28 of the investigation sites and sent for laboratory analyses of chemical and physical parameters.

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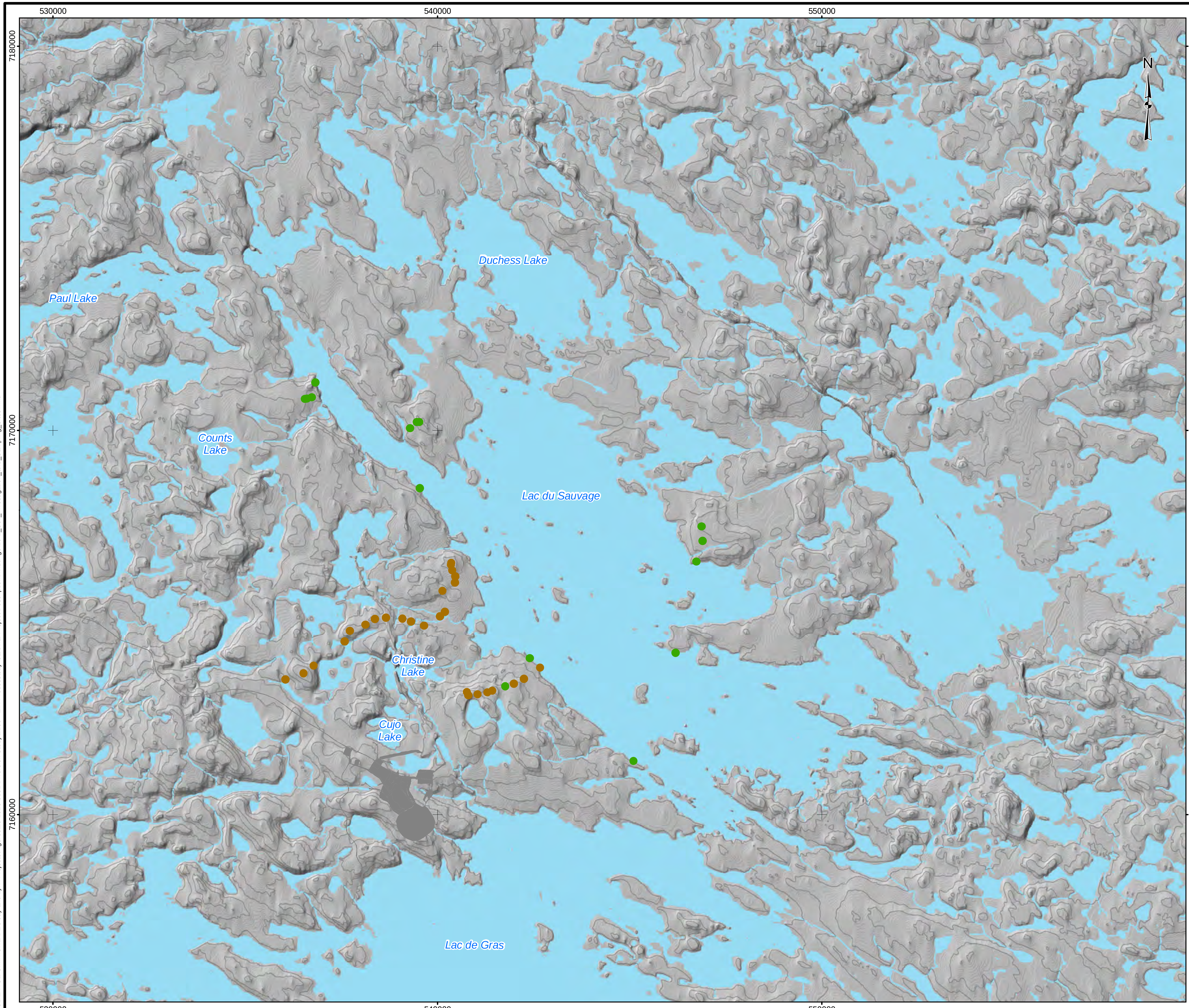

G:\CLIENTS\DOMINION\DDEC Jay and Lynx Projects\Figures\13-1328-0031 Diversion Study\2130 - EIR Process\Jay-Cardinal Project Description\mxd\Fig3.10-1_Soil_Investigation_and_Sampling_Sites.mxd

LEGEND

- SOIL INVESTIGATION SITE - SURVEYED
- SOIL INVESTIGATION SITE - SURVEYED AND SAMPLED
- EKATI MINE FOOTPRINT (MISERY OPERATION)
- 10M CONTOUR
- WATERCOURSE
- WATERBODY

REFERENCE

1:50,000 LAKES AND STREAMS - CANVEC
1:50,000 DEM - GEOBASE
DATUM: NAD83 PROJECTION: UTM ZONE 12N

2 0 2

SCALE 1:100,000 KILOMETRES

PROJECT

JAY-CARDINAL PROJECT
LAC DU SAUVAGE,
NORTHWEST TERRITORIES, CANADA

TITLE

SOIL INVESTIGATION AND SAMPLING SITES

DOMINION DIAMOND

PROJECT		13-1328-0031	FILE No.
DESIGN	RC	03/10/13	SCALE AS SHOWN REV 0
GIS	RC	03/10/13	
CHECK	ED	17/10/13	FIGURE: 3.10-1
REVIEW	ED	17/10/13	

3.10.2 Vegetation

Environmental Setting

Typical for the area, the predominant vegetation/land cover types are heath tundra (less than 30% boulder), heath tundra with boulders (30% to 80% boulder), heath tundra with bedrock (30% to 80% bedrock), and tussock/hummock types (9%). Heath tundra is the most widespread and characteristic vegetation/land cover type.

The terrestrial vegetation community is composed of species adapted to freezing temperatures, low nutrients, and localized areas of drought and standing water. The short growing season, cool soil temperatures, and lack of soil development limit the establishment of productive, diverse plant communities. The most common plant species associated with the predominant vegetation/land cover type (i.e., heath tundra types) are dwarf birch (*Betula glandulosa*), Labrador tea (*Ledum palustre decumbens*), crowberry (*Empetrum nigrum*), and bearberry (*Arctostaphylos rubra*). Lichen dominated communities are found in areas with very thin layers of soil that are typically associated with health bedrock and/or boulder land cover types. Taller shrubs, such as willows (*Salix* spp) and dwarf birch, are found in sheltered riparian areas along streams and lakeshores where there are depressions in the depth of the permafrost. The vegetation surrounding lakes and streams is dominated by sedges (*Carex* spp) and cottongrasses (*Eriophorum* spp), which are characteristic of the sedge wetlands and tussock-hummock land cover types that occur in low lying depressions.

2013 Baseline Program

A baseline vegetation program was completed in 2013, as part of the vegetation inventory program including surveys for listed plant species and traditional plant species, as well as general aerial and ground vegetation surveys to confirm the Ecological Land Cover (ELC) classification. The study area included a 500 m buffer around the shoreline of Lac du Sauvage and a 25 km^2 x 25 km^2 area to the west of Lac du Sauvage (Figure 3.10-2). Shoreline surveys were focused towards the riparian willow along the margins of the lakes, as well as birch seep, sedge meadow and tussock hummock ELC units associated with inlets and outflows of the lake.

In total, 8 detailed plots, 16 ground reconnaissance plots (including traditional use plant surveys) and 25 listed plant survey sites were completed (Figure 3.10-2).

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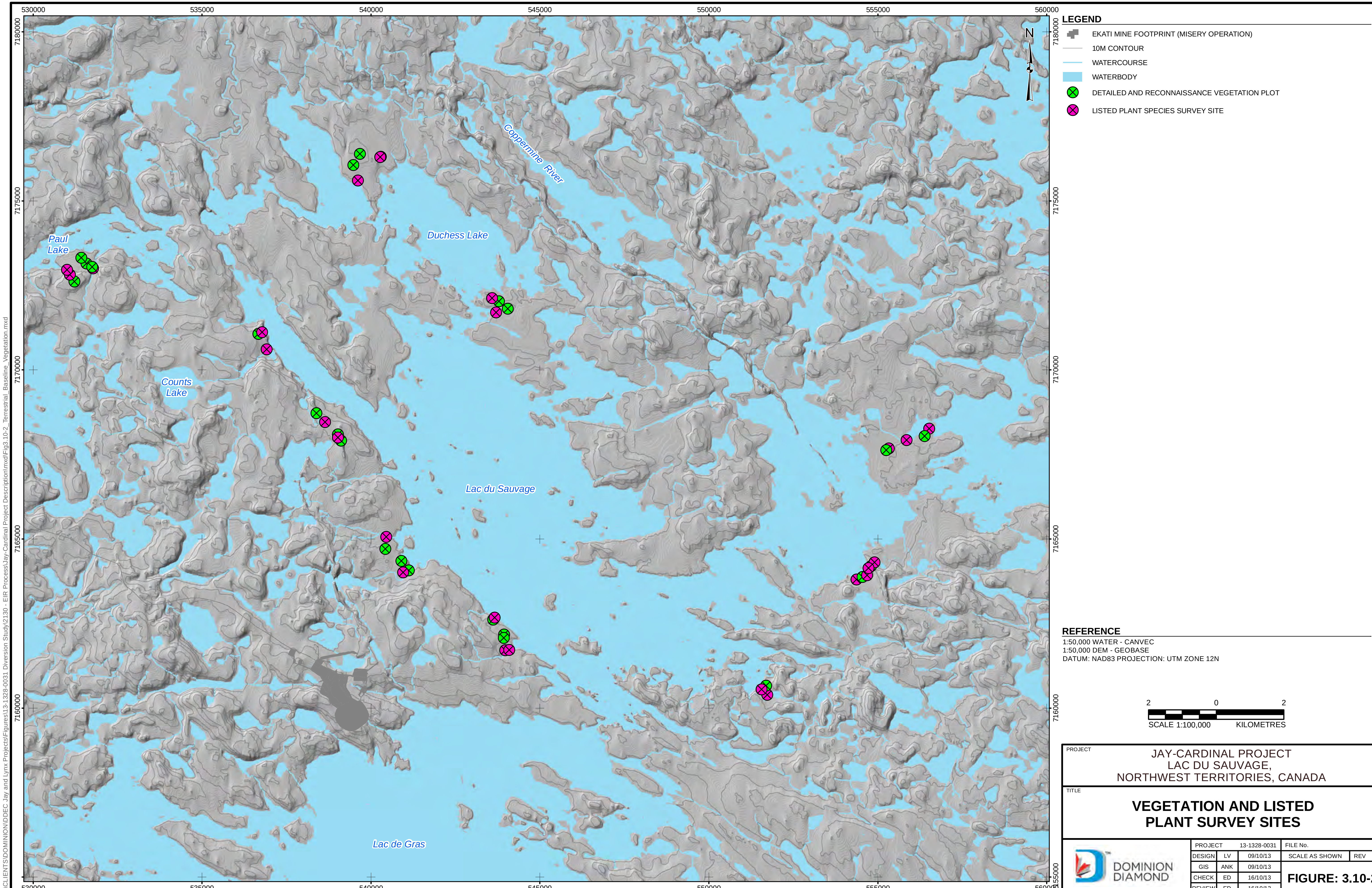

PROJECT

JAY-CARDINAL PROJECT
LAC DU SAUVAGE,
NORTHWEST TERRITORIES, CANADA

TITLE

VEGETATION AND LISTED PLANT SURVEY SITES

DOMINION DIAMOND

PROJECT		13-1328-0031	FILE No.	
DESIGN	LV	09/10/13	SCALE AS SHOWN	REV 0
GIS	ANK	09/10/13	FIGURE: 3.10-2	
CHECK	ED	16/10/13		
REVIEW	ED	16/10/13		

3.10.3 Wildlife

Environmental Setting

The Ekati Mine area is characterized by a mixture of landscape features and habitat types that support an array of wildlife species. Eighty-four bird species and sixteen mammals have been confirmed as permanent or summer residents, migrants, or summer visitors. Half of the bird species breed in the area (all year residents include ravens and snow owls [*Bubo scandiacus*]), while the remainder are migrants (loons, sandpipers, passerines, and a few raptor species) or uncommon visitors.

The Bathurst caribou herd migrates through the area to access spring calving and winter forage grounds, specifically, the outlet of Lac du Sauvage into Lac de Gras and along the esker on the west side of Lac du Sauvage are known to be important caribou movement site. Grizzly bears, wolves, foxes, wolverines and small mammals are present at different times of the year. Several large eskers in the study area, in addition to travel routes for caribou, provide denning habitat for wolves and grizzly bears. Numerous grass and sedge wetland areas provide food for grizzly bears in the spring and breeding habitat for migrating shorebirds, waterfowl, and some songbird species. Ravens and raptors commonly nest on the upper benches of open pits. Where necessary to protect the presence of eggs or chicks, mine operations are temporarily modified in the area of the nest until chicks have fledged. This operating practice would be extended to the Jay-Cardinal Project.

The Ekati Mine Wildlife Effects Monitoring Program (WEMP) provides for the on-going annual collection and reporting of information about the effects of mine activities on wildlife. The WEMP is provided to and reviewed by Aboriginal communities, government agencies and the IEMA through report submissions, group workshops and individual meetings. Program modifications are proposed by the Ekati Mine on an annual basis. The WEMP can be refined or amended as necessary and appropriate and can be readily expanded to incorporate the Jay–Cardinal Project.

2013 Baseline Program

Surveys of wildlife and wildlife habitat were completed during the 2013 baseline program:

- serial surveys at Lac du Sauvage for water birds (water bird survey);
- ground-based searches of selected esker habitat for carnivore dens (carnivore den survey);
- wildlife and wildlife habitat surveys along the proposed Jay–Cardinal Project road routes (environmental setting survey); and,
- a caribou pathway survey.

The Lac du Sauvage water bird survey included eight aerial transects spaced 2 km apart and an aerial survey of the shoreline (Figure 3.10-3). The helicopter surveys were completed 80 m above the ground at a speed of 80 to 100 km/h. Water birds observations were recorded within 200 m on either side of the helicopter. The environmental setting survey, consisted of two biologists and a local guide walking in parallel 50 m a part along the Jay–Cardinal Project proposed linear development alignments (Figure 3.10-4). A follow-up aerial survey was also completed along the proposed alignments. The caribou pathway survey (Figure 3.10-5) consisted of an aerial survey completed at 400 m above the ground. The survey document the pathways available for caribou migrating through the area surrounding the Lac de Gras region and the obstacles, including lakes, rugged terrain, and development infrastructure that may influence their route choice.

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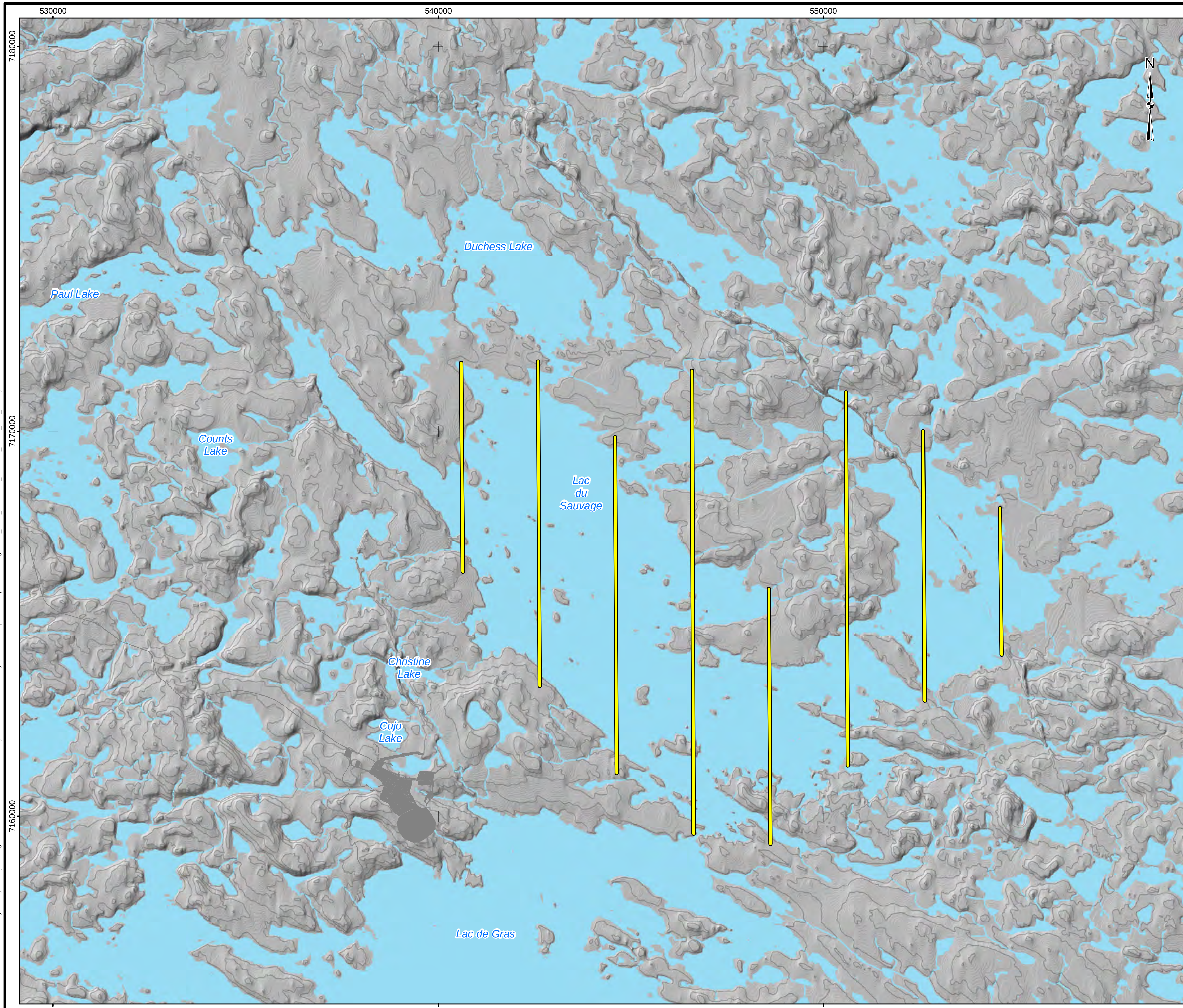

LEGEND

- WATER BIRD SURVEY TRANSECT LINE
- EKATI MINE FOOTPRINT (MISERY OPERATION)
- 10M CONTOUR
- WATERCOURSE
- WATERBODY

REFERENCE

1:50,000 LAKES AND STREAMS - CANVEC
1:50,000 DEM - GEOBASE
DATUM: NAD83 PROJECTION: UTM ZONE 12N

2 0 2
SCALE 1:100,000 KILOMETRES

PROJECT
JAY-CARDINAL PROJECT
LAC DU SAUVAGE,
NORTHWEST TERRITORIES, CANADA

TITLE
2013 TERRESTRIAL BASELINE: WATER BIRD SURVEY

DOMINION DIAMOND

PROJECT	13-1328-0031	FILE No.	
DESIGN	RC	07/10/13	SCALE AS SHOWN	REV 0
GIS	RC	07/10/13	
CHECK	ED	16/10/13	FIGURE: 3.10-3
REVIEW	ED	16/10/13	

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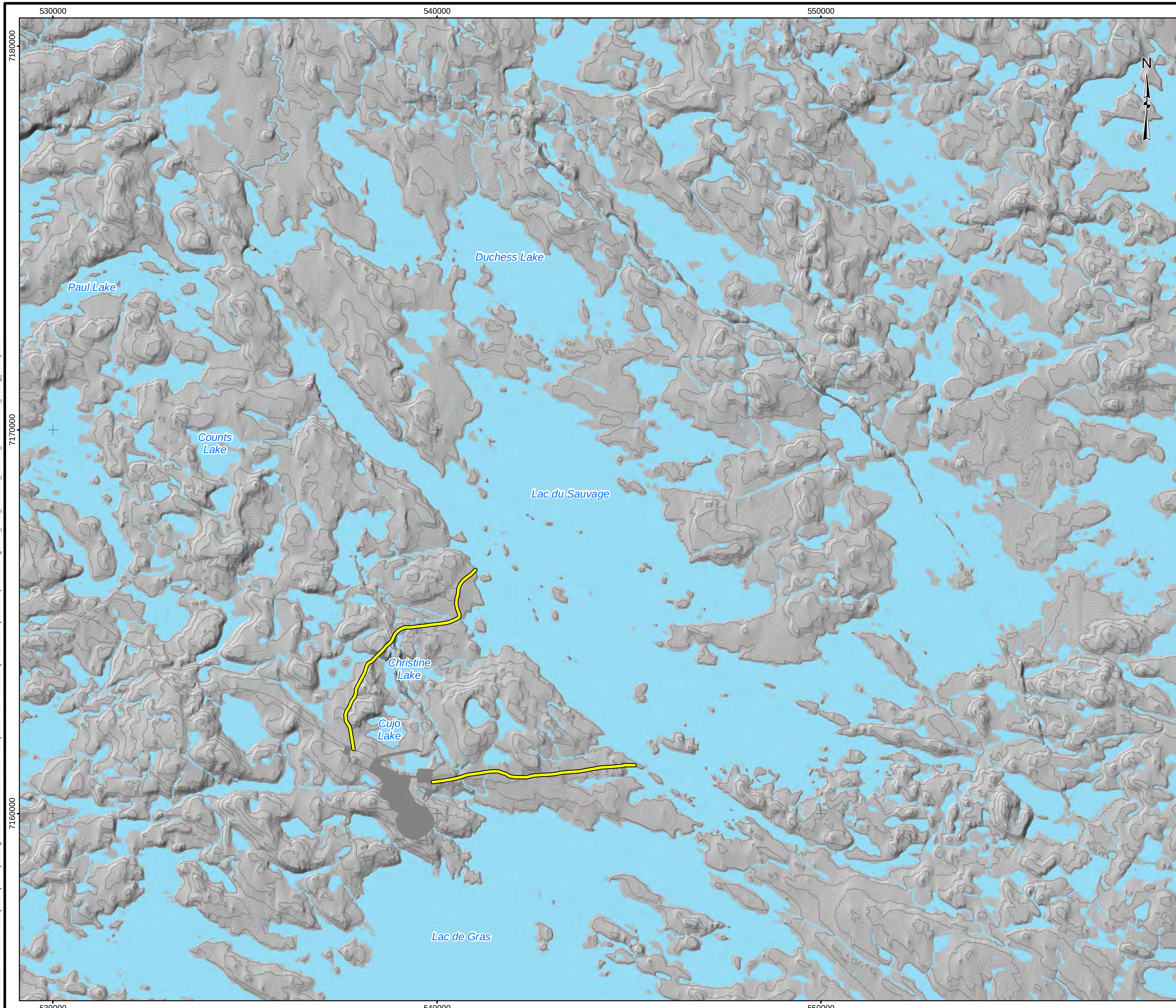

LEGEND

- ENVIRONMENTAL SETTING SURVEY ROUTE
- EKATI MINE FOOTPRINT (MISERY OPERATION)
- 10M CONTOUR
- WATERCOURSE
- WATERBODY

REFERENCE

1:50,000 LAKES AND STREAMS - CANVEC
1:50,000 DEM - GEOBASE
DATUM: NAD83 PROJECTION: UTM ZONE 12N

2 0 2
SCALE 1:100,000 KILOMETRES

PROJECT
JAY-CARDINAL PROJECT
LAC DU SAUVAGE,
NORTHWEST TERRITORIES, CANADA

TITLE
2013 TERRESTRIAL BASELINE: ENVIRONMENTAL SETTING SURVEY

DOMINION DIAMOND

PROJECT		13-1328-0031	FILE No.	
DESIGN	RC	07/10/13	SCALE AS SHOWN	REV 0
GIS	RC	07/10/13		
CHECK	ED	16/10/13	FIGURE: 3.10-4	
REVIEW	ED	16/10/13		

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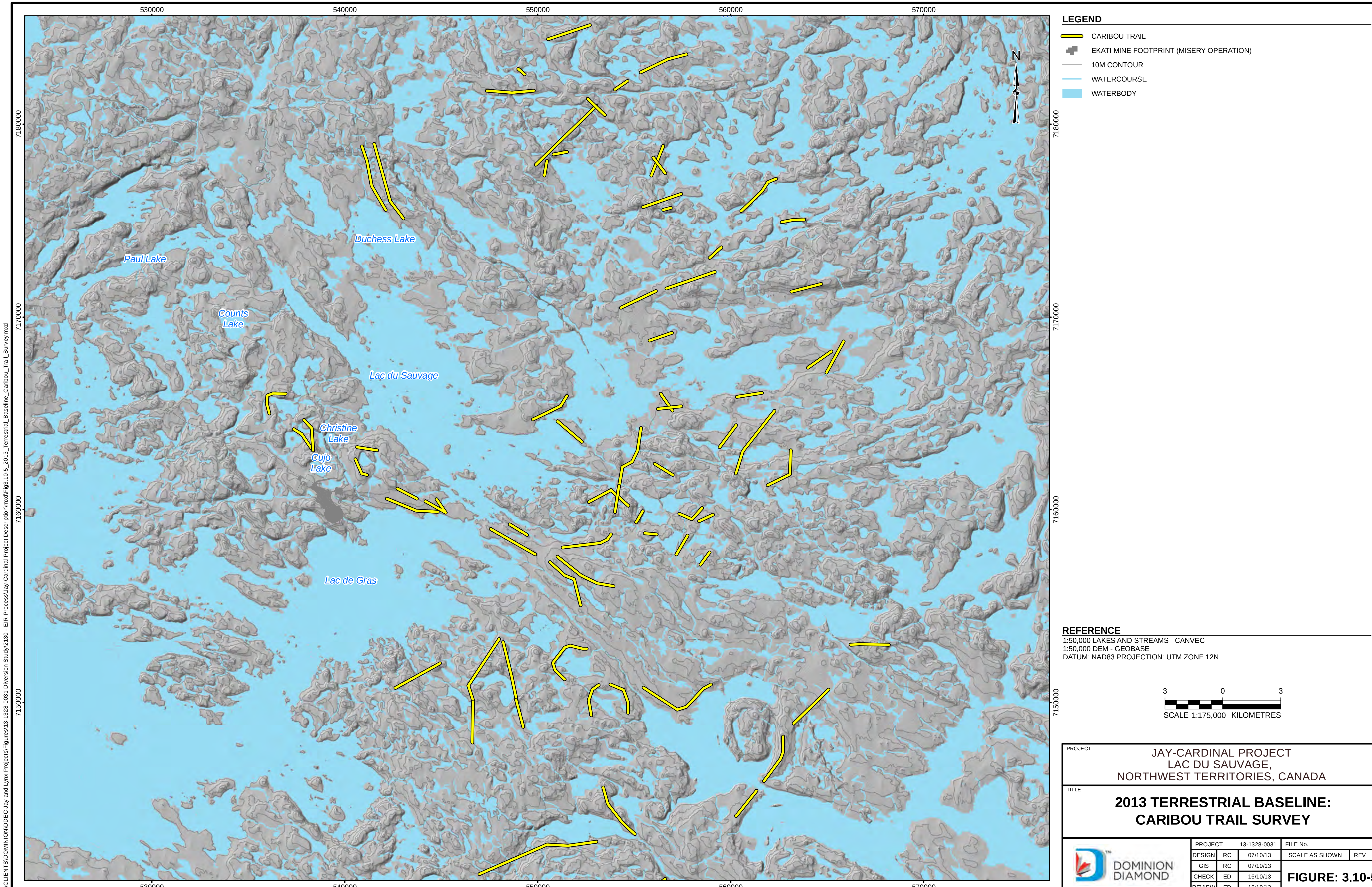

PROJECT

JAY-CARDINAL PROJECT
LAC DU SAUVAGE,
NORTHWEST TERRITORIES, CANADA

TITLE

2013 TERRESTRIAL BASELINE:
CARIBOU TRAIL SURVEY

DOMINION DIAMOND

PROJECT		13-1328-0031	FILE No.
DESIGN	RC	07/10/13	SCALE AS SHOWN REV 0
GIS	RC	07/10/13	
CHECK	ED	16/10/13	**FIGURE: 3.10-5**
REVIEW	ED	16/10/13	

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4.0 PROJECT DESCRIPTION

4.1 Approach to the Jay-Cardinal Project

The Jay-Cardinal Project is the cornerstone of Dominion's strategy for a long-term sustainable Northern diamonds business that is an on-going source of benefits for the North (Figure 4.1-1 depicts current existing conditions and Figure 4.1-2 illustrates the Project overlaying the existing environment). In itself, the Jay-Cardinal Project will maintain benefits flowing from the Ekati Mine for 10 to 20 additional years. There are also a number of undeveloped kimberlite resources (e.g., Sable pipe, Fox deep) and possible additional undiscovered diamond-bearing kimberlite pipes within Dominion's mineral holdings. These kimberlite pipes represent even longer-term possibilities for Dominion's vision of a prosperous future for the NWT diamonds business. The Jay-Cardinal Project serves this larger vision by providing a stable operating platform from which additional resources can be brought into development in the future. Dominion's strategy is to secure the immediate future of the Ekati Mine through the Jay-Cardinal Project, and to then progress additional opportunities for a long-term sustainable Northern diamonds business that benefits the people of the North.

The Jay-Cardinal Project is an extension of a large, stable and successful mining operation that has been a foundational element of the Northern economy for 15 years. The Jay-Cardinal Project is unique among recently proposed mining projects in the NWT because it is not a 'new project'. New mining projects require extensive construction of basic infrastructure such as site access roads, process plant, camp, and processed kimberlite tailings facilities. As a result, new projects have significantly greater costs to develop, which creates financing risks that can, on occasion, interrupt, delay, or prevent construction. By comparison, expansion projects, such as the Jay-Cardinal Project represent a lower risk means of ensuring the continuation of economic benefits for the North through a long-term sustainable mining project.

Although Jay-Cardinal is an expansion of the Ekati Mine, feedback from Dominion's pre-application engagement indicates that the Project "might cause significant public concern" pursuant to the *Mackenzie Valley Resource Management Act*. This is a regulatory test for referral of a project to the Mackenzie Valley Review Board. Dominion respects this feedback and acknowledges that the Jay-Cardinal Project will be referred for Environmental Assessment by the Mackenzie Valley Environmental Impact Review Board (MVEIRB).

Dominion has made all parties aware that the financial viability of the Jay-Cardinal Project is linked to the release of diamond-bearing kimberlite for processing prior to the currently scheduled closure of the Ekati mine in 2019. Dominion is committed to working rigorously on the regulatory process to ensure that the process is complete, fair, and comes to a timely conclusion. Dominion has also been clear in requesting all parties to commit to also working rigorously to support a complete, fair, and timely review process. Dominion views it as being in all parties' interests that the Jay-Cardinal Project be given the opportunity to continue operations at the Ekati Mine, with continued economic benefits to Northern people.

Dominion has developed a design of the Jay-Cardinal Project that:

- respects cultural and environmental values;
- ensures uninterrupted operation of the Ekati Diamond Mine;

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- maximizes the use of existing infrastructure; and,
- provides positive project economics, realistic schedule, and mitigation of potential environmental effects.

Examples of how Dominion has achieved these objectives are as follows:

- The Project design avoids any physical disruption at the outlet of Lac du Sauvage into Lac de Gras and surrounding area because of the area's traditional use for camping, fishing, and caribou movement.
- The fundamental approach to the Project delivers acceptable project economics by including the Cardinal open pit into the Project, and by selecting an approach (diversion and drawdown) that can realistically be constructed in time to avoid mine closure. During only 6 months of ownership, Dominion has already completed a number of important tasks that facilitate the overall 2019 schedule, including:
  - submitting the (September 2013) Lynx Project application that will result in an incremental increase in the operating life of the Ekati Mine;
  - dedicating immediate resources to the Jay-Cardinal Project such that this project submission is provided only six months after taking ownership of the Ekati Mine;
  - conducting open and immediate community engagement on the Jay-Cardinal Project in a manner that shared project concepts even as they were being developed;
  - respecting initial feedback received through the engagement process and requesting that the referral procedure be expedited; and,
  - preparing a Draft Terms of Reference for Environmental Assessment of the Jay-Cardinal Project as a means of facilitating the Review Board's initial stage of work - Scoping.
- The Project design makes full use of existing Ekati Mine facilities to reduce environmental footprint, and to avoid the need for costly and time-consuming construction of major mine components such as process plant, tailings facility, camp, airstrip, and primary access roads, among others.
- Dominion compared the Jay-Cardinal Project alternatives on the basis of cost, schedule, socio-economics, and environmental effects with the result that the selected approach (diversion and drawdown) was significantly superior to the other options. This option maximizes potential economic benefits by allowing access to both the Jay and Cardinal pipes, provides a schedule expected to integrate with the current mine plan, and provides reasonable mitigations for potential environmental effects.

The proposed approach to mining the Jay and Cardinal kimberlite pipes is by isolating an area of Lac du Sauvage behind dikes that divert a majority of the inflows to the north and south of the isolated area. This approach takes advantage of the natural shape of Lac du Sauvage, which is generally a shallow lake. The shape of Lac du Sauvage is conducive to exposing the areas of the Jay and Cardinal kimberlite pipes for open pit mining by dawning down the lake water level within a diked area. The fundamental components and activities of Project are as follows:

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At Lac du Sauvage:

- Roads and power line to Lac du Sauvage;
- Granite rock borrow areas and quarries for construction;
- Duchess Lake Diversion (Dike JP2);
- Lake E1 Diversion Channel;
- North Arm Water Management Area (Dike JP1 and outlet control structure);
- Lac du Sauvage Diversion (Dike JP4);
- Jay and Cardinal open pit berms;
- Lac du Sauvage Pumping Station(s) (initial drawdown and on-going operational pumping);
- Lac du Sauvage fish-out;
- Jay and Cardinal open pits and underground workings;
- Jay and Cardinal WRSA;
- Continued use of existing Misery site; and,
- Reclamation (re-established surface flows, dike breaching, and other activities).

At Ekati Main Camp and Site:

- Processed kimberlite deposition into mined-out Koala and Panda open pits;
- Continued use of Misery access road;
- Continued use of Ekati Mine camp, process plant, airstrip, and all other related facilities; and,
- On-going reclamation of completed areas (certain areas of the LLCF, and others).

The design of these facilities and activities uses standard approaches that have been successfully implemented at the Ekati Mine and other Northern mines. The existing Ekati Mine environmental monitoring, management, and mitigation programs can all be expanded to incorporate the activities proposed for the Jay-Cardinal Project.

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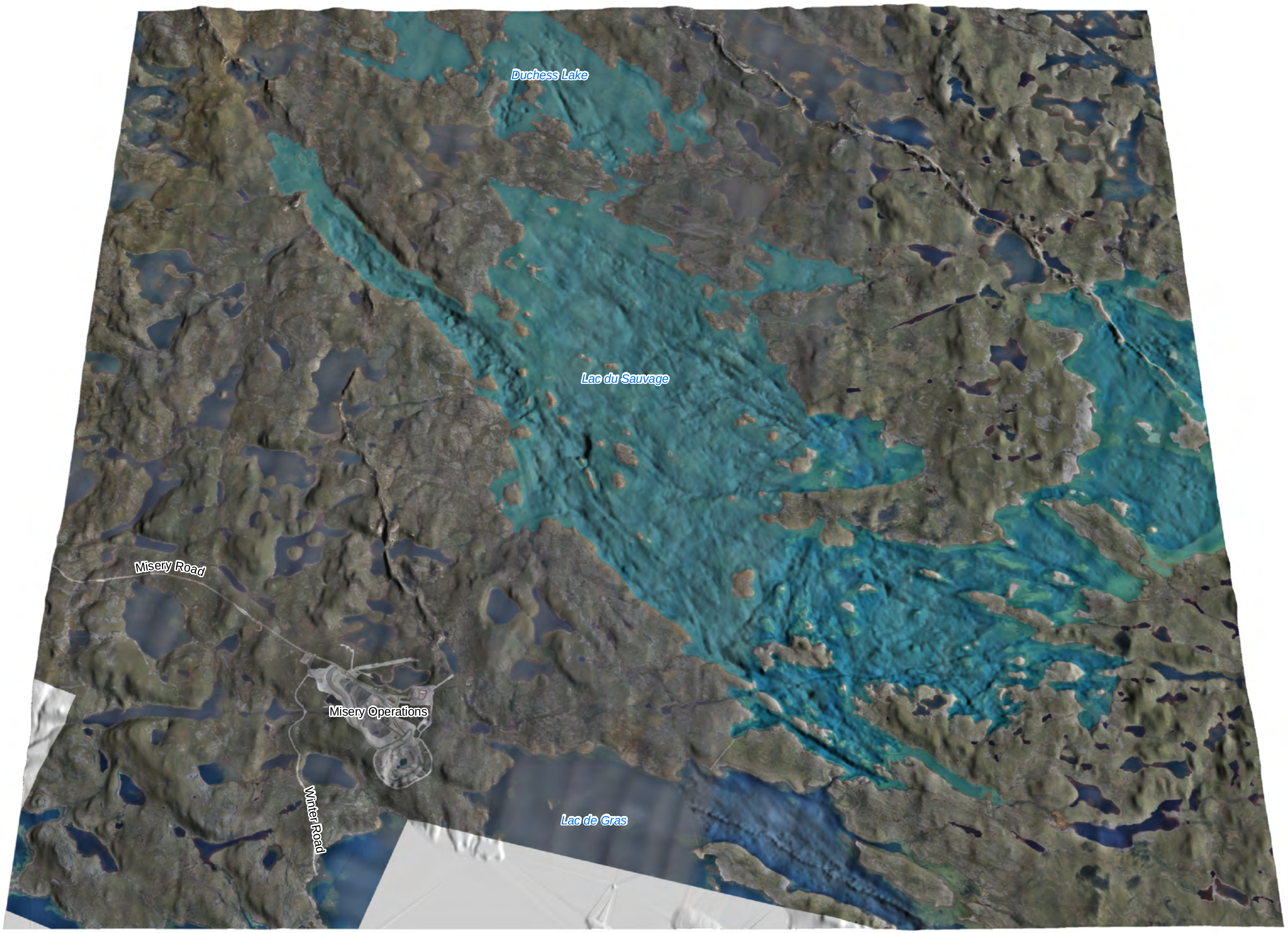

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PROJECT

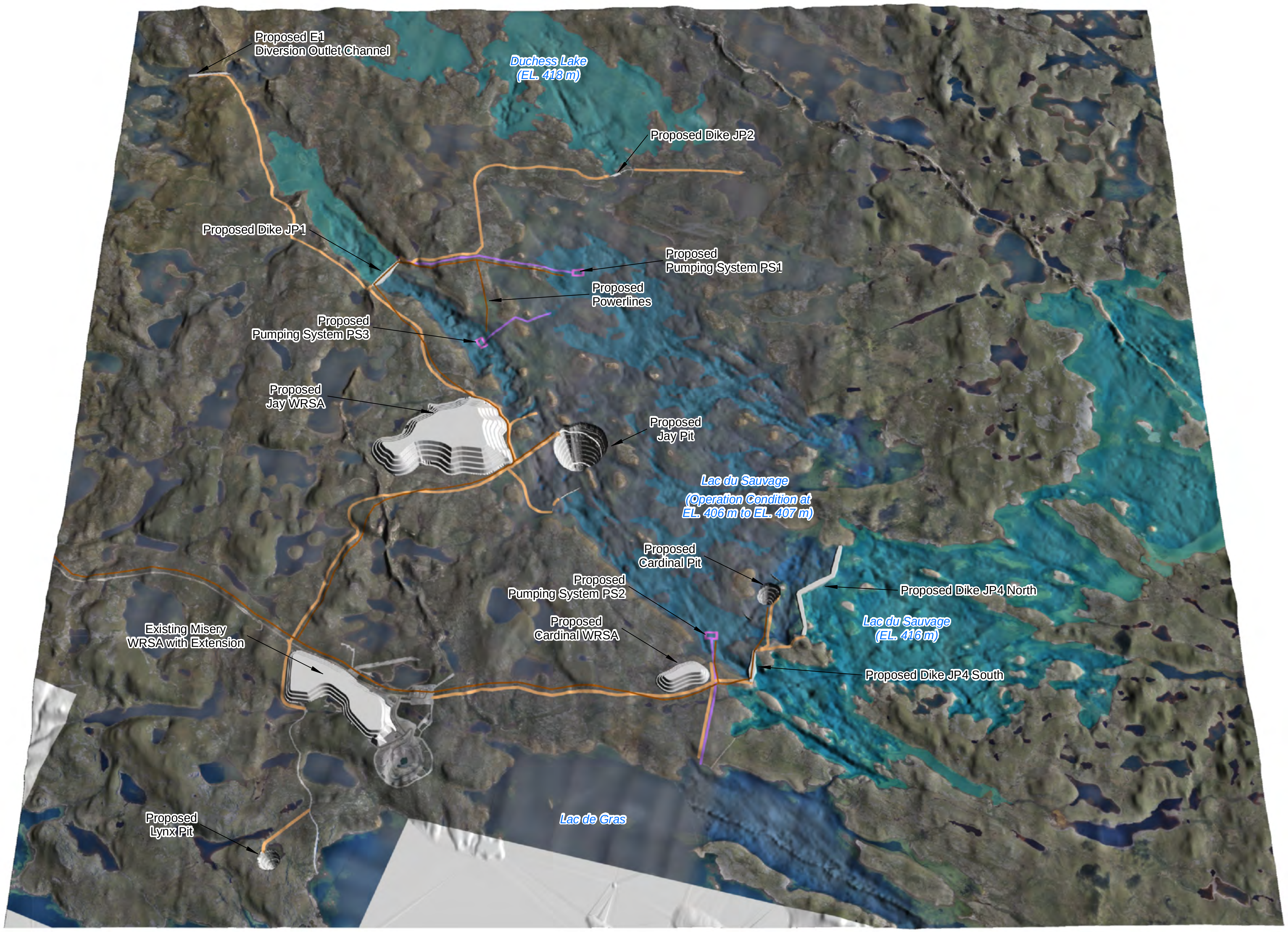
JAY-CARDINAL PROJECT
LAC DU SAUVAGE,
NORTHWEST TERRITORIES, CANADA

TITLE

EXISTING CONDITIONS

DOMINION DIAMOND

PROJECT		13-1328-0031	FILE No.
DESIGN	NT	16/10/13	SCALE AS SHOWN REV A
GIS	LMR	17/10/13	
CHECK	ED	17/10/13	**FIGURE: 4.1-1**
REVIEW	ED	17/10/13	



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PROJECT

JAY-CARDINAL PROJECT
LAC DU SAUVAGE,
NORTHWEST TERRITORIES, CANADA

TITLE

OPERATIONAL CONDITION

DOMINION DIAMOND

PROJECT		13-1328-0031	FILE No.
DESIGN	NT	16/10/13	SCALE AS SHOWN REV A
GIS	LMR	17/10/13	
CHECK	ED	17/10/13	**FIGURE: 4.1-2**
REVIEW	ED	17/10/13	

4.2 Project Schedule

The primary time constraint for the Jay-Cardinal Project is that kimberlite production must be delivered to the process plant by 2019. This is needed to avoid a shutdown of the Ekati Mine according to current mine planning schedules. To achieve this requirement, the following general milestones are envisioned for the Project's seven-year start-up schedule:

2013

- Initial application (i.e., this submission)
- Referral to the MVEIRB for Environmental Assessment
- MVEIRB Scoping and Terms of Reference for Environmental Assessment (begins)

2014

- MVEIRB Scoping and Terms of Reference for Environmental Assessment (completed)
- DDEC Developers Assessment Report
- Environmental Assessment review process (begin)

2015

- Environmental Assessment review process (complete)
- Ministerial approval on Environmental Assessment
- Applications for operational permits and authorizations

2016

- Regulatory review for operational permits and authorizations (complete)
- Construction of land-based access (roads and power line) to Lac du Sauvage and other allowable Project activities
- Issuance of Operational Permits and Authorizations

2017

- Construction of dikes, channels, and pumping facilities
- Drawdown pumping and Fish-out (begin)

2018

- Drawdown pumping and fish-out (complete)
- Construction of Jay and Cardinal berms and access causeways
- Pre-stripping for Jay and Cardinal open pits (begin)

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2019

- Pre-stripping for Jay and Cardinal open pits (continue / complete)
- Production of kimberlite to process plant from Cardinal open pit (begin)

2020

- Pre-stripping for Jay open pit (complete)
- Production of kimberlite to process plant from Jay and Cardinal open pits (begin / continue)

After 2020, mining would proceed through Jay and Cardinal open pits and underground workings (projected 10 to 20 year timeframe). Closure and reclamation activities are envisioned to require approximately five years, followed by closure monitoring and progressive relinquishment of liabilities.

DDEC considers this general timeframe to be achievable and has been working diligently over its six months of ownership of the Ekati Mine to create this opportunity (see Section 4.1). The construction timeframe is accelerated to as great a degree as is considered realistic as the means of achieving the 2019 time constraint while providing a reasonable amount of time for regulatory review and approval. The timely receipt of regulatory approvals is critical to the success of this project opportunity.

DDEC recognizes that amendments to *Mackenzie Valley Resource Management Act* and *Devolution* are scheduled to occur during the Project start-up timeframe, which could affect this project opportunity. DDEC will work collaboratively with government and Aboriginal communities to avoid potential project delays and to take advantage of potential project opportunities that may become apparent as these processes are implemented.

4.3 Existing Project Facilities

The principal facilities at the Ekati site include:

- main accommodations complex: dorm-style sleeping rooms; dining, kitchen, and recreation areas; first aid station, emergency response / mine rescue stations; maintenance shops; a sewage treatment plant; water treatment facility; and incinerator room;
- process plant;
- power plant;
- truck shop / office / warehouse complex that provides for heavy and light vehicle maintenance, heated warehouse storage, change rooms, an environmental laboratory, and an administration offices;
- bulk storage for diesel fuel;
- bulk lubrication facility, that is situated adjacent to the truck shop and holds bulk lubricant and glycol; and,
- all related support facilities and equipment for operation of the above.

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Ancillary buildings located at the Ekati main camp area include:

- ammonium nitrate storage facility;
- emulsion plant;
- waste management building, where waste is prepared for transport to off site management facilities;
- site maintenance shed and Sprung facility, which is used for shipping and receiving;
- airport building; and,
- geology and helicopter facility, that consists of a few small structures on the geology laydown pad to support exploration drilling activities and helicopter flight operations.

Surface facilities to support the Koala North and Koala underground operations include: two maintenance shops, a warehouse, an office complex / change house, a compressor building and batch plant (for mixing concrete), a cold storage building, and a one million litre fuel tank located within a bermed area.

Facilities at the Fox pit include: two 9 million litre (ML) fuel tanks, a truck line-up area, a dispatch trailer, and trailer complex with washrooms and offices. Further, an explosive storage facility is provided to serve the Fox pit operations.

The principal facilities at the Misery Pit include:

- an accommodation complex for 115 people, consisting of single occupancy rooms, kitchen complex, recreation room and exercise gym;
- mine office and dry;
- three Type 4 explosive magazines;
- mine maintenance shop and wash bay;
- utility service building;
- communication tower and trailer;
- diesel power generators with electrical substation
- 9 ML fuel tank farm with off-loading and dispersing; and,
- incinerator with waste handling facility.

A brief description of the existing primary facilities that relate directly to the Jay-Cardinal Project is provided below.

4.3.1 Process Plant

A single, centralized process plant is located within the Ekati main camp, southwest of the Koala Pit. Kimberlite processing through the plant averages 12,500 tonnes per day (tpd) as a continuous operation (i.e., 24 hours a day, 365 days a year). The processing of kimberlite is a physical process rather than a chemical process. Simplified, the general process can be described by size reduction (crushing); washing

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(also referred to as scrubbing); screening (filtering by size); and, then primary and secondary concentration (separating the material by density).

4.3.2 Haul Roads

Transportation of personnel or equipment from the Misery camp or material from the Misery site to either the waste rock stockpile or the Ekati process plant is completed on the Misery Haul Road. The road is approximately 29 km in length and connects to the Tibbitt to Contwoyto Winter Road.

4.3.3 Fine Processed Kimberlite Storage Facilities

There are two active deposition areas for the fine processed kimberlite (FPK; >0.5 mm in diameter) that remains after processing of the kimberlite through the process plant, LLCF and Beartooth Pit. The FPK is mixed with water and pumped as a slurry into the deposition areas. Deposition is regulated under the Ekati Mine Wastewater and Processed Kimberlite Management Plan.

4.3.3.1 Long Lake Containment Facility

The LLCF is located at the headwater of the western Koala Watershed, which feeds into the Lac de Gras Watershed. The LLCF currently includes the following components:

- five containment cells; cells A, B, and C currently receive and store FPK and waste water; Cell D is currently used as a water management area and may receive FPK in the future; and Cell E which acts as a finishing pond prior to discharge to the receiving environment;
- three filter dikes; Dikes B, C, and D are designed to retain processed kimberlite solids within the upstream cell while allowing water to filter through to the downstream cell;
- the outlet dam; which serves as the downstream water control structure that retains water until sampled, authorized, and then pumped to the receiving environment;
- water pumps; pumps on the upstream side of Dike C are used to pump water from Cell C to the reclaim barge in Cell D to supply recycled water to the process plant, pumps at Dike D are used seasonally to transfer water to Cell E, and pumps in Cell E transfer the water that meets Water Licence discharge criteria to the receiving environment (discharge point is Leslie Lake);
- access roads; roads are located along the north side of Cell A, around the perimeter of Cell B, and the east and south sides of Cell C and D; a road and discharge pipeline on the west side of Cell C and the south side of Cell A are under construction; and,
- associated pipelines.

The current operating plan for the LLCF maximizes the use of the upstream areas (cells A, B, and C) for FPK deposition and, combined with the use of the mined out Beartooth Pit, defers the use of Cell D for FPK deposition until late in the mine life. This approach consolidates the area of disturbance (i.e., FPK beaches) requiring reclamation and is valid for the current operating life of the Ekati mine to 2019. FPK deposition into Cell B is complete except for possible minor or emergency deposition into the lower areas. The upper areas of Cell B are being used as a reclamation pilot study at this time.

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4.3.3.2 Mined-out Beartooth Pit

Since late 2012, the mined out Beartooth Pit has been used for FPK deposition. This approach makes effective use of a completed mining facility and serves to validate the concept of FPK deposition into open pits at the Ekati Mine. FPK deposition is currently planned to proceed to an elevation 30 m below the final pit lake overflow elevation. DDEC may develop technical work to optimize the depth of water required for reclamation, thereby increasing the storage capacity for FPK and reducing deposition into the LLCF surface facility.

4.3.4 Coarse Kimberlite Management Area

The Coarse Kimberlite Reject Storage Area within the Panda/Koala/Beartooth WRSA, was commissioned in 1998. The screened coarse fraction (0.5 to 1.6 mm diameter) of kimberlite feed (de-grit) and HMS light fraction (HMS float; <25 mm) from processing of kimberlite at the process plant is stored at this location. The runoff from this storage area drains to the LLCF.

4.3.5 Ancillary Facilities

4.3.5.1 Sewage / Greywater

Between April 1997 and January 1999, treated sewage was discharged to the Kodiak Lake and in 1999 a pumping station and pipeline was built to redirect the treated sewage to the process plant, where it is now combined with the processed kimberlite prior to discharge to the LLCF.

There are two main sources of sewage, the sanitary sewage system at the main site and the sewage from the remote work sites (e.g., Fox Pit and the Misery Pit facilities). Sewage collected from the underground operations and the remote working sites is trucked to the main camp sewage facility. An enclosed sanitary sewage treatment plant treats all domestic wastewater, and provides both primary and secondary levels of treatment. The final treated effluent is pumped to the process plant and discharged to the LLCF.

4.3.5.2 Landfill

The main camp solid waste landfill was commissioned in 1998 and is located on the western side of the Panda/Koala/Beartooth WRSA. The landfill is used for the disposal of inert non-hazardous wastes (wood, metal, concrete, cardboard, etc.) that is generated as part of operations.

A landfill at Misery site was commissioned in 2001 and is located north of the Misery Pit, within the footprint of the Misery WRSA.

4.3.5.3 Landfarm

The landfarm was constructed in 1998 and is a lined facility designed with a leachate collection system and side berm to control runoff. The landfarm is used for the management of hydrocarbon-impacted soil generated as a result of operational spills of diesel, glycol, gasoline, kerosene, jet fuels, hydraulic oil, transmission fluid, and lube oil. Hydrocarbon impacted soil with an average particle size of less than 4 cm are bio-remediated at the landfarm facility. Hydrocarbon-impacted material that is unsuitable for on-site bioremediation is stored here temporarily until it is shipped offsite for proper disposal.

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4.3.5.4 Contaminated Snow Containment Facility

The contaminated snow/ice facility was constructed in 2004. The bermed and lined facility is designed for the containment of hydrocarbon-impacted snow and ice that are generated as a result of operational spills of diesel, glycol, gasoline, kerosene, jet fuels, hydraulic oil, transmission fluid, and lube oil. Following the spring melt, the hydrocarbon contaminant sheen is removed and properly disposed, and the remaining water is pumped to the LLCF.

4.3.5.5 Water Supply

Freshwater is supplied to the Ekati operations from Grizzly Lake, Little Lake, Thinner Lake (Misery Camp), and Two Rock Lake. A water treatment plant for potable water is located at the Ekati main camp. Potable water for the Misery site is trucked from the Ekati main facility.

Water for the process plant is recycled within the process plant or pumped back from the LLCF.

4.3.5.6 Power and Electrical

Ekati's main power plant consists of seven 4.4 megaWatt (MW) diesel generator sets operating at 4,160 volts (V). The main plant provides power to the process operations, accommodations complex, and truck shop/office complex. Waste heat from the power plant is recovered by means of glycol heat exchangers to heat buildings and process water.

The Misery operation uses three 455 kiloWatt (kW) standalone diesel generators connected to a common synchronized power distribution system. This power distribution system has two distribution centers, the synchronized power distribution center, and a second distribution center located at the accommodation complex. Underground cables provide power to the site and terminate at each respective building.

4.3.5.7 Fuel Storage

Fuel storage on site has a capacity of 98 ML. A central bulk fuel farm that contains 8 tanks and approximately 68 ML is located at the Ekati main camp. Other satellite fuel farms are currently located at the Misery (9 ML fuel tank with dispensing and offloading facilities), Fox, and Koala North sites. To support the logistics of fuel delivery to site, Ekati leases a tank farm in Yellowknife with a capacity of 80 ML.

The fuel tanks are double-lined and housed within bermed areas on an impervious liner.

4.3.5.8 Communications

On-site communications are provided by microwave link from Yellowknife, which is operated by a local telecommunication company, Northwestel. The microwave link has dedicated bandwidth to provide voice, data, and internet services. Also located on-site is a backup satellite connection that has lower capacity than the main microwave link, but can be used as required. Communications at the Misery site are provided by an extension of the microwave link from the Ekati main camp.

Internal site communications are provided by radio, phone, local area network, and wireless internet. A fleet management system, Wenco, is also used to track material movement and equipment status.

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4.4 Project Alternatives

4.4.1 Alternatives to the Project

A number of alternatives to the Project were considered. The alternatives to the Project, with the exception of "No Project", were assessed against the following fundamental project requirements:

- respects cultural and environmental values;
- enables uninterrupted operation of the Ekati Diamond Mine;
- maximizes the use of existing infrastructure; and,
- provides positive project economics, realistic schedule, and mitigation of potential environmental effects.

4.4.1.1 No Project

The reserves of the two largest operating mines in the NWT (the Ekati and Diavik mines) are declining. The Ekati Mine is currently scheduled to close in 2019, while mining at Diavik becomes significantly more challenged beyond 2019. The continued development of new mineral deposits is a means of allowing Northerners to continue to benefit from a viable mining sector and contribute to a healthy Northern economy.

Mining of the Jay and Cardinal kimberlite pipes represents 10 to 20 years of additional mine life at the current ore processing rates. Development of the Jay and Cardinal pipes will extend employment at the Ekati Mine site, increasing long-term employment stability for the current mine employees. Consequently, DDEC has rejected the "No Project" option in favour of gaining the most benefit from the available natural resources at the Ekati Mine for the general benefit of all parties.

4.4.1.2 Underground Mining

It would be possible to mine the Jay kimberlite pipe exclusively by underground methods. The kimberlite would be accessed from an adit located on the shore of Lac du Sauvage. Dominion commissioned Stantec Engineering to develop a conceptual underground mining approach for the Jay kimberlite pipe, which is provided as Appendix 4A.

This approach requires little surface disturbance relative to the other approaches considered. However, this approach has a number of potentially fatal flaws that render it inapplicable as a viable project, specifically:

- the conceptual cash flow projection is clearly and strongly negative, to the point where the approach could not likely be made economically viable in light of current or projected costs and product pricing;
- intensive, up-front capital investment is required to a much greater degree than other approaches, contributing to additional negative economics;
- the timeframe to construct an underground operation that could consistently produce the necessary 12,500 tpd of process plant feed is in the order of 4years, which is not a realistic means of production by 2019 given the required permitting timeframe;
- the Cardinal kimberlite pipe would not be mined, leaving potentially valuable resources in the ground;

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- large uncertainty in water inflow rates from the overlying Lac du Sauvage would require a large crown pillar of kimberlite resource to remain unmined, and there would be heightened cost and operating risks related to highly uncertain water inflows; and,
- an underground mining workforce at a Northern mine is less conducive for high Northern and Northern-Aboriginal employment than an open pit operation.

4.4.1.3 Open Pit Mining Within Ring Dike

It would be possible to mine the Jay kimberlite pipe by isolating an area for open pit mining behind a ring dike constructed in Lac du Sauvage. This approach is similar in concept to the approach implemented for the Diavik Mine, although substantively more dike construction would be required to fully encircle the Jay pipe area, including a roadway connecting the ring dike to the shore of Lac du Sauvage. Dominion commissioned EBA Engineering to develop a conceptual ring dike approach for the Jay kimberlite pipe, which is provided as Appendix 4B. The EBA report included persons and firms that were directly involved in the design and construction of the Diavik dikes, such that opportunities for optimizations and efficiency improvements in dike construction were considered.

This approach has several positive aspects:

- the open pit mine could be designed to produce the necessary 12,500 tpd feed to the process plant;
- the in-lake environmental effects are largely reversible at the conclusion of mining operations; and,
- an open pit mining workforce typically offers greater Northern and Northern-Aboriginal employment opportunities as compared to underground mining.

However, this approach also has a number of negative aspects:

- the conceptual cash flow range is marginal to negative;
- the engineering design and construction requirements are intensive, which requires greater up-front capital investment and a longer construction period;
- the projected timeframe to construct a ring dike that achieves the necessary sophisticated engineering design is in the order of four years, which is not a realistic means of production by 2019 given the required permitting timeframe; and,
- there is no option to mine the Cardinal pipe.

4.4.1.4 Diversion and Drawdown

The presence of continuous talik beneath Lac du Sauvage and the identified geologic structures, if permeable, could provide a hydraulic connection between the proposed pits and the deep groundwater system. If a water retention ring dike was built around the Jay kimberlite pipe and the current lake levels were maintained, the water inflow into the pit could be larger than if the lake water level was lowered; therefore increasing the volume of mine water to be managed and the operating risks. As such, a system of strategically placed dikes that would isolate an area of Lac du Sauvage large enough for the Jay and Cardinal pits is considered a more appropriate approach.

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It would be possible to mine the Jay and Cardinal kimberlite pipes by isolating an area in Lac du Sauvage behind dikes that divert a majority of the inflows to the north and south of the isolated area. This approach takes advantage of the natural shape of Lac du Sauvage, which is generally a shallow lake. The shape of Lac du Sauvage is conducive to exposing the areas of the Jay and Cardinal kimberlite pipes for open pit mining by drawing down the lake water level within a diked area. In this approach, the engineering design of the dikes is less sophisticated than the "Diavik-style" ring dike because the increase in available surge capacity within the diked off areas reduces operating risks. Dominion commissioned Golder Associates Ltd. to describe several possible variations on carrying out this approach, which is provided as Appendix 4C and described further in the following sections.

This approach satisfies the fundamental requirements and has several positive aspects:

- the conceptual cash flow projection is positive;
- the open pit mines could be designed to produce the necessary 12,500 tpd feed to the process plant;
- mining the Cardinal kimberlite pipe is possible, increasing the benefits of the Project;
-
- underground mining in either or both kimberlite pipes is possible to further extend mine life;
- the in-lake environmental effects are largely reversible at the conclusion of mining operations;
- a large minewater management area is available in the North Arm of Lac du Sauvage; and,
- an open pit mining workforce typically offers greater Northern and Northern-Aboriginal employment opportunities as compared to underground mining.

This approach also has negative aspects:

- more road construction is required; and,
- a larger area of Lac du Sauvage is affected during the period of mine operations as compared to the "Diavik-style" ring dike approach.

4.4.1.5 Other Approaches

Several other concepts were considered and quickly identified as impractical for the Project for clear reasons, as described below.

Lake Drawdown and Underground Mining

It would be conceptually possible to drain Lac du Sauvage to the point where underground mining could pursue a caving method similar to the methods used in the Panda and Koala underground workings at the Ekati Mine. The lake draining would be accomplished similar to the "Diversion and Drawdown" concept described above or by draining Lac du Sauvage entirely. The advantage of this approach would be that the caving methods are generally less expensive relative to other underground mining extraction techniques. However, the operating risks, costs and other flaws would be substantively the same as described above for "Underground Mining"; as such this approach is not suitable as a project.

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Wet Mining

The concept of "wet mining" is based on using a dredge, or otherwise floating platform to raise kimberlite to surface after underwater blasting. Water quality Lac du Sauvage would be protected by slit curtains; however, it is not envisioned as practical to design this approach using current technology to produce the necessary 12,500 tpd process plant feed. Additionally, the shape and depth of the Jay and Cardinal kimberlite pipes (i.e., vertical 'carrot' shapes) are not ideal for this approach. For these reasons, this approach is not suitable as a project.

Underwater Mining

The underwater mining concept would use a remote-operated underwater crawler, equipped with cutting-head and suction pump, to excavate and pump kimberlite to surface. This approach would be modelled after mining techniques used in South Africa in sand deposits. While conceptually possible, the basic technology for using this concept in kimberlite containing granite inclusions is not developed. This approach is not suitable as a project at this time.

4.4.1.6 Selected Project

The diversion and drawdown approach provides the greatest opportunity for success as a project that will substantively extend the operating life of the Ekati Mine, with the attendant continuation of benefits for all parties involved.

The diversion and drawdown approach will require the construction and operation of a pumping and pipeline diversion system. During the mine operation period, lake drawdown would be maintained with pumping. During operations it is assumed that the lake drawdown elevation will fluctuate to allow for some attenuation of spring freshet inflows and as part of turbidity management.

Alternative means of carrying out this Project are described in the following sections.

4.4.2 Alternative Means of Carrying Out the Project

4.4.2.1 Diversion and Drawdown Approaches

A conceptual engineering study was completed to evaluate a range of options for a diversion and drawdown project (Appendix 4C). The general concept of lake drawdown includes pumping to establish an initial drawdown that would provide access to the Jay and Cardinal kimberlite pipe areas, and allow for construction of local water management infrastructure.

Lake drawdown to support the development of mining at both the Jay and Cardinal pipes can be achieved with a range of combinations of pumping the Lac du Sauvage base water down and diverting watershed inflows. The alternatives considered range from pumping the lake with limited diversion, to diverting inflows to the lake away to allow for mine development of both Jay and Cardinal pipes. Pumping stations and a sediment pond are proposed for drawdown, and construction of dikes and channels are proposed for diversion of the watershed inflows.

The target lake drawdown elevation was determined using the following criteria:

- bathymetry of the Lac du Sauvage lakebed relative to the geometry of the proposed open pits;
- limited ring dike requirements around the proposed open pit areas; and,

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- freeboard between the pit rim and lake drawn-down that accounts for seasonal fluctuations and a design storm inflow event to the drawn-down area of Lac du Sauvage.

A number of key assumptions were made to calculate the lake drawdown volume by elevation for the alternative options. These include the assumptions that the mean normal lake elevation is 416 m and that all in-lake ponds gradually isolated by the lake drawdown are hydraulically connected so that drawing down the lake in one area results in drawdown of all areas of the lake. Some of the isolated ponds may be hydraulically disconnected from the rest of the lake, which will significantly reduce the water volume for pumping. Further investigation of potential hydraulic connection of sub-basins within the lake will be part of the next stage of the design for this Project.

Based on the assumptions noted above, the water volume (base volume) of the entire Lac du Sauvage is approximately 500,000,000 m^3 between elevation (EL) 416 m and EL 406 m.

Five alternatives (ALT1 to ALT5) for drawdown of Lac du Sauvage were evaluated that consider pumping the lake and diverting the inflows. Diversion is based on the construction of dikes at up to four locations (dikes: JP1, JP2, JP3, and JP4) and open channels. Each of the five alternatives includes access roads, pumping stations, a sediment pond, and between one and three dikes. Table 4.4-1 presents a summary of the dikes, pumping, diversion, initial base water withdrawal volume and annual inflow volumes for each of the five alternatives that were considered and are described below. Additional details on each alternative are provided in Appendix 4C.

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Table 4.4-1 Summary of Five Conceptual Lake Drawdown Options

	Dike				Pumping				Diverting				Lake E1 Diversion Outlet Channel	Initial Drawdown Volume to EL. 406 m (1,000,000 m^3)	Ongoing Mean Annual Inflow (1,000,000 m^3)
Alternative Number	JP1	JP2	JP3	JP4	Duchess Arm	East Arm	South Arm	West Arm	Duchess Arm	East Arm	South Arm	West Arm			
ALT1	yes	no	no	no	yes	yes	yes	Yes	no	no	no	no	yes	487	217
ALT2	yes	yes	no	no	no	yes	yes	Yes	yes	no	no	no	yes	457	150
ALT3	yes	no	yes	no	yes	no	yes	Yes	no	yes	no	no	yes	422	143
ALT4	yes	yes	yes	no	no	no	yes	Yes	yes	yes	no	no	yes	392	38
ALT5	yes	yes	no	yes	no	no	no	Yes	yes	yes	yes	no	yes	284	20

Note 1: Planned lake drawdown over one year requires pumping to transfer both the initial base volume plus one year ongoing mean inflow.

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4.4.2.2 Alternative One

The following summarizes the components that are required for drawdown alternative one (ALT1). These components also form the basic components required for the additional four alternatives considered.

Dikes, Ponds, and Channels

- Dike JP1 separates the North Arm of Lac du Sauvage from the rest of Lac du Sauvage and creates the North Arm Water Management Area;
- North Arm Water Management Area has two main functions: one is a pond for turbidity control, and the other is a pond to manage the discharge through a channel into Lac de Gras through Paul Lake; and,
- The Lake E1 Diversion Outlet Channel diverts inflow from Sub-basin E to Paul Lake and provides an overflow channel from the North Arm Water Management Area allowing discharge into Paul Lake.

Roads and Causeways

- Jay Road is 6.9 km long and connects the existing Misery Road and Jay Causeway;
- Jay Causeway, part of Jay Pit development, is 1.2 km long and connects Jay Road and Jay Pit;
- JP1 Road is 4.5 km long and connects Jay Road and Dike JP1;
- Lake E1 Outlet Road is 7.2 km long and connects JP1 Road and the Lake E1 Diversion Outlet Channel and provides access to the channels for construction and maintenance;
- Cardinal Road is 5.4 km long and connects the Misery Road and Cardinal Causeway; and,
- Cardinal Causeway, part of Cardinal Pit development, is 4.0 km long and connects Cardinal Road and Cardinal Pit.

Berms

- Jay Berms
  - Two berms in the area of the proposed Jay Pit development are required and will be constructed of rockfill and lined with locally borrowed lakebed till from pit pre-stripping if possible. The berms will create sumps to collect local seepage flows, groundwater flow and precipitation, and keep the drawn-down lake from the pit area.
- Cardinal Berms
  - Two berms in the area of the proposed Cardinal Pit development are required and will be constructed of rockfill and lined with locally borrowed lakebed till from pre-stripping if possible. The berms will create sumps to collect local seepage flows, groundwater flow and precipitation, and keep the drawn-down lake from the pit area.
  - An additional pumping station will be required in the isolated pond north of Cardinal Pit and below Dike JP4 North to maintain this area at a drawdown level of El 400 m.

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- Pumping Stations and Pipelines
  - PS1 Pump Station and a 3.5 km long pipeline pumps water from PS1 Pump Station to the North Arm Water Management Area during lake drawdown and maintains lake drawdown during operations;
  - PS2 Pump Station and a 2.3 km long pipeline pumps water from PS2 Pump Station to Lac de Gras during lake drawdown and maintains the drawdown level during operations; and,
  - PS3 Pump Station and a 1.5 km long pipeline pumps water from the trench along the southwest shoreline of Lac du Sauvage to PS1 Pump Station.

4.4.2.3 Alternative Two

The additional components required for alternative two (ALT2), in addition to those listed above for ALT1, include the following:

- JP2 Road, which is 6.3 km long and connects Dike JP1 and JP2; and,
- Dike JP2, which diverts the inflow from Duchess Arm of Lac du Sauvage to Paul Lake through the Lake E1 Diversion Outlet Channel.

4.4.2.4 Alternative Three

The additional components required for alternative three (ALT3), in addition to those listed above for ALT1, include the following:

- Dike JP3, which retains water in the Sub-basin Aa of Lac du Sauvage. Inflows to the Sub-basin Aa from the Sub-basins H, I, and, J will overflow Dike JP3 and are diverted to the location of the PS2 pump station through the Sub-basin Ab channels;
- JP3 Laydown, which provides storage for Dike JP3 construction material and equipment.
- The dike will be constructed in winter by using stockpiled construction materials and equipment at a JP3 Laydown. The construction materials and equipment will be hauled and mobilized to the JP3 Laydown a few months to one year earlier through JP3 Winter Road;
- JP3 Winter Road, which is 7.3 km long and connects Cardinal Road and JP3 Laydown;
- Sub-Basin Ab Channel, which connect the isolated pond at EL 406 m for spilled water discharge to the PS2 pump station; and,
- Ab pumping station to maintain drawdown level in the east arm area of the lake.

4.4.2.5 Alternative Four

The additional components required for alternative four (ALT4), in addition to those listed above for ALT1, include the following

- JP2 Road, which is 6.3 km long and connects Dike JP1 and JP2;

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- Dike JP2, which diverts the inflow from Duchess Arm to Paul Lake through the Lake E1 Diversion Outlet Channel;
- Dike JP3, which holds water in Sub-basin Aa and allows the inflow from the Sub-basins H, I, and J to spill over it. The spilled water will then be diverted to the location of PS2 pump station through the Ab Sub-basin channels;
- JP3 Laydown, which provides storage for Dike JP3 construction material and equipment. The dike will be constructed in winter by using stockpiled construction materials and equipment at JP3 Laydown. The construction materials and equipment will be hauled and mobilized to the JP3 Laydown a few months to one year earlier through JP3 winter road;
- JP3 Winter Road, which is 7.3 km long and connects Cardinal Road and JP3 Lay-down;
- Sub-Basin Ab Channel connecting the isolated pond at EL. 406 m for spilled water discharge to the PS2 Pump Station; and,
- Ab Pumping Station, which will maintain the drawdown level in the east arm area of the lake.

4.4.2.6 Alternative Five

The additional components required for alternative five (ALT5), in addition to those listed above for ALT1, include the following:

- JP2 Road, which is 6.3 km long and connects Dike JP1 and JP2;
- Dike JP2, which diverts the inflow from Duchess Arm to Paul Lake through the Lake E1 Diversion Outlet Channel;
- Dike JP4, which is divided into two sections: JP4 North and JP4 South. This dike diverts the natural flow from the east and south catchment areas to Lac de Gras via the natural Lac du Sauvage outlet channel; and,
- JP4 Road, which is 0.8 km long and constructed on the island south of Dike JP4 South, connects the two sections. Road construction material can be supplied locally on the island.

4.4.2.7 Pumping and Diverting Volumes

Assuming the nominal Lac du Sauvage surface elevation is EL 416 m and the drawdown elevation is EL 406 m, a 10 m drawdown of a portion of Lac du Sauvage results in different pumping volumes for the five alternatives as shown in Table 4.4-2. The five alternatives also divert different portions of the Lac du Sauvage watershed. The diverted volumes of annual inflow are also shown in Table 4.4-2.

Table 4.4-2 Pumping and Diverting of Five Alternatives

Alternative Number	Base Volume for Pumping to EL 406 m (Mm^3)	Pumping Ratio[a] (%)	Diverted Annual Inflow (Mm^3)	Diverting Ratio[b] (%)
ALT1	487	97	42	14
ALT2	457	91	108	42
ALT3	422	84	116	45

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Table 4.4-2 Pumping and Diverting of Five Alternatives

Alternative Number	Base Volume for Pumping to EL 406 m (Mm^3)	Pumping Ratio[a] (%)	Diverted Annual Inflow (Mm^3)	Diverting Ratio[b] (%)
ALT4	392	78	222	86
ALT5	284	57	239	92

(a) Pumping ratio: base volume for pumping to EL 406 m divided by the Lac du Sauvage total base volume between EL 416 m to EL 406 m (500 Mm^3).
(b) Diverting ratio: diverted annual inflow divided by total inflow to Lac du Sauvage basin (259 Mm^3).

Diversions will be created during mine construction, and will remain functional throughout mine operation. The highest pumping requirements and lowest diversion structures are associated with ALT1, where as ALT5 has the lowest pumping requirements and largest diversion structures.

During initial lake drawdown, it is calculated that the pumping flow rate from Lac du Sauvage to the North Arm Water Management Area will be approximately 63,395 m^3/h for ALT1 and 33,367 m^3/h for ALT5. The pumping flow rates for ALT2 to ALT4 will be between the two rates.

In all five alternatives, the pumping systems are designed to allow the drawdown of Lac du Sauvage while considering controls to limit the transfer of solids.

Dike Design

The construction of low permeability dikes, in particular those constructed in lakes located in the Arctic, can be a high capital cost for projects. Previously at other diamond mine operations in the Canadian Arctic region, dikes with a low permeability barrier cutoff system were constructed directly adjacent to open pits. The construction sequence necessary to create a low permeability dike is time consuming, equipment specific, and expensive (capital expenditure); however, results in lower operational costs (operational expenditure) because of low seepage through dikes.

Alternatively, DDEC has proposed a permeability dike concept for the Project. The permeability dike can be constructed of crushed rockfill and results in more seepage through the dike. The rockfill is readily available and can be crushed to different sizes to meet design criteria at low cost. Specific construction equipment may not be needed. The large seepage volume can be pumped back to the impoundment area. The higher permeability dike will result in lower capital expenditures and higher operational expenditures compared to the low permeability dike.

A summary of the average water depth, maximum water depth, and dike length for the proposed dikes is shown in Table 4.4-3.

Table 4.4-3 Summary of Water Depths along Proposed Dike Centreline

Dike	Crest Elevation (m)	Approximate Length[a] (m)	Water Depth (m)	
			Average[b][c]	Maximum[c]
JP1	420	800	6.4	10
JP2	420	600	<1	<1

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Table 4.4-3 Summary of Water Depths along Proposed Dike Centreline

Dike	Crest Elevation (m)	Approximate Length[a] (m)	Water Depth (m)	
			Average[b][c]	Maximum[c]
JP3	418	450	1.3	2
JP4 North	418	2200	5.5	10
JP4 South	418	600	6.6	16

(a) Measured along the proposed dike crest (i.e., top of densification platform).
(b) Average water depth calculated using a weighted average according to dike length.
(c) Calculated assuming a lake surface at EL 416 m.

The proposed Dike JP4 North and South have been classified as high consequence structures according to the CDA (2007). Dike JP4 North is approximately 2.2 km long and has a maximum water depth of around 10 m according to 2013 bathymetric data. Dike JP4 South is approximately 0.6 km long and has a maximum water depth of 16 m. The water depth at the proposed Dike JP1 also has a maximum depth of 10 m along the proposed dike centreline. Dike JP1 is currently classified as a significant structure according to CDA (2007) due to its distance from the proposed Jay Pit.

In comparison to proposed Dikes JP1, JP4 North and South, proposed Dikes JP2 and JP3 are much smaller in size and water depth. Dike JP2 and JP3 have a water depth of less than 3 m and are between 450 and 600 m in length. These dikes have been classified as significant structures according to CDA (2007).

Alternative Selected

Following preparation of a general arrangement for the five alternatives, a conceptual design was prepared for each required dike, outlet channel, and pumping and pipeline system. Based on quantity estimates for the conceptual designs, a cost estimate for each ALT1 to ALT5 was prepared.

Table 4.4-4 provides a summary of the alternatives considered in terms of access road requirements, lake drawdown and diversion areas, and construction quantities and costs.

Table 4.4-4 Comparison of the Five Lake Drawdown Alternatives

		Alternatives	ALT1	ALT2	ALT3	ALT4	ALT5
		Dikes	JP1	JP1, JP2	JP1, JP3	JP1, JP2, JP3	JP1, JP2, JP4
Length of Access Roads		km	22	27	22	27	27
Area	Lake drawdown	km^2	94.4	76.7	80	62.3	46.3
	Catchment	km^2	1,176	817	736	168	90
	% Diversion		14	42	45	86	92
Volume	Dike[1]	Mm^3	0.57	0.58	0.62	0.63	2.33
	Year 1 pumping	Mm^3	743.2	607.6	565.2	429.6	305
	Operational pumping	Mm^3	256	150.8	142.7	37.5	20.5
Relative Capital costs (including initial drawdown) [2]			1.0	1.04	1.09	1.12	1.33

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Table 4.4-4 Comparison of the Five Lake Drawdown Alternatives

Alternatives	ALT1	ALT2	ALT3	ALT4	ALT5
Dikes	JP1	JP1, JP2	JP1, JP3	JP1, JP2, JP3	JP1, JP2, JP4
Relative Annual Operational pumping costs (2)	6.2	3.8	5.9	3.6	1.0
Relative Capital with ten years of Operational pumping Costs	1.1	1.0	1.2	1.0	1.1

(1) Includes outlet channels.

(2) Based on 2013 conceptual level costs estimates assuming the lowest cost is one cost unit.

M= 1,000,000.

The relative capital costs, which include the initial drawdown pumping, were found to increase from the lowest costs for ALT 1 up to the highest cost for ALT 5 as the total length and volume of dikes to construct increased. The relative annual operating pumping costs were found to increase from the lowest for ALT 5, to similar costs for ALT 2 and 4, up to the highest costs for ALT 1 and 3. For a ten-year mine life (estimated Jay open pit only mine life) the relative capital costs with ten years of operational pumping costs resulted in similar undiscounted costs for all alternatives when the accuracy was considered. ALT5 presented the lowest lake drawdown area and retained the outflow of about 40% of Lac du Sauvage through the existing outflow channel. Based on these considerations, ALT5 is the preferred option to advance to a pre-feasibility study, including geotechnical investigations that will begin in winter 2014.

4.4.2.8 Road and Pipeline Alignments

The proposed road and pipeline alignments have been selected based on the results of previous decisions made regarding the mining method, water diversion alternatives, the use of existing camp and processing facilities, and from heritage assessments, traditional knowledge studies, and community engagement completed to date. Other criteria included in the selection of road and pipeline alignments included:

- keeping the linear disturbances as short as possible;
- avoiding creek and other water crossings;
- avoiding conflict with previously identified archaeological sites, ceremonial sites, wildlife crossings, and other areas of interest; and
- minimizing road slope.

The final alignment of the roads and pipelines will be determined through engagement with the surrounding communities.

Where possible, water pipelines have been routed to follow proposed road corridors to reduce the amount of linear disturbance to the extent possible.

An option for the construction of the new roads required for the Jay-Cardinal Project is to make use of the non-acid generating waste rock from the Lynx Pit. Waste rock from the Lynx Pit will be stored in the

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expanded Misery WRSA. This reduces the Project footprint by reducing the need for a number of aggregate quarries by taking advantage of a ready stockpile of granite construction material.

An aggregate quarry (e.g., borrow source) will be used as a back-up source for granite construction material. The volume of material that may not be able to be supplied by the Lynx Pit waste rock can be supplied by a smaller quarry identified within an area that would be disturbed by Project activity even if the quarry were not required, namely the Jay WRSA.

4.4.2.9 Power Supply

Approximately 8 MW of power will be required at the pump locations for the drawdown stages of the Project and 2 MW of power, thereafter, for the life of the mining activities to handle annual runoff collection, pit dewatering, and underground mining. Sources of electrical power normally include connection to a local municipal electrical distribution system or production of dedicated power locally, using fuels such as water (hydroelectric power), natural gas, biomass, or wind.

There is no local municipal electrical distribution system, nor are there any ready sources of water for hydroelectric power, natural gas, and biomass; therefore, these options were eliminated from consideration.

Wind power was eliminated from further consideration for the following reasons:

- the average wind farm will only produce power 30% to 40% of the time due to either insufficient or too high wind velocity thereby requiring 100% standby capacity from other fuel sources which doubles the capital cost and significantly increases the operating costs; and
- wind turbines do not operate in extremely low temperatures below about minus 35° C, which will occur in this geographical location a significant percentage of the year.

Therefore, the electrical power will be provided by diesel generators. Four options were considered for generation of electricity using diesel fuel and delivery of the electricity to the Project.

Option 1 Expand the diesel generation plant at the Misery Pit

Option 2 Purchase/lease capacity at Diavik Diamond mine and purchase electricity from Diavik

Option 3 Supply capacity from the powerhouse at Ekati Mine

Option 4 Supply capacity from a new powerhouse at the Project site

Use of surface cables placed directly on the ground instead of overhead transmission lines to distribute electricity was eliminated from consideration in all four options for the following reasons.

- surface cables can act as barriers to animal migration;
- surface cables are more readily subject to damage by equipment;
- surface cables are more difficult to repair in the winter months when there is snow coverage; and,
- surface cables may not meet the code for high voltage when off mine property.

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Each option was evaluated on the following metrics using a weighted numerical system:

- reliability;
- fuel storage site requirements;
- system control capability; and,
- total capital and operating cost over 10 years.

Option 3, to provide power from the Ekati powerhouse was determined to be the preferred option based on these metrics, and was selected as the means to provide power to the Project.

4.4.2.10 Waste Rock Storage Areas

Two options were considered for the storage of waste rock and overburden generated by excavation of the Jay open pit. The options are described in Table 4.4-5 and shown in Figure 4.4-1.

Table 4.4-5 Jay Waste Rock Storage Area Options

Option	Height (m)	Available Storage Volume (Mm^3)	Distance From Jay Deposit (km)	Footprint Area (ha)
1: West of Jay pit	50	113	2.7	292
2: South of Jay pit	50	113	3.0	263

m = metre; Mm^3 = million cubic metres; km = kilometre; ha = hectare

Similarly, three options were considered for the storage of waste rock and overburden generated by excavation of the Cardinal open pit. The options are described in Table 4.4-6 and shown in Figure 4.4-1.

Table 4.4-6 Cardinal Waste Rock Storage Area Options

Option	Height (m)	Available Storage Volume (Mm^3)	Distance From Cardinal Deposit (km)	Footprint Area (ha)
1: Southwest of Cardinal pit	50	11	2.6	37
2: Extension of Jay Option 2	50	9	5.0	40
3: Between Misery and Cardinal pits	15	9	4.4	72

m = metre; Mm^3 = million cubic metres; km = kilometre; ha = hectare

In addition to the options shown in Figure 4.4-1, options for in-lake and in-pit waste rock storage were considered but were not selected. Storage of waste rock in the basin of Lac du Sauvage was not selected due to potential regulatory and permitting issues that may not be resolved within the required project timeframe, and because other viable waste rock management alternatives exist. Storage of waste rock in mined pits, such as Misery, Lynx, Panda, and Koala was rejected due to uneconomic hauling and placement requirements.

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Criteria used to develop the WRSA options included:

- storage of granite waste rock, metasediments and overburden from Jay Pit, for a conservative design volume of 112 million Mm^3;
- storage of granite waste rock and overburden from Cardinal Pit, for a conservative design volume of 9 Mm^3;
- maximum height of 50 m above the tundra;
- minimum distance from natural water bodies and open pits of 100 m;
- outer slopes benched, with an overall slope angle not greater than 25 degrees; and,
- the waste rock is non-acid generating with the exception of meta sediments from Jay.

All of the options provide for secure, long-term storage. For all options, the existing Ekati Mine WRSA Seepage Monitoring Program would be expanded to incorporate the new WRSA(s).

Jay WRSA Option 1 is located west of the Jay Pit on the shore of Lac Du Sauvage. Waste rock would be hauled from the pit to the WRSA by a short access road. Drainage from the WRSA would be towards Lac de Sauvage. This option sits on granite, and is a potential quarry site for dike construction.

Jay WRSA Option 2 is located south of Jay Pit, on the shore of Lac Du Sauvage. Roads are not shown for Option 2 on Figure 4.4-1; however, it is anticipated that a short road across the drawdown zone of Lac Du Sauvage and re-orientation of the Jay Pit haul ramp would be required.

Cardinal WRSA Option 1 is located on the shore of Lac Du Sauvage, adjacent to the Cardinal access road. This option presents the smallest footprint and shortest haul distance.

Cardinal WRSA Option 2 is an extension of Jay WRSA Option 2, with waste rock from Cardinal stored in the southeast portion of the footprint. Option 2 would require a longer haul road.

Cardinal WRSA Option 3 is a standalone option, with waste rock stored along the road between the Cardinal and Misery sites.

Based on a review of the options, Jay WRSA Option 1 has been identified as the preferred alternative. This option has a shorter haul distance, and has the potential for double use as a quarry, which will help minimize the overall project footprint.

Based on a review of options, Cardinal WRSA Option 1 was selected as the preferred alternative. This option has a shorter haul distance, and a reduced footprint area.

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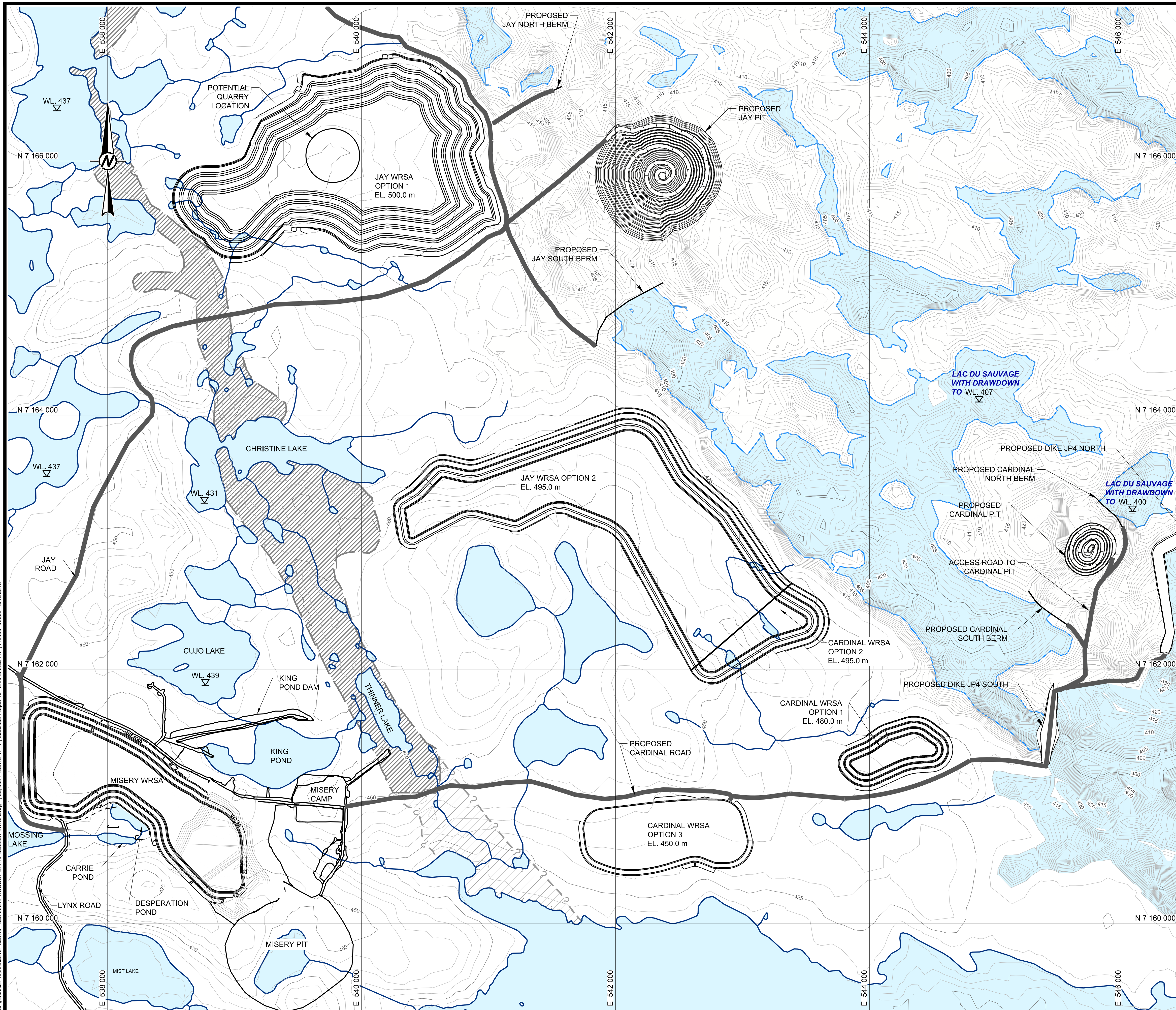

LEGEND

- WATER BODY
- ESKERS (SEE NOTE 4)
- ESKERS (SEE NOTE 5)
- WATER COURSE
- LAC DU SAUVAGE DRAWDOWN SHORELINE AT EL. 407
- EXISTING ROAD
- PROPOSED ROAD
- MINE WATER MANAGEMENT PIPELINE
- WL. WATER LEVEL
- WRSA WASTE ROCK STORAGE AREA

NOTES

1. ALL UNITS ARE IN METRES UNLESS NOTED OTHERWISE.
2. GROUND SURFACE CONTOURS ARE SHOWN AT 5 m INTERVALS AND BATHYMETRY CONTOURS ARE SHOWN AT 1 m INTERVALS.
3. COORDINATES ARE SHOWN IN DATUM: NAD 83, PROJECTION: UTM ZONE 12.
4. EXTENT OF ESKER SHOWN IS BASED ON THE GEOLOGICAL MAP BY MINERAL SERVICES.
5. EXTENT OF ESKER SHOWN AT THE GROUND SURFACE IS APPROXIMATE AND IS FOR DISCUSSION PURPOSES ONLY. THE AREA SHOWN IS NOT INCLUDED IN THE GEOLOGICAL MAP BY MINERAL SERVICES AND HAS BEEN TRACED FROM AN AERIAL PHOTOGRAPH.

REFERENCES

1. CONTOUR DATA PROVIDED BY AURORA GEOSCIENCES LTD., FILE: compilation_Elev_Gridded.xyz, DATE RECEIVED: JULY 30, 2013, IS BASED ON CANVEC DATA UPDATED WITH 2013 RTK SURVEYS IN SELECTED AREAS.
2. GEOLOGICAL MAP USED TO INTERPRET LOCATION OF ESKER CREATED BY MINERAL SERVICES, JUNE 14, 2013.
3. JAY PIT MODEL: GOLDER ASSOCIATES LTD., 2013. PRELIMINARY MINE DESIGN - JAY PROJECT. SUBMITTED TO DOMINION DIAMOND CORPORATION, DATED OCTOBER 3, 2013. REFERENCE NO: 1313280031-003-R-REV0-4000. (FILE NAME: Jay_CAT793_str.dxf)
4. CARDINAL PIT MODEL: GOLDER ASSOCIATES LTD., 2013. PRELIMINARY MINE DESIGN - CARDINAL PROJECT. SUBMITTED TO DOMINION DIAMOND CORPORATION, DATED OCTOBER 8, 2013. REFERENCE NO: 1313280031-008-R-REVB-4001. (FILE NAME: Cardinal_pitshell_design_str.dxf).

0 600 1,200 1,800
SCALE METRES

PROJECT
JAY-CARDINAL PROJECT
LAC DU SAUVAGE
NORTHWEST TERRITORIES, CANADA

TITLE
WASTE ROCK STORAGE AREA OPTIONS

DOMINION DIAMOND

PROJECT No.		13-1328-0031	FILE No. 1313280031-WRSA
DESIGN	CM	2013-09-30	SCALE AS SHOWN REV 0
CADD	LR	2013-09-30	FIGURE
CHECK	JC	2013-10-11	FIGURE 4.4-1
REVIEW	ED	2013-10-11	

4.5 Geology and Geotechnical Conditions

4.5.1 Geology

4.5.1.1 Ekati Mine

Bedrock at the Ekati Mine is dominated by Archean meta-greywackes of the Yukon Supergroup, intruded by granitoids and transected by Proterozoic mafic dykes. No younger cover sediments are preserved. Bedrock is overlain by Quaternary glacial deposits, which are generally less than 5 m thick.

The kimberlite pipes at the Ekati Mine are part of the Lac de Gras kimberlite field, which is located in the central Slave craton. The kimberlites intrude both granitoids and metasediments.

Fine-grained sediments have been preserved as xenoliths and disaggregated material in kimberlite, which indicates that some sedimentary cover was present at the time of the kimberlite emplacement. The Ekati Mine kimberlites range in age from 45 to 75 Ma; they are mostly small pipe-like bodies (surface areas are for the most part less than 3 ha, but they can extend to as much as 20 ha) that typically extend to project depths of 400 to 600 m below the current land surface. Kimberlite distribution is influenced by fault zones, fault intersections, and dyke swarms.

Pipe infill can be broadly classified into six rock types:

- magmatic kimberlite (MK) – hypabyssal;
- tuffistic kimberlite;
- primary volcaniclastic kimberlite (PVK);
- olivine-rich volcaniclastic kimberlite (VK);
- mud-rich, resedimented volcaniclastic kimberlite (RVK); and,
- kimberlitic sediments.

With few exceptions, the kimberlites are made up almost exclusively of VK, including very fine to medium-grain kimberlitic sediments, RVK, and PVK. The RVK represents pyroclastic material that has been transported (e.g., by gravitational slumping and flow process) from its original location (likely on the crater rim) into the open pipe and has undergone varying degrees of reworking with the incorporation of surficial material (mudstone and plant material). In rare cases (e.g., Grizzly Pipe) pipes are dominated by or include considerable portions of MK.

While occasional peripheral kimberlite dykes are present, geological investigations undertaken to date do not provide any evidence for the presence of complex root zones or markedly flared crater zones.

Economic mineralization is mostly limited to olivine-rich re-sedimented volcaniclastic and primary volcaniclastic types. Approximately 10% of the 150 known kimberlite pipes in the Ekati claim block are of economic interest or have exploration potential.

4.5.1.2 Jay Pipe

A total of 16 diamond drill holes (3,872 m) and 17 reverse circulation holes (4,979 m) have been completed in the Jay pipe area. Core drilling using synthetic diamond-tipped tools and/or carbide bits was used to define the pipe contacts and internal geology. Geological logging was completed on all 33 drill holes, and core from 15 diamond drill holes was photographed.

The Jay kimberlite pipe is located within Lac du Sauvage, in the southeastern corner of the property, about 25 km southeast of the Ekati main camp and about 7 km north-northeast of the Misery Pit. The pipe is overlain by overburden that is 5 to 10 m thick, which is then covered by approximately 35 m of water.

The Jay pipe has a roughly circular outline in plan view (Figure 4.5-1), with a surface area of approximately 13 ha (375 by 350 m) and a steep-sided vase shape as illustrated in by the isometric view (Figure 4.5-2). The sides of the pipe are interpreted to be roughly planar with minor concavities and bulges. The shape, particularly the north side, is believed to be coincident with geological structures.

The Jay pipe is hosted within granitic rocks, ranging from granite to granodiorite in composition. A regional contact with meta-sedimentary rocks occurs to the west, and a diabase dyke trending approximately east-west occurs to the north of the pipe. Early interpretation of the regional airborne magnetic images suggested the presence of two linear features extending northeast-southwest (E-W lineament) along the northern Jay pipe contact and northwest-southeast (N-S lineament) to the west of the Jay pipe that could be related to geological structures. The east-west structure to the north of the Jay pipe may be associated with the diabase dyke; however, other zones of increased jointing have also been recognized in two core holes. The north-south structure may be associated with the metasediment-granite contact.

The pipe is divided into three domains:

(1) The RVK domain is the uppermost 110 to 170 m in stratigraphic thickness. Small-scale chaotic bedding is present which is defined by waves of silty to sandy laminates, and variations in olivine abundance. Variable amounts and sizes of black, pale grey, blue-grey, blue-green, brown, and tan coloured mudstones and siltstone xenoliths are present. In core intersections, the RVK domain is comprised of repeating, large-scale graded mega-beds defined by mud, breccia, and olivine content. The upper portion of the mega-beds is composed of olivine-poor, mud- and clay-rick unconsolidated mudstone to RVK. Small-scale bedding is present but is very-fine grained. Rare shale breccia is present.

(2) The transitional kimberlite (TransK) domain is a 30 to 70 m thick package of interbedded RVK and VK material of varying degrees of alteration. The transition from the RVK domain to the VK domain is indistinct and is marked by the appearance of small interbeds of fresh to highly altered, dark to pale coloured VK.

(3) The PVK domain which is primarily olivine-rick, competent, grey-blue to green PVK with partially altered olivine set in a serpentinised matrix. The upper contact of the VK domain is marked by the absence of RVK and presence of highly-altered, pale-coloured VK material. Small, irregularly shaped, mudstone, and granitic xenoliths are present, but decrease in abundance with depth.

The domains are sub-horizontal and are interpreted to extend the width of the pipe. The boundaries between the domains are transitional in nature.

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The geological logging indicates that four geological units exist at the Jay site: granite, metasediment, diabase dike, and kimberlite.

The current resource estimate for the Jay kimberlite pipe includes 36.2 (Mt) of indicated resource at 2.2 carats per tonne (cpt) and 9.5 Mt of inferred resources at 1.4 cpt (Heimersson and Carlson 2013).

4.5.1.3 Cardinal Kimberlite Pipe

A total of four diamond drill holes (658 m) and five reverse circulation holes (920 m) have been completed in the Cardinal pipe area. Geological logging was completed on nine holes, core from three holes was photographed, and partial geotechnical logging was carried out on one hole.

The Cardinal kimberlite pipe is located in the southeastern corner of the property, about 30 km southeast of the Ekati main camp, 4.4 km southeast of the Jay pipe, and 14 km northeast of the Misery Pit, within Lac du Sauvage. The pipe is covered by approximately 18 m of water, as well as overburden that is 10 m thick.

The Cardinal pipe has a roughly circular outline in plan view (Figure 4.6-3) and a steep-sided shape as illustrated in the isometric view (Figure 4.6-4). The kimberlite appears to be approximately one hectare in surface area, but the pipe is constrained by drilling only on the eastern and western margins and by several vertical drill holes within the pipe. It is overlain by approximately 18 m of water and up to 25 m of overburden. The kimberlite has been intersected by four diamond drill (core) holes and three reverse circulation bulk sample holes. The kimberlite is interpreted to have a pipe-like shape and is comprised of a RVK hosted within two-mica granite. Drill hole pierce points indicate that the kimberlite pipe is steep sided.

The reverse circulation drill holes were completed in 2005 (1) and 2007 (4), using 44.45 cm hole diameters; however, only three of the five holes intersected the kimberlite. In total 114 m^3 (approximately 208 dry metric tonnes [dmt]) of kimberlite material was collected in 48 samples (dominantly 15 m sample intervals). Processing was completed at the Ekati sample plant using a 1 mm slot degrit screen which resulted in the recovery of 216 carats, indicating an average grade of 1.90 carats per cubic meter or 1.04 cpt.

The tonnage and average grade ranges for the Cardinal kimberlite pipe are estimated at 1.6 million to 3.8 million tonnes and 0.8 to 1.2 cpt, respectively.

4.5.2 Geochemical Conditions

Acid rock drainage and metal leaching can result from chemical weathering of minerals present in rock that is exposed during construction and mining. Oxidation of sulphide minerals, such as pyrite, can produce acidity, sulphate, and metals. The acidity produced by oxidation of sulphide minerals can be neutralized by the dissolution of carbonate minerals and, to a lesser degree, certain silicate minerals present in the rock.

The primary waste rock expected to be encountered during mining is granite (quartz diorite, granodiorite, two-mica granite, and pegmatite). All of the waste rock mined at the Cardinal pipe and in the order of two-thirds of the waste rock mined from the Jay pipe is anticipated to be granite. The remainder of the waste

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rock mined from the Jay pipe will be metasediment, with minor amounts of diabase and barren/low grade kimberlite.

Geochemical characterization of the main rock types expected to be encountered at the Jay and Cardinal pipes has been undertaken at the Ekati Mine. Granite (including granodiorite and two-mica granite) consists of silicate minerals including quartz, potassium feldspar, plagioclase, biotite, and muscovite. Sulphide minerals are rare in two-mica granite, and fine-grained pyrite has been occasionally observed in granodiorite. The granitic rock at the Ekati Mine has been clearly characterized as non-acid generating. Metasedimentary rock is known to contain trace concentrations of sulphide minerals, with occasional concentrations up to 2 to 5%. Diabase dykes are classified as magnetic or non-magnetic. Diabase dykes contain trace concentrations of sulphide minerals, including pyrite, chalcopyrite and pyrrhotite, and magnetic diabase dykes contain the iron mineral magnetite. The metasedimentary rock and diabase at the Ekati Mine are classified as potentially acid generating.

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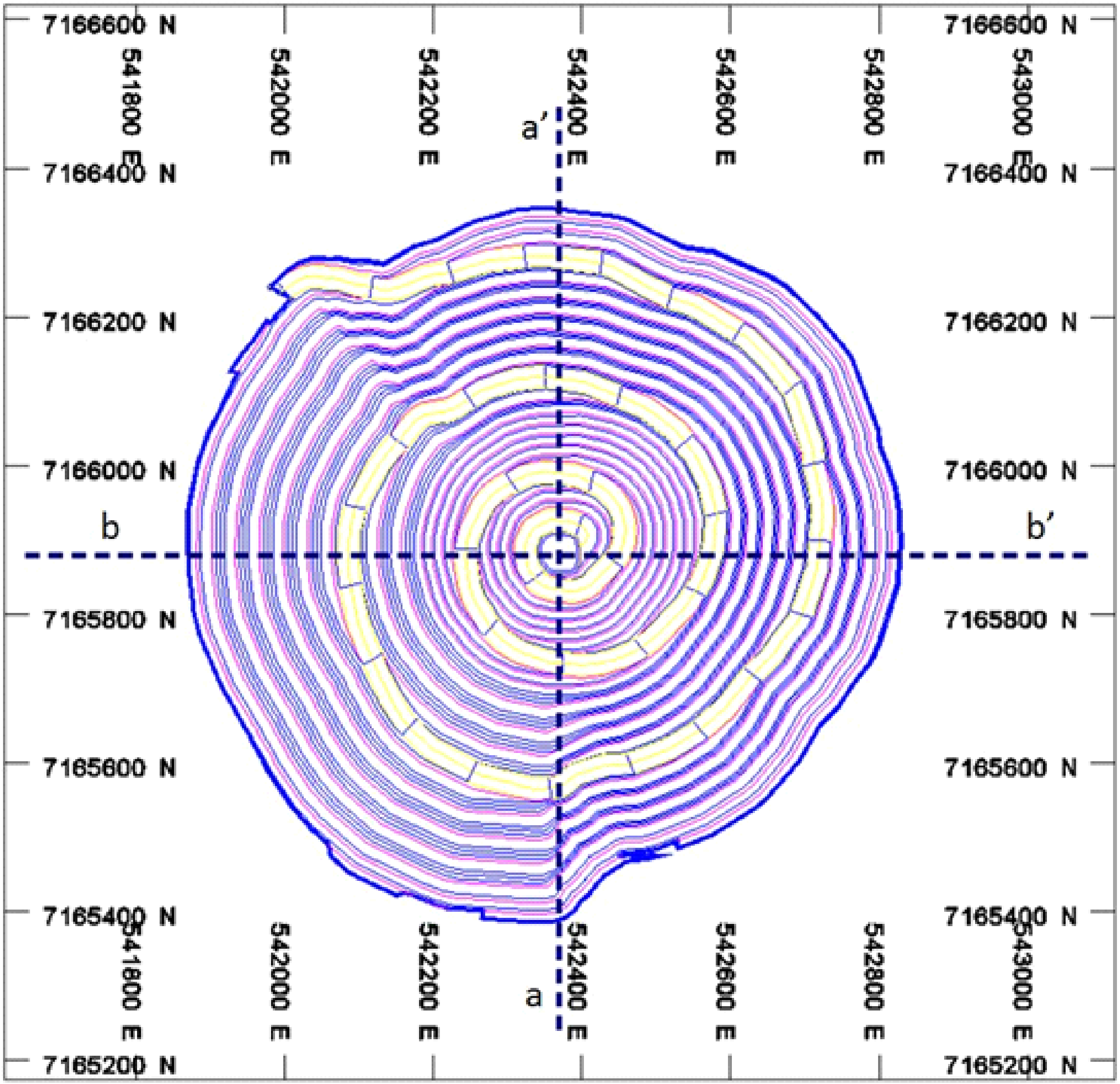


PROJECT

JAY-CARDINAL PROJECT
LAC DU SAUVAGE,
NORTHWEST TERRITORIES, CANADA

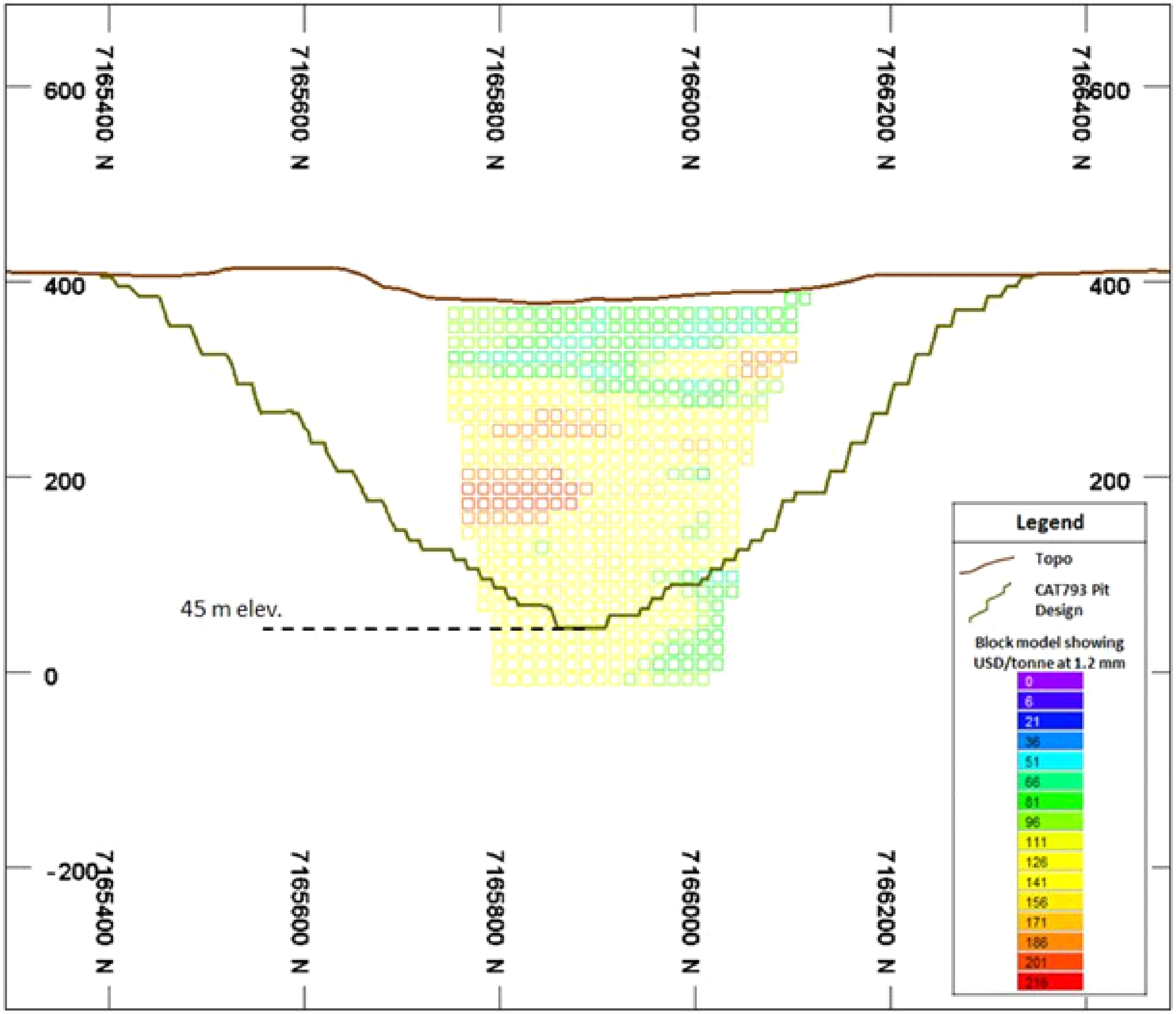
TITLE

JAY KIMBERLITE
PLAN VIEW

DOMINION DIAMOND™

PROJECT		13-1328-0031	FILE No.	
DESIGN	WD	08/10/13	SCALE AS SHOWN	REV 0
GIS	LMR	17/10/13	**FIGURE: 4.5-1**	
CHECK	AL	17/10/13		
REVIEW	ED	17/10/13		

G:\CLIENTS\DOMINION\DDEC Jay and Lynx Projects\Figures\13-1328-0031 Diversion Study\2130 - EIR Process\Jay-Cardinal Project Description\mxd\Fig4.5-1_Jay_Kimberlite_Plan_View.mxd



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PROJECT

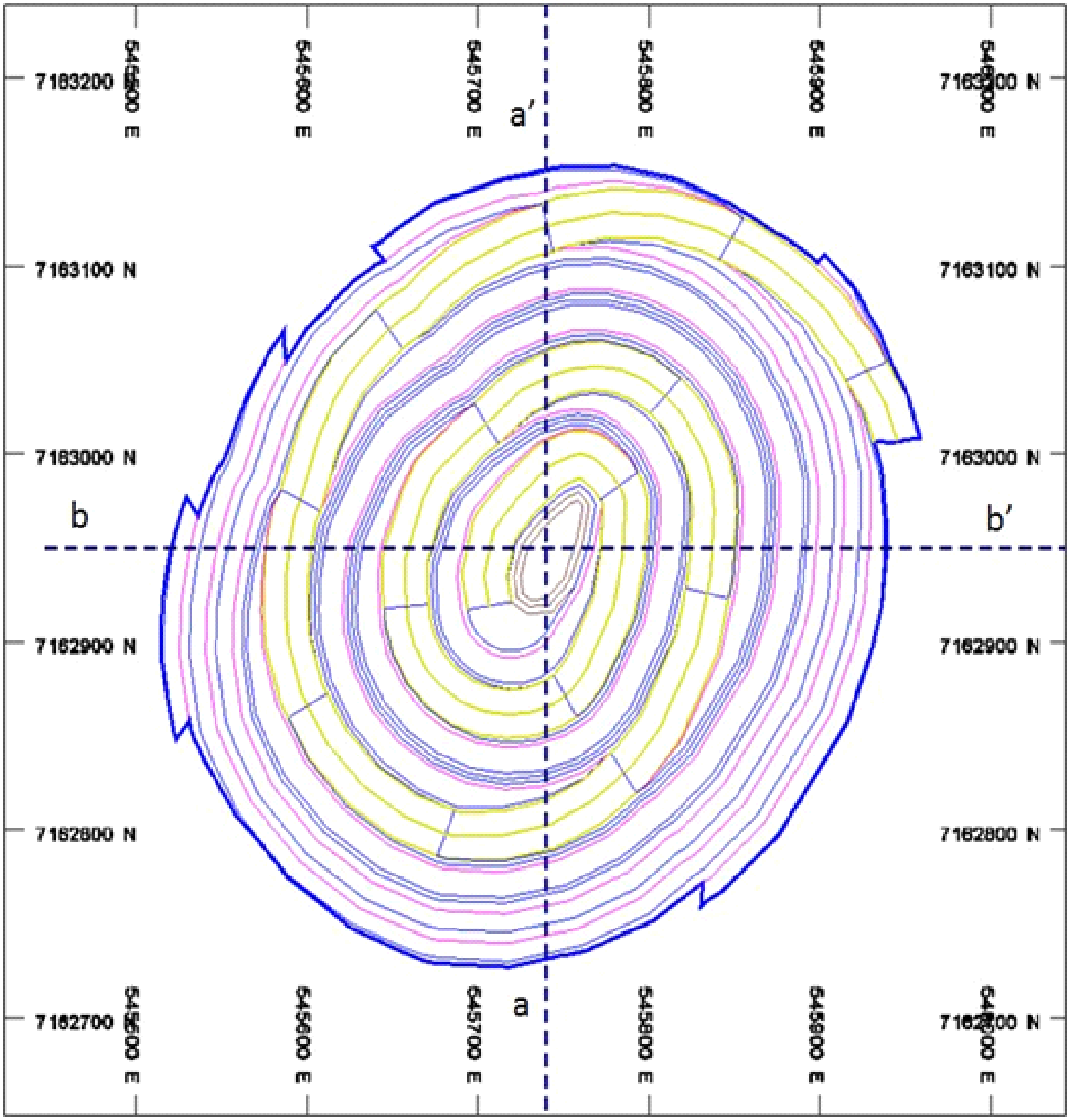
JAY-CARDINAL PROJECT
LAC DU SAUVAGE,
NORTHWEST TERRITORIES, CANADA

TITLE

JAY KIMBERLITE
ISOMETRIC VIEW

DOMINION DIAMOND

PROJECT		13-1328-0031	FILE No.
DESIGN	WD	08/10/13	SCALE AS SHOWN — REV 0
GIS	LMR	17/10/13	**FIGURE: 4.5-2**
CHECK	AL	17/10/13	
REVIEW	ED	17/10/13	



PROJECT

JAY-CARDINAL PROJECT
LAC DU SAUVAGE,
NORTHWEST TERRITORIES, CANADA

TITLE

CARDINAL KIMBERLITE
PLAN VIEW

DOMINION DIAMOND

PROJECT		13-1328-0031	FILE No.	
DESIGN	WD	08/10/13	SCALE AS SHOWN	REV 0
GIS	LMR	17/10/13	**FIGURE: 4.5-3**	
CHECK	AL	17/10/13		
REVIEW	ED	17/10/13		

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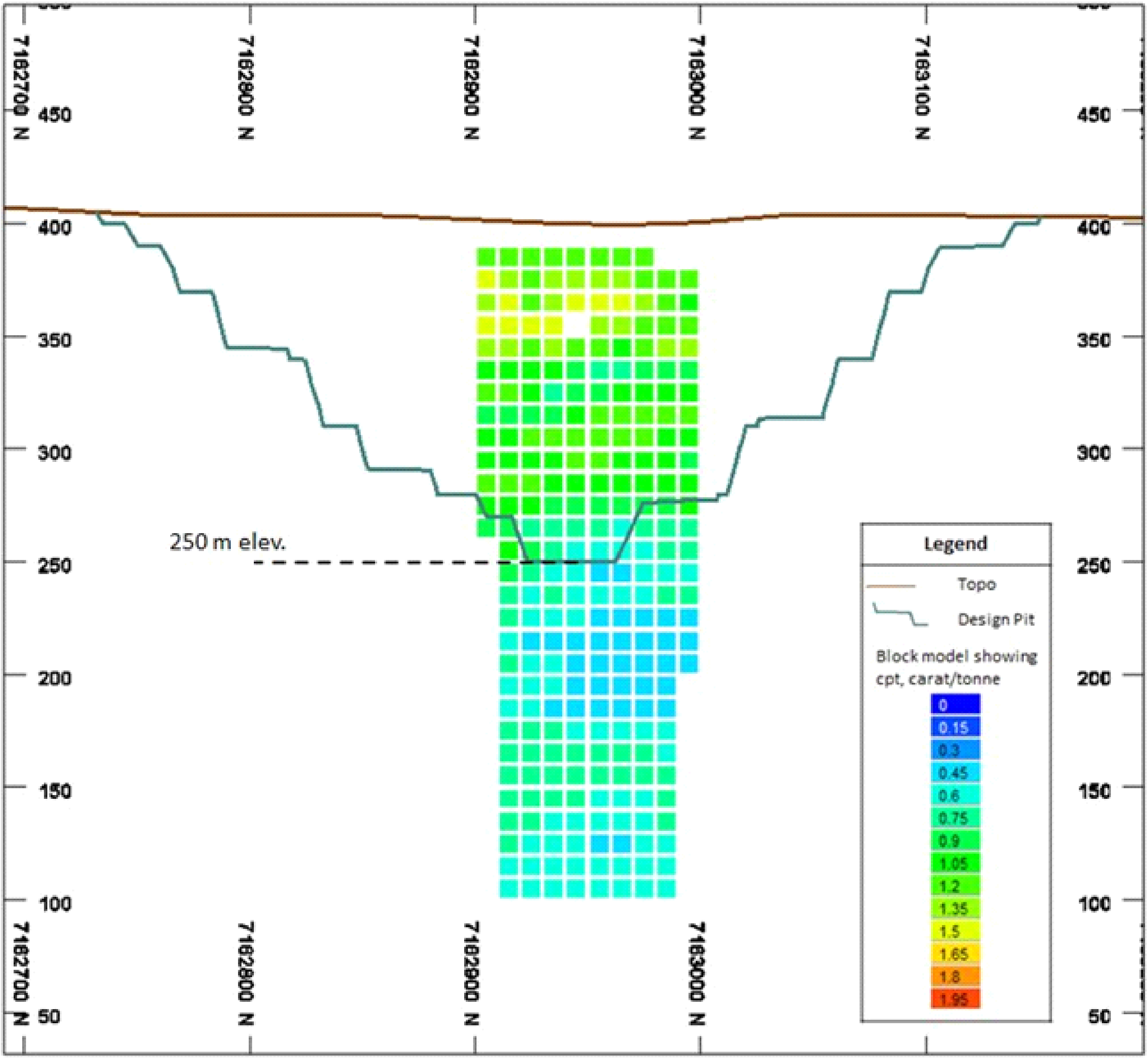

PROJECT	JAY-CARDINAL PROJECT LAC DU SAUVAGE, NORTHWEST TERRITORIES, CANADA
TITLE	**CARDINAL KIMBERLITE ISOMETRIC VIEW**

DOMINION DIAMOND

PROJECT		13-1328-0031	FILE No.	
DESIGN	WD	08/10/13	SCALE AS SHOWN	REV 0
GIS	LMR	17/10/13	**FIGURE: 4.5-4**	
CHECK	AL	17/10/13		
REVIEW	ED	17/10/13		

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4.5.3 Geotechnical Conditions

Geotechnical logging of core from core holes is completed to determine rock mass rating (RMR) according to the Laubscher system. For key holes, core is oriented using an ACT (ACE) tool, and detail structural logging completed. In 2009, an acoustic and optical televiewer system was introduced to augment the structural logging program in waste rocks at the Misery pipe.

The following geotechnical parameters were determined for all core drill holes at Misery:

- percentage core recovery;
- rock quality designation;
- fracture frequency;
- point load strength index; and,
- joint condition and water.

Rock samples are collected following a core drill core sampling procedure and are occasionally shipped for off-site testing at an accredited third-party materials testing facility. Strength index testing included:

- unconfined compressive strength;
- triaxial strength;
- direct strength;
- shear strength;
- Poisson's Ratio; and,
- Young's Modulus Evaluation.

Measurements suitable for the pit wall stability study are obtained with an oriented core device to provide information on the orientation of joints, faults, bedding planes, and other structures.

The RMR system used for logging and mapping at the Ekati Mine is based on the Laubscher RMR system where the following ratings equate to different rock strengths:

- 0-20: Very Poor;
- 21-40: Poor;
- 41-60: Fair;
- 61-80: Good; and,
- 81-100: Excellent.

The major kimberlite lithologies in the Ekati Mine production pipes have a wide range of measured strengths. The kimberlite pipes at the Ekati Mine are mostly situated within granite, a competent host rock.

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An extensive geotechnical characterization has been completed within the Project area, as a result of the local regional mining activities, including that for the Misery Pit. The same four geological units encountered at the Jay site exist at the Misery site. Due to the close proximity of the Jay-Cardinal Project to the Misery Pit (approximately 7 km to the southwest), it is reasonable to assume the country rock properties will be similar in the two sites. The rock mass quality of the Misery site is summarized below.

- Observations in the existing Misery Pit suggest good quality conditions for the granite and fair to good quality for the biotite schist and diabase dike. Few very continuous structures are visible.
- The granite at the Misery site is generally good to very good quality. The quality becomes fair to good near the ground surface. The rock quality of the granite near the diabase dike is generally classified as good, with no increase in fracturing or apparent loss of strength due to alteration visible in the core photos. Increased fracturing is observed in the granite immediately around the kimberlite satellite pipes. A fracture zone surrounding the kimberlite intrusion is less evident in the data for the Misery Pit as compared to the other pipes at Ekati mine. Observations of core do not indicate the presence of significant weak infilled joints or weak altered zones in the country rock in the immediate vicinity of the main pipe.
- Information on the diabase is provided by core photos from two boreholes drilled at the Misery site and observations of the Mackenzie trend diabase dikes elsewhere. This information indicates that the rock is of good quality with a fracture frequency of approximately two or three factures per metre.
- The majority of the metasediment present at the Misery Pit can be classed from fair to good rock mass quality.
- Metasediment is generally the weakest geological unit of the country rocks. Foliation acts as a plane of weakness and results in continuous join surfaces that are generally smooth and planar. Slope behavior within the metasediments will be governed by the foliation orientation, and failure within the rock mass is not expected.

4.5.4 Hydrogeology

The Jay and Cardinal open pits and underground workings are expected to be excavated in unfrozen ground within the Lac du Sauvage talik. Local areas of Lac du Sauvage that contain water may become a source of shallow groundwater inflow to the two pits. In addition, the excavation of the pits may induce the upward flow (referred to as saline upwelling) of deep-seated saline groundwater. The resulting minewater pumped from the open pits and underground workings will be the result of the mixing of fresh water from Lac du Sauvage and groundwater. Minewater will be expected to contain elevated concentrations of chloride, and other ions characteristic of deep groundwater, in relation to the lake water.

The upper levels of the Jay and Cardinal open pits would not be expected to encounter substantive quantities of deep groundwater. As the pits and underground workings are excavated deeper towards the regional base of permafrost (e.g., in the order of 350 m below ground surface), the quantity of deep groundwater encountered in fault zones, and the concentration of characteristic ions such as chloride, may increase. The minewater management plan is described in Section 4.6.6.

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4.5.5 Pit Design

Geotechnical parameters used during open pit mine design include inter-ramp and inter-bench angles, structural domains determined from wall mapping, and geotechnical drilling. Pit wall designs are reviewed using commercially available software so that appropriate wall angles and catch bench widths are safe and efficient. The existing geotechnical information for the Project area, data for the Misery Pit, and the above geotechnical and hydrogeological considerations have been used to design the open pits. Refer to Figure 4.5-5 for a schematic representing the pit slope design process.

4.5.5.1 Jay Open Pit

The conceptual design for the Jay Pit is as follows:

Based on current information, the north, west, and south wall of the planned Jay Pit will be excavated in granite, but the west wall is expected to be mined in metasediments. If the rock masses at the Jay Pit exhibit high strengths and good quality similar to the Misery Pit, failure through the rock masses would be unlikely to occur and the main consideration for rock slope failure mechanisms would be through structurally controlled mechanisms on either a small scale or a larger scale. In this case, the analysis of major joints sets and major structure distribution will be critical for assessing the required slope configuration to control slope kinematics failures.

The Jay Pit will be mined using conventional open pit truck-shovel operations in 10 m bench heights, with a triple bench configuration. A single circular access ramp that is designed at 29.5 m in width is sufficient for two-way traffic, a safety berm, ditch, and will allow for dewatering pipes to be placed along the edge of the road. The ramp will be designed to accommodate 225 t capacity off-road haul trucks.

The footprint of the designed Jay Pit, at the intersection with the topography, is approximately 960 m x 960 m and has an approximate surface area of 700,000 m^2 (70 ha).

4.5.5.2 Cardinal Open Pit

The conceptual design for the Cardinal Pit is as follows:

Based on the current information at the Cardinal site, all of the pit walls will be excavated in granite. If the rock masses at the Cardinal Pit exhibit high strengths and good quality similar to the Misery Pit, failure through the rock masses would be unlikely to occur and the main consideration for rock slope failure mechanisms would be through structurally controlled mechanisms on either a small scale or a larger scale. In this case, the analysis of major joint sets and major structure distribution will be critical for assessing the required slope configuration to control slope kinematics failures.

The Cardinal Pit will be mined using conventional open pit truck-shovel operations in 10 m bench heights, with a triple bench configuration. A single circular access ramp that is designed at 26 m in width is sufficient for two-way traffic, a safety berm, ditch, and will allow for dewatering pipes to be placed along the edge of the road. The ramp will be designed to accommodate 90 tonne capacity off-road haul trucks.

The footprint of the designed Cardinal Pit, at the intersection with the topography, is approximately 420 m x 420 m and has an approximate surface area of 140,000 m^2 (14 ha).

4.6 Jay-Cardinal Primary Project Components and Activities

The Project will use the existing mining infrastructure already in place at the Misery site and the Ekati main camp. The conceptual design of the Project components is described below; however, it will be subject to further refinement based on on-going data collection, community engagement, and design iterations.

4.6.1 Buildings and Infrastructure

4.6.1.1 Truck Shop

The existing truck shop at the Misery site will not be adequate for performing maintenance work on large (225 t) haul trucks; as such, an additional six bay truck shop (30 m x 70 m) will be required at the Misery site. It is expected that the shop can be constructed within the existing Misery infrastructure footprint (Figure 4.6-1). The conceptual design of the truck shop is as follows:

- one wash bay;
- three mobile equipment repair bays;
- one tire repair bay; and,
- one satellite warehouse bay.

The shop will be equipped with overhead crane and lubricant distribution. A new welding shop will be located in the existing truck shop at the Misery site. The new truck shop will use existing services at the site for power, fresh water, discharge water, and sewage at the Misery camp. A stand by area for vehicles will be developed close to the new truck shop.

4.6.1.2 Power Line and Substation

The diesel generators to provide 8 MW of power at the pump locations for the drawdown stages of the Project and 2 MW of power, thereafter, for the life of mining activities to handle runoff collection, pit dewatering, and underground mining are located at the Ekati Mine in the same building as the existing powerhouse.

Power will be delivered to the Project via overhead 550 MCM ACSR (aluminum) transmission lines at 69 kV to limit line losses. The transmission lines will be supported on 60 to 65 foot wood poles, and will be constructed adjacent to the existing road between the Ekati Mine and Misery Camp, and adjacent to the new access roads to the Project.

The power generating facilities currently in place at Misery Camp (three – 750 kW generators) will be retained to provide backup power in the event of power interruptions between the Ekati main camp and Misery Camp. The ability to back feed power to the Ekati main camp will be included in the event power is needed due to maintenance or breakdown of the plant.

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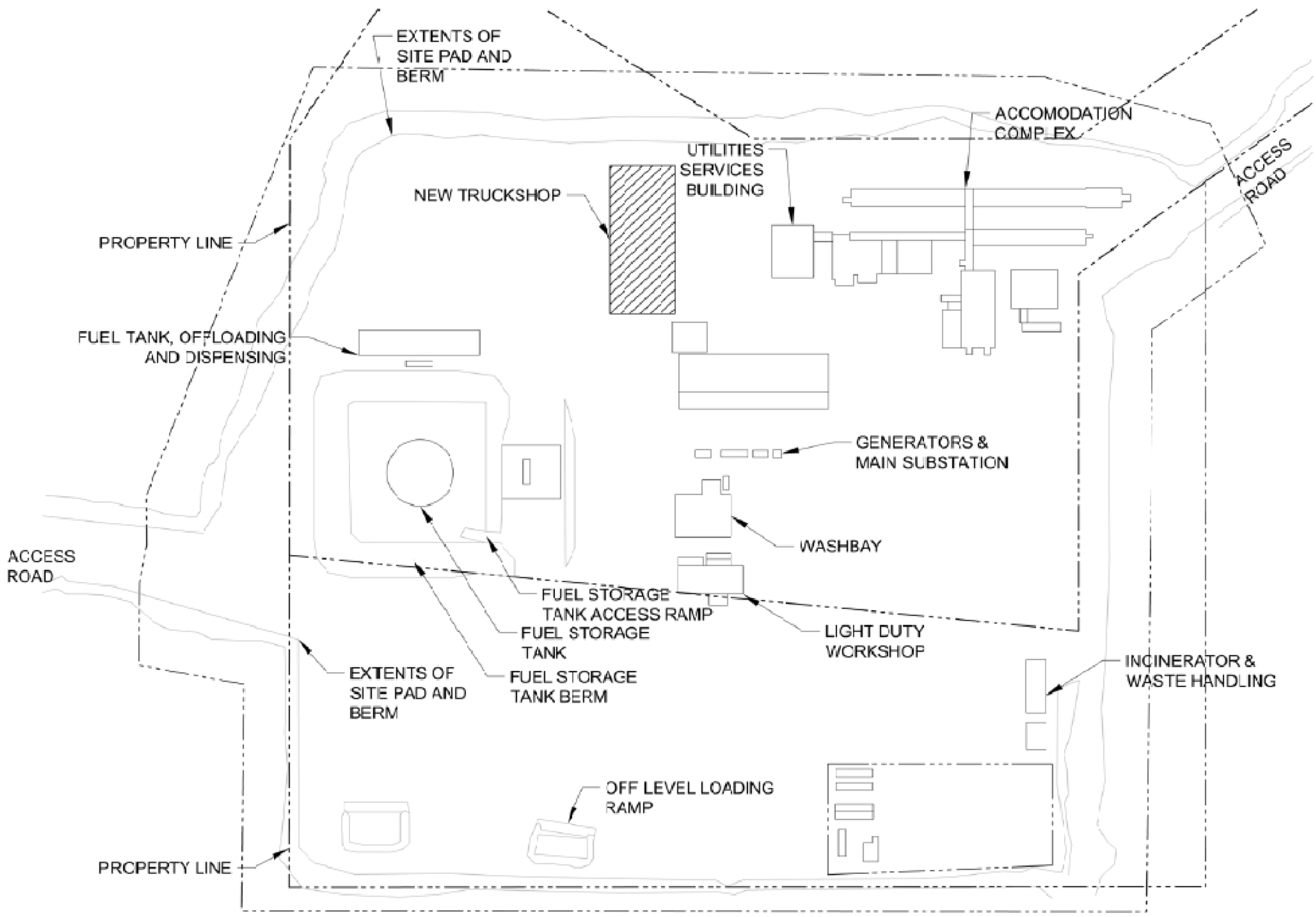

G:\CLIENTS\DOMINION\DDEC Jay and Lynx Projects\Figures\13-1328-0031 Diversion Study\2130 - EIR Process\Jay-Cardinal Project Description\mxd\Fig4.6-1_New_Truck_Shop_at_Misery.mxd

PROJECT	JAY-CARDINAL PROJECT LAC DU SAUVAGE, NORTHWEST TERRITORIES, CANADA			
TITLE	**NEW TRUCK SHOP AT MISERY**			
DOMINION DIAMOND	PROJECT		13-1328-0031	FILE No.
	DESIGN	RC	04/10/13	SCALE AS SHOWN — REV 0
	GIS	RC	04/10/13	**FIGURE: 4.6-1**
	CHECK	AL	04/10/13	
	REVIEW	ED	04/10/13	

Substations will be constructed at the Ekati main camp and Misery Camp to step up power to 69 kV, and at four locations at the Project site on Lac du Sauvage to step down the power to operate the pumps and mining equipment. The substations will be low profile, pad mounted design containing the required components, such as breakers, switches, and controls. The sizes will range from 200 kVA to 3 mVA.

Figure 4.4-2 shows the general location of the transmission lines and the substations, as well as the sizes of the substations.

Site lighting around the Jay Pit and Cardinal Pit may initially be provided by mobile powered light towers similar to the units currently in use at the Ekati Mine.

4.6.1.3 Surface Facilities for Open Pit Mining

A small lunchroom, office, and washroom facility with temporary emergency shelter and supplies will constructed at both the Jay and Cardinal sites. Further, a laydown/truck ready area will also be required.

4.6.1.4 Surface Facilities for Underground Mining

Surface infrastructure near the entrances to the Jay and Cardinal underground workings will include:

- dries;
- substation;
- intake and exhaust fans;
- parking and laydown areas; and,
- for the Jay site a headframe with load-out structure.

This infrastructure is discussed in further detail in Section 4.6.5.

4.6.1.5 Misery Temporary Crusher Station

A temporary crusher station will be set up at the Misery WRSA. This crusher station will be used for crushing granite waste rock required for the roads, dikes, and general construction purposes. This temporary crusher station will produce approximately:

- one million tonnes of - 200 mm material;
- 160,000 tonnes of - 56 mm material; and,
- 420,000 tonnes of -20 mm material.

The crusher station will be electrically powered; a power line will be constructed from a substation at the Misery site to the crusher station.

4.6.1.6 Pumping Stations and Pipelines

The pumping and pipeline systems identified below are described further in Section 4.4.2.1:

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- PS1 Pump Station and a 3.5 km long pipeline pumps water from PS1 Pump Station to the North Arm Water Management Area during lake drawdown and during operations;
- PS2 Pump Station and a 2.3 km long pipeline pumps water from PS2 Pump Station to Lac de Gras during initial lake drawdown and during operations; and,
- PS3 Pump Station and a 1.5 km long pipeline pumps water from the trench along the southwest shoreline of Lac du Sauvage to PS1 Pump Station.

4.6.1.7 Roads and Pads

A number of roads will be constructed to connect the individual components of the Project to the existing winter road, the existing facilities at the Misery site, and the Ekati main camp (Figure 4.4-1). These connector roads will be approximately 30 m wide and will be constructed using granite to a standard that is safe for use by mine operating equipment. While the final routing has not been determined, the following site roads and causeways will need to be constructed:

- an approximately 5.4 km road from the Misery Site to the Cardinal causeway (proposed Cardinal Road);
- an approximately 6.9 km road from the existing Misery Road to the Jay causeway (proposed Jay Road);
- an approximately 4.5 km road from the Jay Road to the Dike JP1 (proposed JP1 Road);
- an approximately 7.2 km road from JP1 dike, to Lake E1 and to construct the Lake E1 Diversion Outlet Channel (proposed Lake E1 Diversion Outlet Channel road);
- an approximately 6.3 km road from Dike JP1 to Dike JP2 (proposed JP2 Road);
- an approximately 0.8 km road between the Dike JP4 North and South (proposed JP4 Road);
- an approximately 4.0 km causeway from the proposed Cardinal Road to the Cardinal Pit; and,
- an approximately 1.2 km causeway from the proposed Jay Road to the Jay Pit.

Small lay-down areas may be constructed at the Jay and Cardinal sites using granite rock. Wherever practical, the existing facilities of the Misery workshop facility will be used.

A temporary kimberlite storage area (location yet to be determined) will be used to store kimberlite from the Jay-Cardinal Project prior to it being hauled to the process plant at the Ekati main camp. The pad will be constructed of granite and built in accordance with practices already implemented at the Ekati Mine.

4.6.1.8 Fuel Storage

Due to the close proximity of Jay-Cardinal Project to the existing Misery fuel storage infrastructure, no additional mobile equipment fuel storage is planned. Mobile heavy equipment will obtain fuel from the Misery dispensing facility per current operating practices.

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4.6.1.9 Quarries

Granite rock in the order of 8 to 10 Mm^3 (either blasted or crushed and screened to various engineering specifications) is required for construction of roads, pads and dikes at Lac du Sauvage. The granite rock for construction will be obtained from one or more local quarries. Once the excavation of granite waste rock is underway from the Jay and Cardinal open pits, the mined rock becomes the source of granite for ongoing maintenance of these facilities.

There are two likely quarry locations for the Jay-Cardinal Project. The primary quarry location would be at the location of the Jay WRSA (option #1). This location could provide the needed quantity of granite rock, and has the advantage of then being completely filled and covered by construction of the Jay WRSA. No reclamation of the quarry would be required. The proposed Lynx WRSA, if constructed, could be an additional quarry location. The waste rock excavated from the proposed Lynx Pit will be granite, which is proposed to be placed as an extension on the northwest side of the existing Misery WRSA. The Lynx Project still requires regulatory approval; therefore, the use of Lynx waste rock is speculative at this time. However, the use of Lynx waste rock could reduce costs and haulage travel times for construction of roads, pads and dikes located in the area of the Cardinal pipe; therefore, would be considered as an additional quarry if available.

4.6.2 Dikes, Ponds, and Channels

The dikes, berms and channels identified below are described further in Section 4.4.2.1;

4.6.2.1 Dikes

- Dike JP1 separates the North Arm from the rest of Lac du Sauvage and creates the North Arm Water Management Area;
- Dike JP2 diverts the inflow from Duchess Arm to Paul Lake through the Lake E1 Diversion Outlet Channel; and,
- Dike JP4 is divided into two sections: JP4 North and JP4 South and diverts natural flow from the east and south catchment areas to Lac de Gras via the natural Lac du Sauvage outlet channel.

4.6.2.2 Berms

- Jay Berms
  - Two berms in the area of the proposed Jay Pit development are required and will be constructed of rockfill and lined with locally borrowed lakebed till from pit pre-stripping if possible. The berms will create sumps to collect local seepage flows, groundwater flow and precipitation and keep the drawn-down lake from the pit area.
- Cardinal Berms
  - Two berms in the area of the proposed Cardinal Pit development are required and will be constructed of rockfill and lined with locally borrowed lakebed till from pre-stripping if possible. The berms will create sumps to collect local seepage flows, groundwater flow and precipitation, and keep the drawn-down lake from the pit area.

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- An additional pumping station will be required in the isolated pond north of Cardinal Pit and below Dike JP4 North to maintain this area at a drawdown level of El. 400m.

4.6.2.3 Channels

- Lake E1 Diversion Outlet Channel diverts inflow from Sub-basin E to Paul Lake and provides an overflow channel from the North Arm Water Management Area allowing discharge into Paul Lake.

4.6.3 Water Diversion and Drawdown

Based on the evaluation of the water diversion and drawdown options available for the Project, there will be three dikes built (JP1, JP2, and JP4 North and South), and three pump stations with associated pipelines (PS1, PS2, and PS3). A discharge structure will be built by the small lake (Ad8) between the North Arm and Lake E1. A water channel will be constructed between Sub-basin E and Paul Lake, the Lake E1 Diversion Outlet Channel.

The general concept of lake drawdown would include pumping to establish an initial drawdown which would provide access to the Jay and Cardinal Pipe areas and allow for construction of local water management infrastructure. During the mine operation period, lake drawdown would be maintained with pumping. During operations is has been assumed that the lake drawdown elevation will fluctuate to allow for some attenuation of spring freshet inflows and as part of turbidity management. During the initial drawdown, all pumped lake water would be discharged into Lac de Gras, either directly if meeting required water quality or through a sediment pond if water quality treatment is required.

Review of the drawdown criterion, the proposed Jay and Cardinal open pits, and the 2013 bathymetry data indicates that the following stages of lake drawdown are required for the project development.

- Initial Lake Drawdown: Pumping to drawdown Lac du Sauvage to EL 406 m (10 m drawdown assuming lake surface at EL 416 m) and expose the lakebed surrounding the Jay and Cardinal Pipes. The initial drawdown is planned to be completed over one year. The total volume includes existing base volume in Lac du Sauvage (between EL 416 m and EL 406 m) plus the volume of annual watershed inflows reporting to the lake during the one-year initial drawdown period. An access road will be advanced towards the proposed pit areas to allow for construction of local water management infrastructure.
- Pit Area Dewatering: Following initial drawdown and development of local water management infrastructure, local pumping at the kimberlite pipes will be required to further drawdown water from EL 406 m down to approximately EL 381 m at the Jay Pipe, and to approximately EL 398 m at Cardinal Pipe. This is required to expose the local areas for open pit development.
- Maintain Lake Drawdown: During mining operations, pumping continues to transfer annual inflows reporting to the drawn-down lake to maintain an operating range between about El 406 and 407 m.

4.6.3.1 Lake Drawdown for Jay Pipe Development

During initial lake drawdown of Lac du Sauvage, a platform to the east of the Jay Pipe will become exposed at about EL 410 m. Drawdown of the lake to EL 406 m will isolate Jay Pipe area from the surrounding west arm sub-basins. Two rockfill causeways to Jay Pit will be constructed from the west

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shore. Sections of these causeways will be lined with till on one side to create sumps within the lake drawdown area which will intercept flows towards the pit area.

4.6.3.2 Lake Drawdown for Cardinal Pipe Development

Most area around the Cardinal pipe will be exposed during the initial lake drawdown to EL 406 m. A rockfill causeway will be advanced from Dike JP4 towards the Cardinal pipe area. Around the Cardinal pipe, two rockfill berms will be advanced to isolate the pipe from other residual ponds. Both berms will require placing compacted till for seepage reduction. With the lake drawdown maintained between El 406 and 407 m, local pumping will be required from the sumps north of Cardinal Pit and below Dike JP4 North.

4.6.4 Open Pit Mining

DDEC will work with DFO and Aboriginal communities to develop a fish-out plan for the drawdown area within Lac du Sauvage. Once fish salvage and drawdown has been completed and the pit can be accessed by heavy equipment, the first step in open pit mining is to remove the overburden material including lake sediments and glacial till that lie within the designed pit perimeter. This will be completed through the use of explosives (if necessary) and standard truck and shovel techniques. As per the established practice at the Ekati Mine, lake bottom sediments will be separated from glacial till and waste rock to the extent practical and stockpiled for possible future use.

Mining of the Jay and Cardinal kimberlite pipes will proceed as an open pit development similar to all of the open pits at the Ekati Mine. The open pits are mined using conventional truck-shovel operations and are developed in benches that are typically 10 m high. Design pit slopes vary and are established based on detailed geotechnical and hydrogeological studies and operational requirements for each pipe.

Production blast holes are 270 mm diameter and drilled on a 6.5 m by 7.5 m equilateral pattern with 10 m bench heights. Wall control blasting practices, including pre-shear firing on the perimeter of the pit excavation, are used to enhance final high wall stability. Wall control procedures on the final pit walls includes drilling 165 mm presplit blast holes on a 2.0 m spacing on the pit perimeter followed by a row of 270 mm wall control blast holes on a 3.0 m burden and 4.0 m spacing. A second row of 270 mm wall control blast holes are placed at a 5.0 m by 5.0 m spacing before switching to the standard production pattern. Further, double or triple benching is used for the final pit walls when in granite. Ongoing high wall stability monitoring is routinely conducted and re-design and/or risk mitigation work is performed as needed.

A single circular access ramp around the perimeter of the pit is developed progressively as the benches are mined. Waste rock is hauled to a WRSA. Kimberlite is either hauled directly from the pit benches to the process plant or, as is done at the Misery Pit and will be the case for the Jay and Cardinal open pits, temporarily stored on a kimberlite storage pad prior to being taken to the process plant in long-haul trucks.

The Jay and Cardinal pits will follow a similar open pit mining method as used at the Misery site. Pit development is anticipated to proceed to a depth of approximately 370 m below grade for the Jay Pit and 160 m for the Cardinal Pit. The anticipated pit dimensions are shown in Figure 4.5-1 and Figure 4.5-2 for the Jay Pit and Figure 4.5-3 and Figure 4.5-4 for the Cardinal Pit.

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4.6.5 Underground Mining

The Jay and Cardinal pipes both have the potential to be mined with underground methods below the proposed pits. However, there is limited geological information in terms of diamond grade, pipe size and shape, and rock strength below the proposed pit bottoms for both pipes. For this reason, a number of assumptions are made based on experience from other similar kimberlite pipes at Ekati and Diavik. The conceptual design of the Jay and Cardinal underground mines are largely based on these assumptions.

4.6.5.1 Mining Method

Both pipes appear to be roughly circular in plan. The upper part of the Jay pipe is carrot shaped in cross section with a moderate reduction of the pipe area down to the bottom of the pit. It is assumed that this carrot shape, typical of many kimberlite pipes, continues at depth. The shape and size of the Cardinal pipe is not well defined. It is assumed the pipe has near vertical pipe walls to a considerable depth.

The Jay pipe is much larger than the Cardinal pipe. The diameter of the Jay pipe at the proposed open pit bottom is about 200 m and the diameter 200 m below the ultimate pit bottom is estimated at approximately 160 m. The Cardinal pipe diameter at the bottom of the proposed pit is assumed to be approximately 60 m and the diameter 150 m below the proposed pit is assumed to be approximately about 50 m.

Indications are that the rock strength is good to very good for waste rock surrounding the pipes and poor to very poor for the kimberlite. The host rocks for the Jay pipe consist predominantly of granites and metasediments, though minor diabase dikes also occur. The Cardinal pipe is entirely enclosed by granite. Based on experience from other pipes in the region, it is reasonable to assume that the kimberlite strength increases with depth. RVK forms the upper parts of the two pipes and typically is less dense and has lower strength than the VK found deeper in the pipes. The underground mine will most likely be entirely located in VK.

This combination of high wall rock strength, low kimberlite strength and steeply dipping sides makes block caving an attractive mining method. Experience from the Koala underground workings indicates that the freshet period (i.e., increased water movement into the kimberlite due to spring thaw) can cause the extracted ore to be very wet to the point that transportation to surface with a long inclined conveyor belt, as is done at Koala, becomes difficult. For this reason, all conveyor belts are conceptualized as being installed flat in the Jay underground workings, with vertical hoisting of the cave material to surface. The Cardinal underground workings will be substantively smaller than the Jay underground workings. Therefore, in the Cardinal underground workings, cave material will be trucked to surface with trucks specially designed to haul wet ore.

Wet ore in the draw points also has the potential to cause mud rushes and mud pushes. In the Koala workings, mitigating efforts in terms of diverting as much surface run off water from entering the pit and the underground workings below are used. For Jay and Cardinal, these mitigating efforts will be implemented before underground mining begins.

Block caving requires a certain size of the ore body (hydraulic radius) to be successful. The size has to be large enough for the rock to cave. The proposed underground Jay workings most certainly are large enough to cave at the extraction level pipe diameter of 160 m and the slightly larger undercut level. For the Cardinal underground workings, it is less certain that the hydraulic radius (approximately 50 m) is

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large enough for the cave to be successfully established. In this case, vertical drill holes would be drilled from the completed pit bottom once the undercut is completed. The lower 2 to 3 m of these pre-drilled blastholes would be progressively blasted to aid the caving process. This method is called vertical crater retreat.

The schematic Figures 4.6-2, 4.6-3, 4.6-4, and 4.6-5 illustrate this mining method as applied to the Jay and Cardinal kimberlite pipes.

4.6.5.2 Construction and Development

The Cardinal Pit is significantly smaller than the Jay Pit and consequently will be finished earlier. The block caving method allows development but limited production before the pits have to be abandoned. The pit floor will be used to drill near vertical holes for instrumentation to control the draw. In the case of Cardinal, vertical drill holes will also be required to assist the cave front.

Main ramps will be collared and driven down to the extraction level, 200 m below the pit floor at Jay and 150 m below the pit floor at Cardinal. The slopes of the main ramps will be 1:7. Safety bays to allow safe passage for personnel on foot meeting rolling equipment, muck bays, and temporary sumps will be developed along the ramp. Ventilation raises will be developed in stages as the ramps advance and will be used to supply fresh air during development, and later on during production. A short distance before the ramp reaches the extraction level an uphill ramp will connect to the undercut level.

In the Jay workings, an underground crusher station will be excavated and connected via a flat conveyor drift to a hoisting shaft drilled from surface.

Undercut drifts and haulage drifts will be developed simultaneously. The undercut, draw point, and draw bells will be sequenced so that the undercut is developed slightly ahead of the draw points and draw bells. The Jay development will have approximately 90 draw points and the Cardinal development will have 6 draw points.

Underground workshops, refuge stations, explosive magazines, sumps, and pump stations will complete the underground development.

The extraction level will be surfaced with high strength concrete and mucking will be with remote controlled scoop trams.

Surface installations at both mines will include substations, a small dry at the Cardinal site and a larger dry at the Jay site, exhaust fans and fresh air fans with oil fired air heating. In addition, the Jay site will have a head frame with a load out facility. Parking and laydown areas will be constructed at both locations.

The total time for construction and development for the Jay underground workings is estimated at 4.5 years and 3 years for the Cardinal underground workings. Most of this development can be done simultaneously with operations in the pits.

All underground development will be with drill and blast methods. Weaker parts of excavations will be reinforced with roof bolts, mesh, shotcrete and possibly spilling. The development waste and ore will initially be transported with underground trucks to surface and deposited on temporary pads. Surface

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trucks continue the transport of waste to designated waste rock storage areas. Ore will be transported to the Ekati Mine process plant.

Underground drilling will be with electro-hydraulic drill rigs, loading of holes with mechanized loaders, blasting with centralized computerized systems, loading with diesel powered loaders, and hauling to surface with diesel powered trucks. Mechanized roof bolters will be used to install roof bolts and screens, mechanized shotcrete equipment will be used for shotcrete placement. The service vehicles will include scissor lift, fuel and lube trucks, flat beds, surface and underground personnel carriers, and ambulances. This is standard underground mining equipment that has been used at the Ekati Mine and other Northern mines.

At later stages of the development at Jay, once the hoisting shaft is in operation, ore and waste will be hoisted to surface rather than trucked.

The work crews will be housed at Misery camp and a bus service will be established from Misery to the two dries at Jay and Cardinal.

There will be mine rescue teams at both Jay and Cardinal and these teams will train regularly and participate in mine rescue competitions.

During the development phase, underground mining at Jay is anticipated to produce approximately 400,000 tonnes of kimberlite and 280,000 tonnes of waste. Underground mining at Cardinal will produce approximately 40,000 tonnes of kimberlite and 200,000 tonnes of waste.

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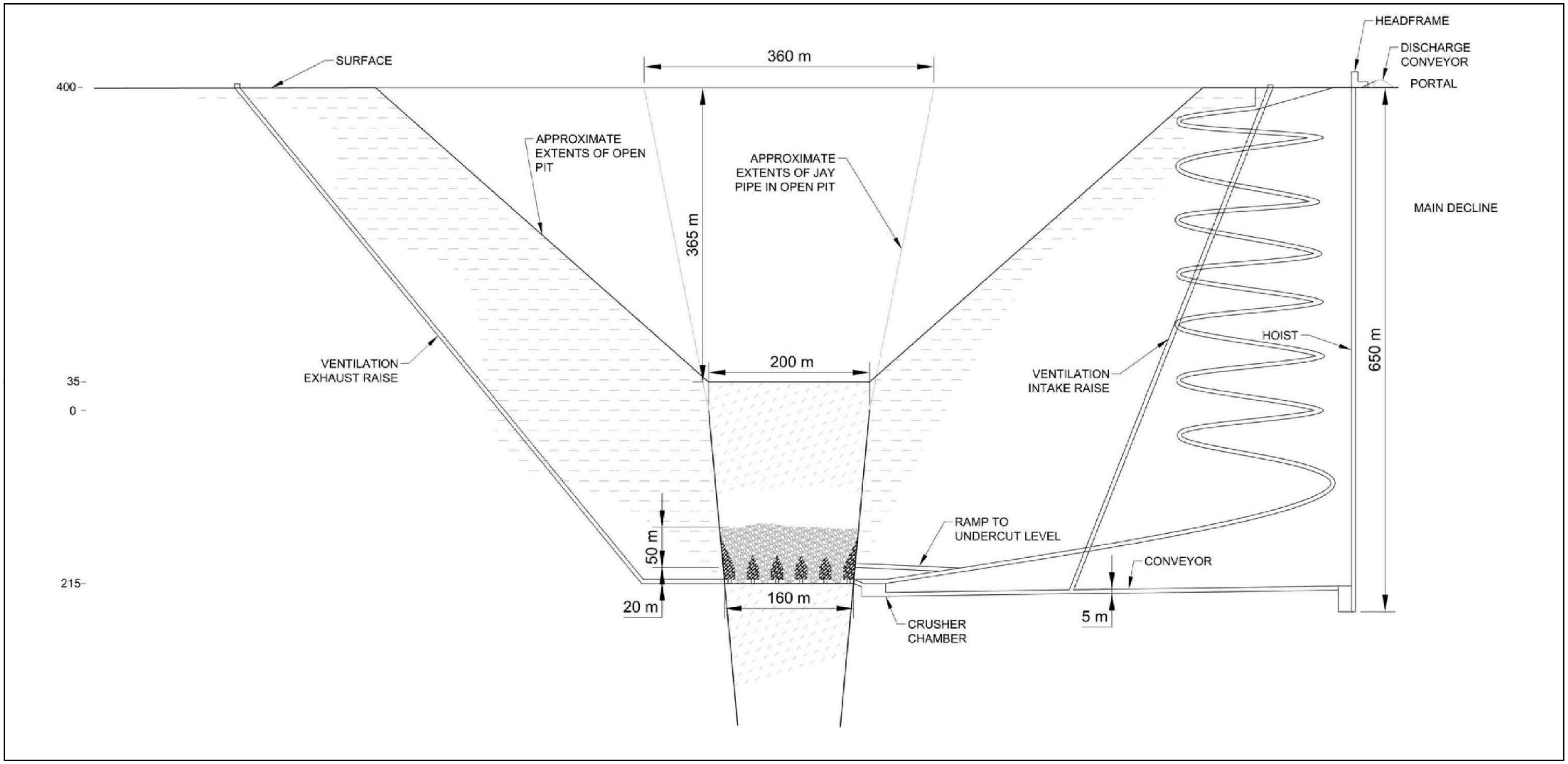
G:\CLIENTS\DOMINION\DDEC Jay and Lynx Projects\Figures\13-1328-0031 Diversion Study\2130 - EIR Process\Jay-Cardinal Project Description\mxd\Fig4.6-2_Jay_UG_Schematic_Cross-Section.mxd



PROJECT	
	JAY-CARDINAL PROJECT LAC DU SAUVAGE, NORTHWEST TERRITORIES, CANADA
TITLE	
	JAY UNDERGROUND SCHEMATIC CROSS-SECTION

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PROJECT		13-1328-0031	FILE No.	
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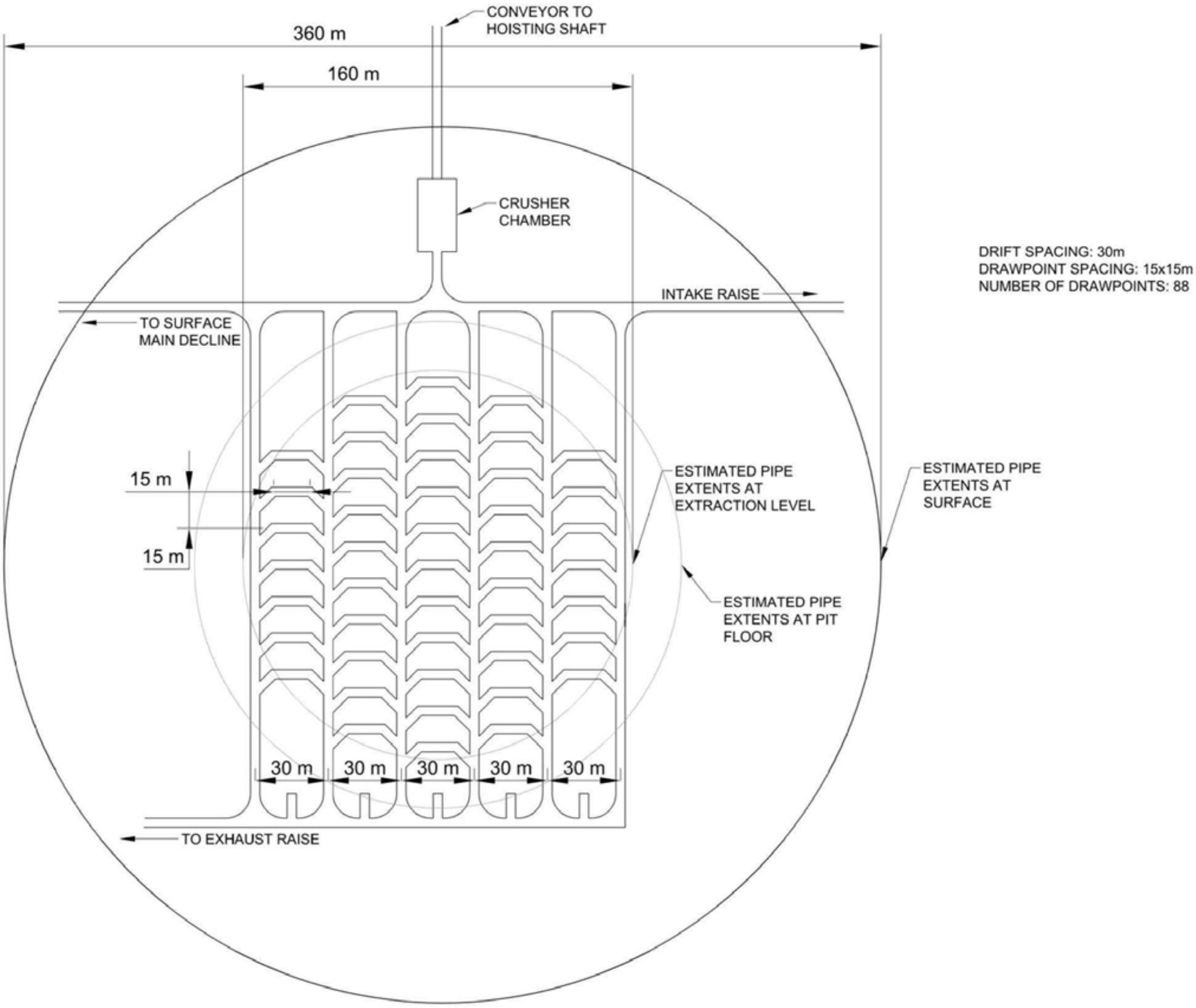
CHECK	AL	17/10/13	**FIGURE: 4.6-2**	
REVIEW	ED	17/10/13		



PROJECT

JAY-CARDINAL PROJECT
LAC DU SAUVAGE,
NORTHWEST TERRITORIES, CANADA

TITLE

JAY UNDERGROUND
SCHEMATIC EXTRACTION LEVEL

DOMINION DIAMOND

PROJECT		13-1328-0031	FILE No.	
DESIGN	WD	08/10/13	SCALE AS SHOWN	REV 0
GIS	ANK	17/10/13	**FIGURE: 4.6-3**	
CHECK	AL	17/10/13		
REVIEW	ED	17/10/13		

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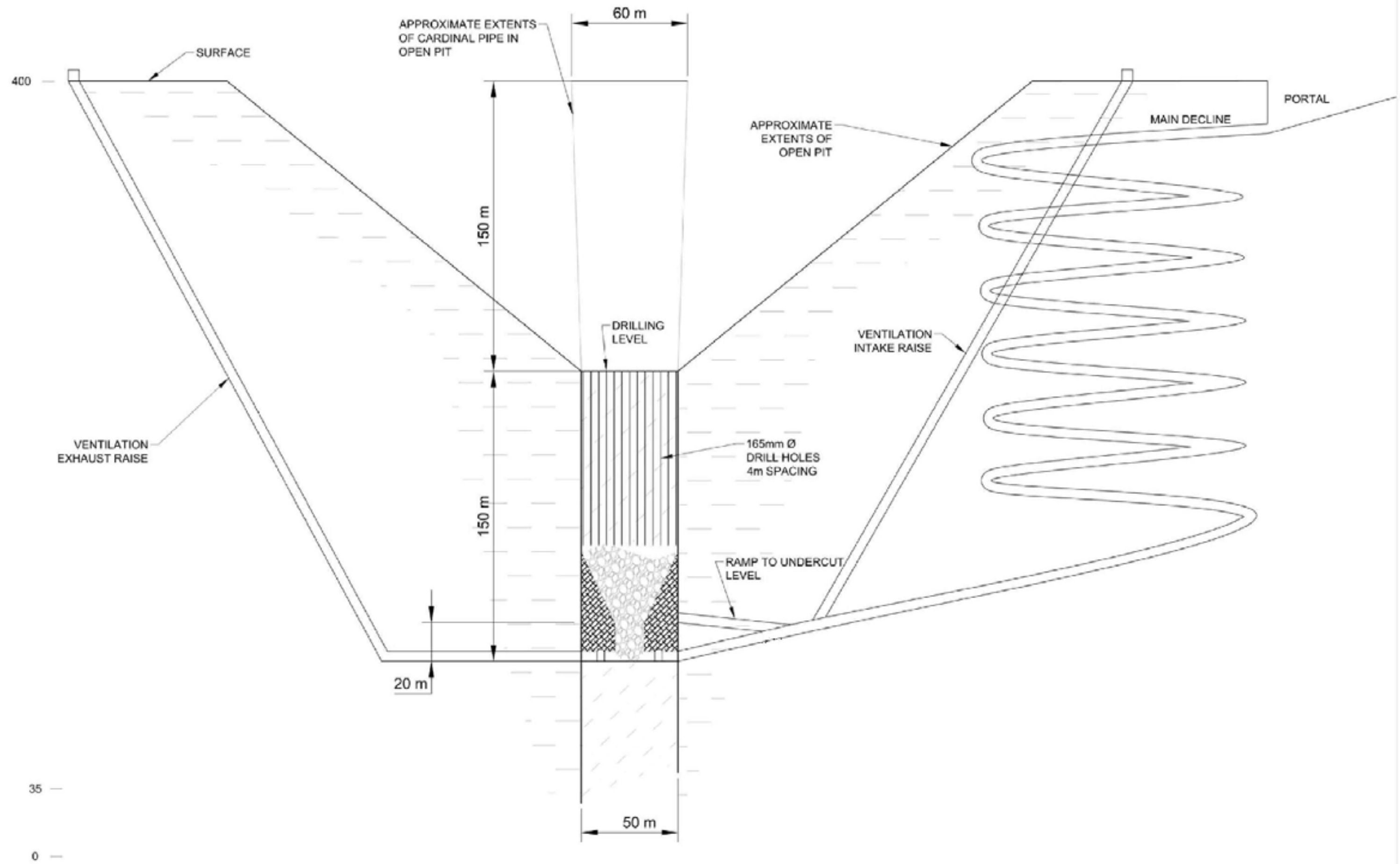

PROJECT
JAY-CARDINAL PROJECT
LAC DU SAUVAGE,
NORTHWEST TERRITORIES, CANADA

TITLE
CARDINAL UNDERGROUND SCHEMATIC CROSS-SECTION

DOMINION DIAMOND

PROJECT		13-1328-0031	FILE No.	
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CHECK	AL	17/10/13	**FIGURE: 4.6-4**	
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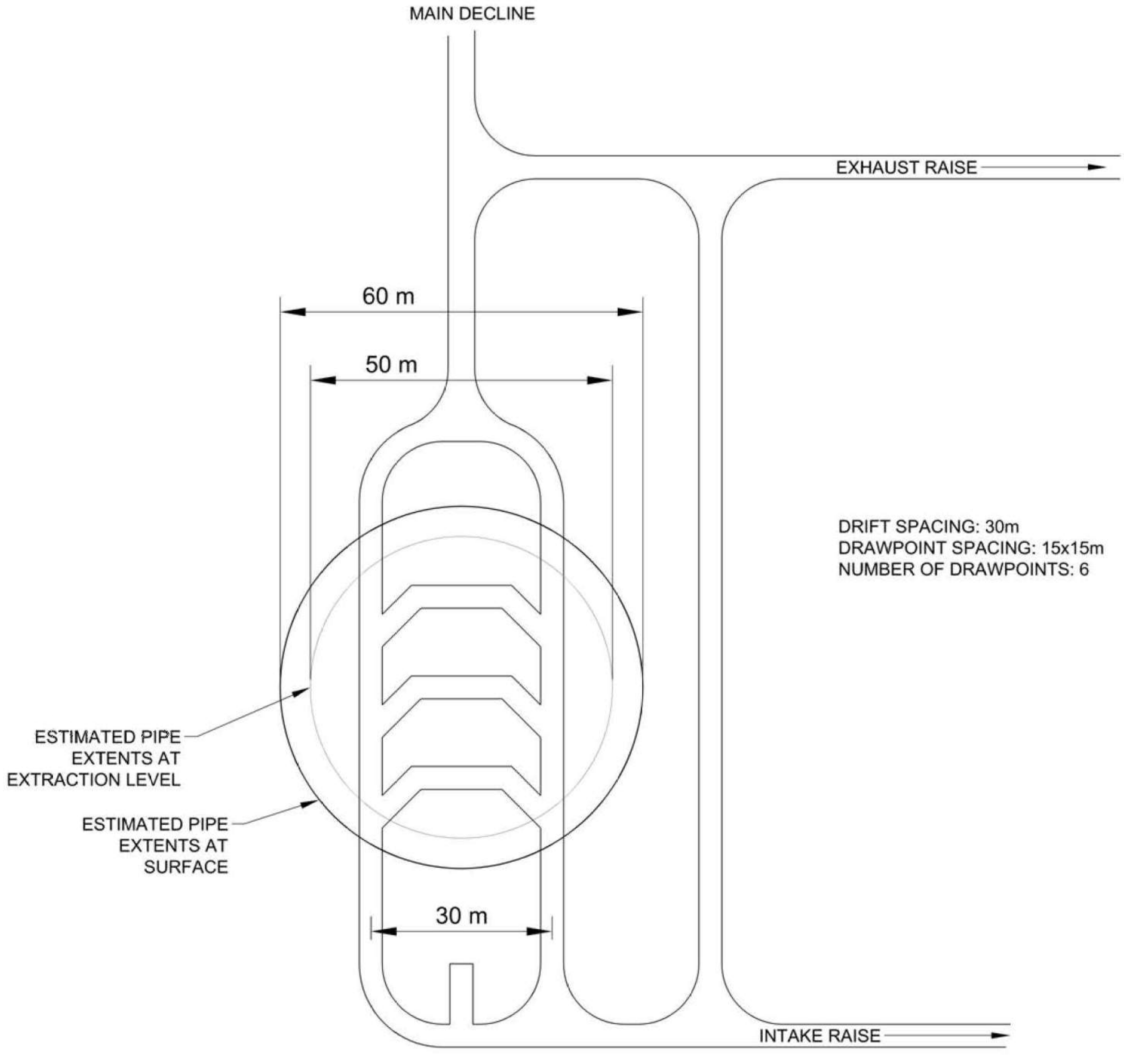

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PROJECT

JAY-CARDINAL PROJECT
LAC DU SAUVAGE,
NORTHWEST TERRITORIES, CANADA

TITLE

CARDINAL UNDERGROUND
SCHEMATIC EXTRACTION LEVEL

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PROJECT		13-1328-0031	FILE No.	
DESIGN	WD	08/10/13	SCALE AS SHOWN	REV 0
GIS	ANK	17/10/13	**FIGURE: 4.6-5**	
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REVIEW	ED	17/10/13		

4.6.5.3 Production

Production will commence once the underground mines are commissioned. The equipment will be similar to that used for the development. In addition, at the Cardinal site a surface long hole drill will be used to drill the vertical crater retreat holes. Once production starts in a block cave mine very little waste is produced. At the Jay site only secondary blasting will be performed. There will be primary vertical crater retreat blasting along with secondary blasting at the Cardinal site.

The production period for the Jay underground workings will be 6 years with a maximum production of 3.3 million tonnes of diamond-bearing kimberlite for processing per year for a total of 14.4 million tonnes. Based on current estimates, the Cardinal underground workings will produce a total of 0.7 million tonnes of diamond-bearing kimberlite for processing over a period of approximately a year and a half.

4.6.6 Drawdown and Minewater Management

During the initial stages of Lac du Sauvage water level drawdown, clean water will be pumped to Duchess Lake, Lac de Gras, or the south area of Lac du Sauvage. Operating experience at the Ekati Mine suggests that TSS concentrations in the pumped water may increase beyond accepted levels during the final stages of drawdown. This risk may be lower for Lac du Sauvage drawdown than for the previous programs of complete lake dewatering. Nonetheless, sediment levels will be monitored and, if necessary, the late stages of drawdown will be pumped exclusively through the North Arm Water Management Area for settlement of solids.

The estimated volume of water to be pumped from Lac du Sauvage is 305,000,000 m^3 during the initial drawdown, then 38,000,000 m^3 each year during operations. Respectively, the average daily volume of water to be discharged in relation to the Project is anticipated to be 835,616 m^3 and 54,800 m^3. A drawdown plan will be prepared specifically for Lac du Sauvage and will be submitted to the WLWB. The freshwater intake pumps will operate in accordance with standards developed in consultation with DFO.

Minewater pipelines will be constructed from the open pits to local sediment ponds contained within the drawn-down lake and then on to the North Arm Water Management Area. The pipeline would be operated year round. The pipelines will also be used in the future for pumping underground minewater.

A preliminary water balance for the Jay and Cardinal controlled area during operation is shown in Table 4.6-1 for mean annual conditions. The controlled area is defined as the drawn-down area of Lac du Sauvage and surrounding land areas draining to that area, within which runoff is managed.

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Table 4.6-1 Preliminary Monthly Water Balance for Jay-Cardinal Project Controlled Area (Mean Annual Conditions)

	Inflows (m^3)							Outflows (m^3)		
	GW Inflow[a]		Dike Seepage		Precipitation		Total Inflows	EVAP	Pumping[b]	Total Outflows
Month	Jay	Cardinal	JP1	JP4	Direct	Runoff				
January	223,200	120,900	84,932	365,205	140,831	0	935,068	0	935,068	935,068
February	201,600	109,200	76,712	329,863	146,849	0	864,225	0	864,225	864,225
March	223,200	120,900	84,932	365,205	196,200	0	990,437	0	990,437	990,437
April	216,000	117,000	82,192	353,425	230,426	58,295	1,057,337	0	1,057,337	1,057,337
May	223,200	120,900	84,932	365,205	377,116	10,605,402	11,776,755	0	11,776,755	11,776,755
June	216,000	117,000	82,192	353,425	690,619	2,127,213	3,586,448	1,294,527	2,291,921	3,586,448
July	223,200	120,900	84,932	365,205	1,016,522	3,131,044	4,941,803	2,452,788	2,489,015	4,941,803
August	223,200	120,900	84,932	365,205	1,280,401	3,943,833	6,018,471	1,612,481	4,405,990	6,018,471
September	216,000	117,000	82,192	353,425	856,205	2,637,243	4,262,064	794,885	3,467,179	4,262,064
October	223,200	120,900	84,932	365,205	519,264	160,893	1,474,394	0	1,474,394	1,474,394
November	216,000	117,000	82,192	353,425	311,754	0	1,080,370	0	1,080,370	1,080,370
December	223,200	120,900	84,932	365,205	207,033	0	1,001,270	0	1,001,270	1,001,270
Annual							37,988,642			37,988,642

a) Groundwater inflow values are based on preliminary estimates of 7,200 m^3/d for Jay Pit and 3,900 m^3/d for Cardinal Pit. The water balance assumes that the quality of groundwater inflow to the pits will be acceptable for release to local settling ponds or the remnant waters of Lac du Sauvage. If groundwater is not acceptable, it will be managed as a separate stream.

b) These values differ from those in the lake drawdown alternatives report because they consider additional contributing areas, including pit inflows and dike seepage.

GW = Groundwater; EVAP = Evaporation; m^3 = cubic metres

The North Arm Water Management Area acts as a sedimentation cell; residence time in the facility improves the water quality, which will be released into the receiving environment (Lake E1 into Paul Lake and then into Lac de Gras) once it meets discharge limits specified in the Water Licence.

In summary, the drawdown and minewater management plan consists of the following:

- Drawdown water clear of sediment will be pumped to the natural environment (Duchess Lake, Lac du Sauvage, and/or Lac de Gras);
- Late stages of drawdown water, if containing elevated sediment, will be pumped to the North Arm Water Management Area for settlement of sediment prior to discharge;
- Annual pumping from the drawn-down lake area will be pumped to the natural environment (Duchess Lake, Lac du Sauvage) if clear of sediment and compliant with the Water Licence;
- Annual pumping from the drawn-down lake area, if not compliant with the Water Licence, will be pumped to the North Arm Water Management Area for settlement prior to discharge;
- Minewater from the Jay and Cardinal open pits and underground workings will be pumped to local sediment ponds contained within the drawn-down lake and then on to the North Arm Water Management Area for settlement prior to discharge;
- Water Licence Effluent Discharge Criteria would be derived on a site-specific basis using the site-specific water quality objectives, as applicable, that are already available for the Ekati Mine;

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- During mine operations, Points of Compliance under the Water Licence would be:
  - discharge from the North Arm Water Management Area to Lac de Gras via Paul Lake and Lake E1 and,
  - water pumped from pumping station PS1 to Lac du Sauvage at Dike JP4.

Minewater management during operations will follow an adaptive management approach, as is the established practice at the Ekati Mine. The Ekati Mine Water Licence requires that a documented Aquatic Response Framework be provided to the WLWB in February 2014. The WLWB-approved Response Framework will be expanded in the future to include the Jay-Cardinal Project. The expanded Response Framework will outline possible response actions for water quality upsets related to the Jay-Cardinal Project. One of the possible response options would be a minewater treatment facility located at the North Arm Water Management Area. Such a facility could be designed to remove sediment or metals and ions from minewater, as necessary, to meet discharge criteria. The potential need for a minewater treatment facility will be assessed during future stages of project design and review, in conjunction with the on-going refinement of anticipated minewater volumes and characteristics. Together the Response Framework and the existing Ekati Mine AEMP will be expanded to incorporate the Jay-Cardinal Project.

4.6.7 Waste Rock Storage Area

Waste rock and overburden excavated from the Jay and Cardinal pits will be stored in two WRSAs located on the shore of Lac Du Sauvage. The existing Ekati Mine Waste Rock and Ore Storage Management Plan, including seepage monitoring, will be expanded in the future to incorporate the Jay and Cardinal WRSAs. The final heights of the WRSAs is planned to not be greater than 50 m above the underlying ground, which is consistent with established practices at the Ekati Mine.

The Jay WRSA will be located west of the Jay Pit on the shore of Lac du Sauvage. The Jay WRSA has been designed to accommodate a volume of 113 Mm^3, covering an area of 292 ha. Waste rock from the Jay Pit and underground workings will be mainly granite with some metasediments and overburden. Granite has been demonstrated, and accepted, over the past 15 years of operation at the Ekati Mine, as non-acid generating and non-metal leaching. At this time, the Jay metasediment is assumed to have the same geochemical classification as the metasediments at the Misery site, namely potentially acid generating. Metasediment will be managed at the Jay WRSA with the same objectives as the Misery WRSA, that the metasediment is frozen into permafrost beneath an encapsulating cover of 5 m thick granite. The proportions of granite versus metasediment to be mined from the Jay Pit provide ample granite for this cover layer.

The Cardinal WRSA will be built on the shore of Lac du Sauvage adjacent to the Cardinal access road. The Cardinal WRSA has been designed to accommodate a volume of 11 Mm^3, covering an area of 37 ha. Waste rock from the Cardinal Pit and underground workings is entirely granite.

4.6.8 Processed Kimberlite Tailing Deposition

Processing of the Jay and Cardinal kimberlite is expected to generate approximately 60 Mt of FPK. The Panda and Koala open pits are the primary deposition locations for processed kimberlite resulting from the Project. The use of mined-out open pits for processed kimberlite deposition has been generally acknowledged as a preferred approach dating back to the original Environmental Assessment in 1996.

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The concept has been demonstrated viable and beneficial through the current use of the mined-out Beartooth Pit for this purpose. Cell D of the LLCF will also be used as a contingency or emergency deposition location for FPK. The Ekati Mine Wastewater and Processed Kimberlite Management Plan, which already anticipates the use of Panda and Koala open pits for FPK deposition, will be updated to incorporate the Jay-Cardinal Project.

4.6.9 Closure and Reclamation

The Ekati Mine is required under its Water Licence and Environmental Agreement to have a closure plan. Version 2.4 of the Ekati Mine Interim Closure and Reclamation Plan (ICRP) was approved by the WLWB in November 2011 (BHP 2011). An annual reclamation update report is provided to the WLWB.

The ICRP describes the Ekati Mine reclamation goal, reclamation objectives, reclamation methods, and required reclamation research that encompass the entire Ekati Mine and all reclamation requirements. The reclamation goal is to return the Ekati Mine site to viable, and wherever practicable, self-sustaining ecosystems that are compatible with a healthy environment, human activities, and the surrounding environment.

Reclamation activities are described in the ICRP according to the following six categories:

- open pits;
- underground workings;
- waste rock storage areas;
- processed kimberlite containment areas (surface impoundments and mined-out open pits);
- dams, dikes, and channels; and,
- buildings and infrastructure.

The Jay-Cardinal Project introduces some necessary changes to the Ekati Mine ICRP, primarily new reclamation activities at Lac du Sauvage and a new pit flooding approach for the Panda and Koala open pits. The ICRP and the resulting reclamation security will be readily amended to address the Jay-Cardinal Project.

The approach to reclamation of the primary components of the Jay-Cardinal Project, and the conceptual changes to the Ekati ICRP resulting from the Jay-Cardinal Project are described below. DDEC views the development of specific closure plans related to the Jay-Cardinal Project as a progressive process that will evolve in detail and specificity throughout the Environmental Assessment and Regulatory Permitting processes.

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4.6.9.1 Approach

The approach to reclamation of the Jay-Cardinal Project components at Lac du Savage that achieves the established Ekati Mine reclamation goal is as follows:

- natural lake water levels are re-established;
- natural flowpaths are re-established (i.e., diversions are removed);
- local fish are able to naturally re-enter Lac du Sauvage; and,
- residual portions of in-lake dikes are environmentally neutral or have positive effects.

Other components of the Jay-Cardinal Project such as WRSAs, roads, pads and other infrastructure will be reclaimed according to the methods described in the Ekati Mine ICRP.

4.6.9.2 Open Pits

Reclamation of the Jay and Cardinal open pits will involve removal of buoyant or hazardous materials, and submergence beneath Lac du Sauvage. In each case, removal of equipment from the open pit can begin upon completion of open pit mining activities, and flooding with water can begin upon completion of underground mining activities. It would not be possible to introduce water into the open pits while underground mining is taking place in the lower areas of that kimberlite pipe.

The shape and location of the Jay and Cardinal open pits as very deep holes in the bottom of a much larger and generally shallow lake creates the likelihood of long-term meromixis within the submerged open pits. That is, an area of ionically dense water is likely to form in the deeper parts of the open pits that does not mix with the overlying lake water. The primary cause of this occurrence is likely to be the presence of sub-permafrost connate (ancient) groundwater in the open pits. Connate groundwater contains elevated concentrations of dense ions such as chloride that form a density gradient resulting in meromixis. The absence of other key drivers of seasonal lake mixing such as penetrating wave turbulence and sunlight would also favour the formation of meromixis. Because meromixis would result in this denser water remaining within the submerged open pits, this water would be prevented from having a negative influence on water quality in overlying Lac du Sauvage.

Surface and underground mining in the Cardinal kimberlite pipe is scheduled to be completed much earlier than in the Jay kimberlite pipe. Flooding of Cardinal surface and underground mining is expected to take place while the jay kimberlite pipe is still being mined. This would be accomplished by siphon to provide a controlled flow of water into the Cardinal Pit. The source area for freshwater would be the Lac du Sauvage east catchment.

4.6.9.3 Underground Workings

The Jay and Cardinal underground workings will be reclaimed according to the methods described in the Ekati Mine ICRP. Reclamation will focus on removal of buoyant and hazardous materials, and sealing of openings to surface. This work can begin upon the completion of underground mining activities (either wholly or in completed areas of the workings), and will be completed prior to general filling of the workings and open pits with water.

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4.6.9.4 Waste Rock Storage Areas

The Jay and Cardinal WRSAs will be reclaimed according to the methods described in the Ekati Mine ICRP. Reclamation will focus on providing a thermally protective surface cover over potentially acid generating materials (i.e., metasediment rock), providing a relatively flat upper surface that discourages snow accumulation, and providing for wildlife safety through caribou emergency egress ramps.

For the Cardinal WRSA, the placed rock will be entirely granite. For the Jay WRSA, the proportion of granite waste rock (approximately 75%) is more than sufficient to provide for a minimum 5 m thick cover of granite, which will maintain permafrost within the underlying metasediment rock.

4.6.9.5 Processed Kimberlite Containment Areas

The Panda and Koala open pits are the primary deposition locations for processed kimberlite resulting from the Jay and Cardinal Project. As described in Section 4.6.8, the use of mined-out open pits for processed kimberlite deposition has been generally acknowledged as a preferred approach dating back to the original Environmental Assessment in 1996. The concept has been demonstrated viable and beneficial through the current use of the mined-out Beartooth Pit for this purpose. The Panda and Koala open pits will be available for processed kimberlite deposition when Jay kimberlite is processed because mining activities will have been completed in the Panda/Koala underground workings.

The design constraint for in-pit deposition of processed kimberlite will remain at a maximum elevation of 30 m below the final pit lake overflow elevation. This design constraint is taken from the initial discussions of the concept in the 1996 Environmental Assessment. During permitting by the WLWB of processed kimberlite deposition into the mined-out Beartooth Pit in 2012, the Ekati Mine's technical consultant (Robertson Geoconsultants) considered 30 m to possibly be unnecessarily overly-conservative. Therefore, DDEC could conduct additional technical studies in future to optimize a site-specific depth of water required over fine processed kimberlite for closure and reclamation.

Reclamation of the Panda and Koala open pits would proceed by pumping freshwater into the pits as a 'cap' overlying the processed kimberlite. This pumping scenario is an improvement over the current Ekati Mine ICRP because substantively less freshwater is required (i.e., approximately 19 Mm^3 versus the current approximately 80 Mm^3), which reduces requirements from the source lakes. Other aspects of reclamation of the Panda and Koala open pits would proceed as described in the Ekati Mine ICRP.

Cell D of the LLCF will serve as a contingency deposition location for processed kimberlite from the Jay-Cardinal Project. This is an essential back-up measure that prevents mine shutdown in the event of line blockage or breakage between the process plant and the primary deposition locations, Panda and Koala open pits. This approach is consistent with the WLWB-approved Ekati Mine Wastewater and Processed Kimberlite Management Plan in that this approach continues to preferentially defer or, if practical, avoid processed kimberlite deposition into Cell D. Any residual processed kimberlite beaches in Cell D would be relatively small in extent and would be reclaimed according to the methods described in the Ekati Mine ICRP.

4.6.9.6 Dams, Dikes and Channels

The three in-lake dikes at Lac du Sauvage (e.g., JP1/North Arm, JP2/Duchess Lake, and JP4/Lac du Sauvage) will be strategically breached. Considerations for the breaches are as follows:

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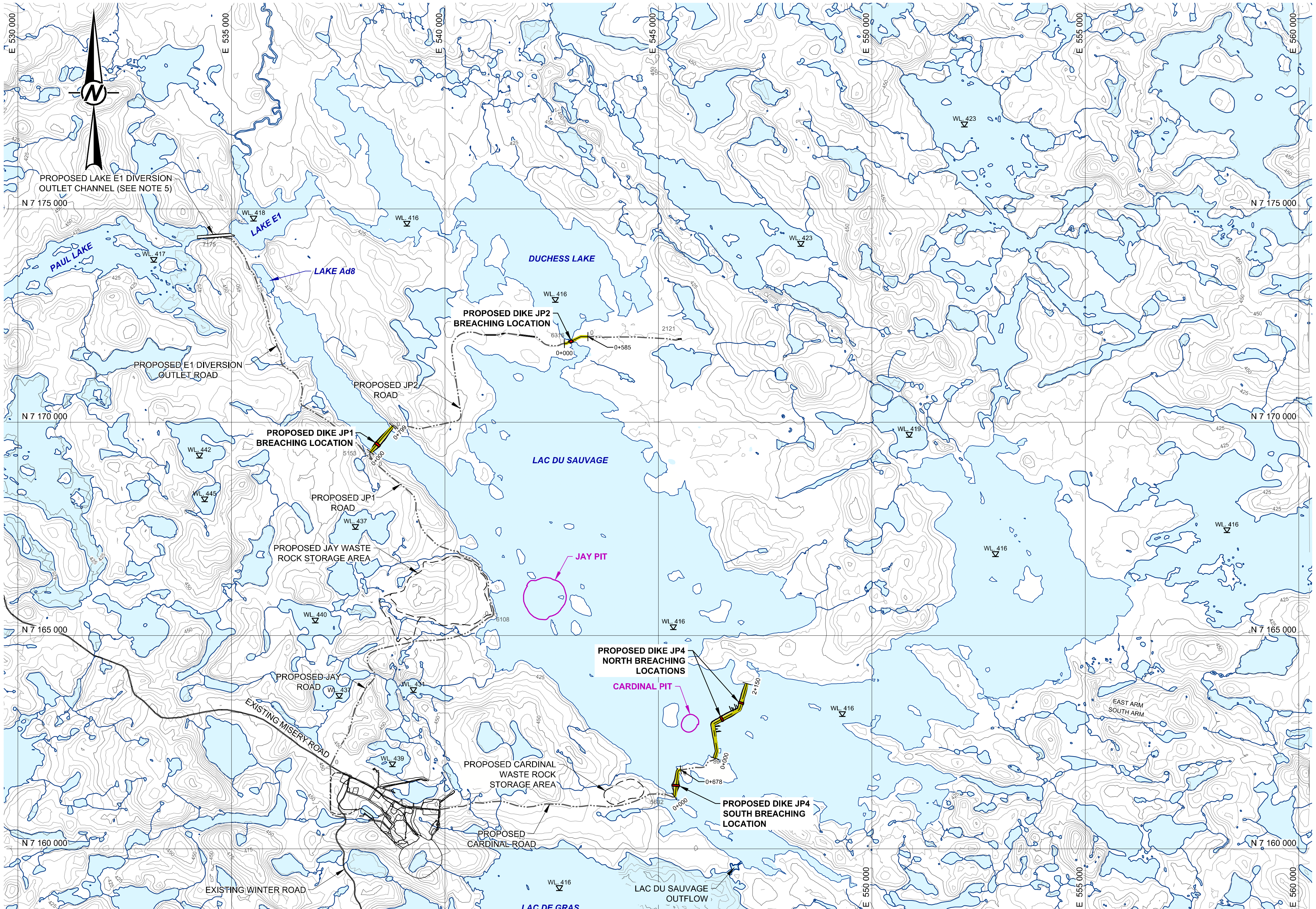
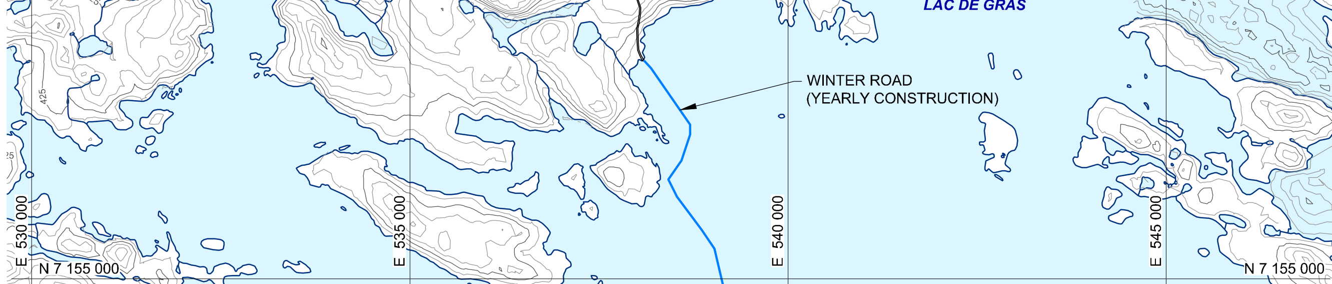
- The water level on the upstream sides of the dikes cannot effectively be drawn-down to enable the breaching work to be completed ‘in-the-dry’. Therefore, water levels will be approximately equalized on both sides by breaching Dike JP2 prior to breaching the remaining dikes after completion of the surface and underground mining of the Jay Pipe. A water flow control structure will be placed in the Dike JP2 breached area to control the flow of water into the main body of Lac du Sauvage where required. By breaching Dike JP2, the source area for freshwater will be the watershed of Duchess Lake. This is a standard engineering approach for this nature of work.
- Dike JP2 will be breached to the original channel elevation. The excavated material (blasted granite rock) from the dikes will be locally placed in a safe manner that is consistent with the current Ekati Mine ICRP.
- Based on current information, it will take about three years for the drawn-down Lac du Sauvage area to flood back to the current lake water levels (416 masl) after completion of mining the Jay and Cardinal kimberlite pipes.
- During excavation of the breaches, silt curtains or other sediment/turbidity mitigation measures will be utilized to reduce risks to water quality where necessary.
- Dikes JP1 (North Arm) and JP4 (Lac du Sauvage) will be breached at one or more locations to approximately 5 m below the minimum water level at Lac du Sauvage. A schematic sketch of the breaching concept is provided in Figure 4.6-6. Excavated materials (crushed granite rock) will be locally placed to extend shallower areas on the residual sides of the dikes and breaches.
- Rip-rap rock or other appropriate erosion mitigation measures will be installed as necessary to provide for long-term physical stability of the dike breach slopes.

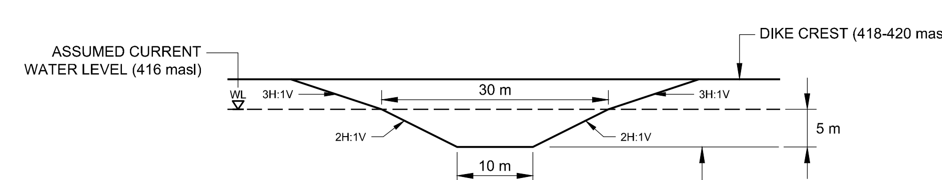
All equipment and installations within the final area of Lac du Sauvage will be removed. This will include the flow control structures, in-lake pump stations, pipelines, and all related items. Residual portions of dikes and access roads will be the only mine components remaining within the lake.

The riparian (shoreline) and littoral (shallow) areas around the perimeter of Lac du Sauvage at its re-established water elevation will be reclaimed where necessary to enable natural regrowth of riparian and aquatic vegetation. The reclamation work is envisioned to include localized repair of erosion, and re-vegetation of select areas with aquatic and riparian plants. This work will be based on experience gained through operations and closure of other areas of the Ekati Mine.

The E1 Diversion Outlet Channel will be made safe for movement of wildlife, particularly caribou, and people. This may include filling the channel with crushed rock, till, or other materials. Water will not enter the backfilled channel from the upstream end (i.e., Lake E1) because the channel invert elevation will remain above the re-established elevation of Lake E1. Incidental runoff into the backfilled channel will evaporate, freeze in-place, or slowly filter through the backfill towards Paul Lake. This incidental water will not be a long-term environmental risk because of the small quantity and use of environmentally inert backfill.

PLAN
SCALE: A



DIKE BREACHING PROFILE
SCALE: B

LEGEND

- WATER BODY
- PROPOSED DIKE LOCATION
- WATER COURSE
- EXISTING ROAD
- PROPOSED ROAD
- PROPOSED PIT LOCATION
- WATER LEVEL ELEVATION
- DIKE BREACHING

NOTES

1. ALL UNITS ARE IN METRES UNLESS OTHERWISE NOTED.
2. GROUND SURFACE CONTOURS ARE SHOWN AT 5 m INTERVALS AND BATHYMETRY CONTOURS ARE SHOWN AT 1 m INTERVALS.
3. COORDINATES ARE SHOWN IN DATUM: NAD 83, PROJECTION: UTM ZONE 12.
4. PROPOSED ACCESS ROADS AND DIKES ARE SHOWN FOR ALTERNATIVE 5.
5. PROPOSED E1 DIVERSION OUTLET CHANNEL WILL BE CLOSED FOR MINE CLOSURE AND RECLAMATION.

REFERENCES

1. CONTOUR DATA PROVIDED BY AURORA GEOSCIENCES LTD., FILE: compilation_Elev_Gridded.xyz, DATE RECEIVED: JULY 30, 2013, IS BASED ON CANVEC DATA UPDATED WITH 2013 RTK SURVEYS IN SELECTED AREAS.
2. JAY PIT MODEL: GOLDER ASSOCIATES LTD., 2013. PRELIMINARY MINE DESIGN - JAY PROJECT. SUBMITTED TO DOMINION DIAMOND CORPORATION, DATED OCTOBER 3, 2013. REFERENCE NO: 1313280031-003-R-REV0-4000. (FILE NAME: Jay_CAT793_str.dxf)
3. CARDINAL PIT MODEL: GOLDER ASSOCIATES LTD., 2013. PRELIMINARY MINE DESIGN - CARDINAL PROJECT. SUBMITTED TO DOMINION DIAMOND CORPORATION, DATED OCTOBER 8, 2013. REFERENCE NO: 1313280031-008-R-REVB-4001. (FILE NAME: Cardinal_pitshell_design_str.dxf).

0	20	40	60

SCALE: B — METRES

0	2,000	4,000	6,000

SCALE: A — METRES

PROJECT

JAY-CARDINAL PROJECT
LAC DU SAUVAGE
NORTHWEST TERRITORIES, CANADA

TITLE

SCHEMATIC OF DIKE BREACHING CONCEPT

DOMINION DIAMOND

PROJECT No.	13-1328-0031	213050	FILE No.	1313280031-2130-50-13
DESIGN	IM	2013-10-10	SCALE AS SHOWN	REV 0
CADD	JD	2013-10-10	FIGURE	
CHECK	-	-		
REVIEW	-	-	4.6-6	

4.6.9.7 Buildings and Infrastructure

Buildings and infrastructure, including roads and pads, will be reclaimed according to the methods described in the Ekati Mine ICRP. This will include removal of the overhead power line and power poles. The on-land portions of dikes associated with Dike JP2 (Duchess Lake) will be reclaimed as roads as described in the Ekati Mine ICRP.

4.6.9.8 Monitoring and Maintenance

Monitoring against closure and reclamation objectives and necessary maintenance of the reclaimed facilities will continue for a period of time after completion of the reclamation work. The schedule and program for monitoring an maintenance will be designed to complement the post-reclamation monitoring schedule already developed for the existing Ekati Mine ICRP. Monitoring of the physical stability of dike breaches and water quality monitoring at the outlet of Lac du Sauvage are anticipated.

4.6.9.9 Sequencing

The schedule for reclamation of certain existing facilities at the Ekati Mine will change as a result of the Jay-Cardinal Project. The primary changes to the timing of reclamation of existing Ekati Mine facilities will be as follows:

- Reclamation of the Ekati Mine camp, process plant, airstrip, tank farm, Misery road, certain components of the Misery site infrastructure, and other required operating facilities cannot be undertaken until the completion of mining and processing related to the Jay-Cardinal Project. At that time, reclamation would proceed as described in the Ekati Mine ICRP.
- Filling of the Panda and Koala open pits with freshwater cannot be undertaken until in-pit deposition of processed kimberlite is completed. At that time, final filling with freshwater can proceed.
- Reclamation of the upper areas of the LLCF (Cells A, B, and C) can proceed as described in the Ekati Mine ICRP in conjunction with the Jay-Cardinal Project. The continuation of Ekati Mine operations in the absence of processed kimberlite deposition into these areas is a positive factor for reclamation of these areas. The on-going availability of operational resources for a 10-20 year period will improve DDEC's ability to undertake the necessary research, reclamation, and monitoring/adaptive management activities at an appropriately staged pace and with the full support of those operational resources.
- Reclamation of the lower areas of the LLCF (Cells D and E) cannot be undertaken until the completion of mining and processing related to the Jay-Cardinal Project. Cells D and E are required for contingency processed kimberlite deposition (Cell D only) and for minewater management/discharge. At that time, reclamation can proceed as described in the Ekati Mine ICRP.

The timeframe for completion of reclamation activities related to or dependent on the Jay-Cardinal Project is envisioned to be in the order of five years after completion of mining and processing activities, and after a determination that there is no remaining, economically viable kimberlite resource. This would be followed by a reclamation monitoring period.

The general sequence of events is envisioned as follows:

- Initial Work:

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- Reclamation of Cardinal open pit and underground workings (removal of equipment), followed by flooding (planned to be completed during mine operations), r;
- Reclamation of Jay open pit and underground workings (removal of equipment);
- Reclamation of pump stations and facilities within the drawn-down area Lac du Sauvage;
- Installation of Lac du Sauvage water recharge equipment (pipes, siphons, pumps, etc.);
- Installation of Panda and Koala open pits freshwater pumping equipment; and,
- Initiation of final reclamation of surface facilities not needed for on-going reclamation.

- Water Recharge and Reclamation Work:
  - Breaching of Dike JP2;
  - Recharge of water into the drawn-down area of Lac du Sauvage, including the Jay open pit and underground workings;
  - Pumping of freshwater into Panda and Koala open pits; and,
  - Reclamation of surface facilities not needed for on-going reclamation.
- Breaching of Lac du Sauvage Dikes and Completion of Reclamation Work:
  - Strategic breaching of Dikes JP1 and JP4; and,
  - Completion of reclamation of surface facilities not needed for on-going monitoring.
- Reclamation Monitoring and Progressive Relinquishment of Liabilities.

4.7 Employment and Spending

Operating staff at the Ekati Mine will have the opportunity for long-term extended employment through the Jay-Cardinal Project. In 2012, the Ekati Mine provided over 1,300 person-hours of direct employment, of which 52% was Northern and 27% was Northern Aboriginal. Over the 13 years from 1999 to 2012, the Ekati Mine has provided over 17,000 person-hours of direct employment, of which 59% has been Northern and 31% Northern Aboriginal. This provides an indication of the tremendous value in direct employment of a substantive extension of the Ekati Mine through the Jay-Cardinal Project.

Similarly, direct business spending will be extended through the Jay-Cardinal Project. In 2012, the Ekati Mine direct business expenditures totaled $400M, of which 67% was Northern and 27% was Aboriginal businesses. Over the 13 years from 1999 to 2012, the Ekati Mine direct business expenditures totaled $5.3B, of which 76% was Northern and 26% was Aboriginal businesses. This provides additional indication of the tremendous value in direct business expenditures of a substantive extension of the Ekati Mine through the Jay-Cardinal Project.

Given that the Jay-Cardinal Project is an open pit, and later underground operation using similar methods to current mining operations, additional personnel may not be needed to support operations. However, additional open pit mining and construction personnel, and contractors are likely to be needed during construction and open pit mine development activities. For example, the current development of the Misery push-back open pit provided approximately $27M to a Northern Aboriginal business in 2012.

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The Ekati Mine SEA sets targets for northern and northern Aboriginal hiring at 33% and 15% (or 44% of the total northern employment target), respectively, during construction, and at 62% and 31% (or 50% of the total northern employment target), respectively, during operations. The Ekati Mine SEA establishes a target of 70% northern purchase of goods and services.

The Ekati Mine has performed well against these, and other, targets and reports on its performance annually.

The 2012 Year in Review Report described the Ekati Mine's prominent role in building NWT communities through financial and in-kind support to numerous community organisations, and discusses how the development of communities and community programs, and the mine itself, considers the culture of the region. Dominion plans to continue support for initiatives that promote the sustainable development of communities and culture around the mine.

The Ekati Mine IBAs establish requirements for funding, training, preferential hiring, business opportunities, and communications.

Dominion works towards focusing employment and economic benefits on Northern and Northern Aboriginal people and businesses. Dominion's location of its head office and senior corporate personnel in Yellowknife, NWT, is a demonstration of this drive. Dominion will continue to work to meet the northern business procurement targets outlined in the Ekati Mine SEA, thereby continuing sustained business opportunities for northern goods and services providers during the life of the Jay-Cardinal Project.

4.8 References

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5.0 COMMUNITY ENGAGEMENT

5.1 Pre-Application Engagement

DDEC's community engagement process is based on open and honest engagement with people affected by our operations, and considering their views in our decision-making process. The primary regulatory guidance document followed is the *Engagement Guidelines for Applicants and Holders of Water Licences and Land Use Permits June 1, 2013*, issued by the Land and Water Boards of the Mackenzie Valley.

The pre-application community engagement for the Jay-Cardinal Project was an extension of the on-going community engagement undertaken for operation of the Ekati Mine. Specifically, discussion of the Jay-Cardinal Project was an integral part of the community engagement undertaken by Dominion in its role as new operator of the Ekati Mine. Engagement concentrated on Aboriginal groups that have Impact and Benefits Agreements (IBAs) with the Ekati Mine, as well as the Federal and Territorial regulatory agencies and the IEMA. Engagement has previously been conducted on all aspects of the Ekati Mine as part of the environmental assessment and regulatory processes, including the issuance of the most recent Renewal Water Licence in August 2013.

From the time of the announcement that Dominion would purchase the Ekati Mine in November 2012, Dominion has been clear and transparent about its intent to extend the operating life of the Ekati Mine. From November 2012 to close of the business transaction in April 2013, two to three meetings were held with the leadership of each of the Ekati Mine IBA groups: Tłı̨chǫ, Inuit of Kugluktuk, Akaitdene (Yellowknives and Lutsel K'e), and North Slave Metis. At each of these meetings, Dominion's intention to extend the operating life of the Ekati Mine was clearly articulated.

Following the close of the business transaction in April 2013, Dominion, now operator of the Ekati Mine as DDEC, immediately initiated a "Phase 1" series of engagement meetings with the leadership of the Ekati Mine IBA groups. The purpose of these meetings was to build on the intent previously conveyed and to share DDEC's ideas on what some of the potential future projects might be at the Ekati Mine. In April and May 2013, each IBA group was sent a letter of introduction from DDEC as operator of the Ekati Mine, and an in-person meeting was held with the leadership of each group.

At the same time that DDEC initiated environmental and engineering studies of possible future projects, it also initiated a "Phase 2" series of engagement meetings with the leadership and, in some cases, staff of the Ekati Mine IBA groups. The purpose of these meetings was to provide progressively more details about possible future projects, even while those possible projects were under conceptual development. This represents the transparent approach that DDEC is following in all of its community engagement programs. DDEC is sharing its ideas and concepts at the outset of their development. From June through September 2013, two or three additional meetings were held with the leadership or, in one instance, staff of each of the Ekati Mine IBA groups. These meetings included specific discussion of the Project and of DDEC's intent and schedule for this Water Licence Application.

In October 2013, prior to submission of its application, DDEC hosted a technical information meeting to which staff from all of the Ekati Mine IBA groups and local regulators were invited. At this meeting, DDEC presented the information contained in its submission with the intent of facilitating the initial stages of Project review.

The initial feedback from the engagement meetings has consistently identified priority areas of interest:

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- caribou, specifically caribou movement through the Lac du Sauvage outlet narrows and the esker on the west side of Lac du Sauvage;
- water quality and flow directions, specifically changes in water flows or water quality entering Lac de Gras through the north (Duchess Lake) diversion;
- fish and fish habitat; and,
- reclamation.

These topics, as they apply to the Project, are addressed through project design, and the environmental mitigation and monitoring measures described in this report.

The engagement record for this application is appended as Appendix 5A: Dominion Diamond Ekati Corporation Engagement Registry, September 2013. Each meeting was attended by DDEC's senior management, primarily Dominion Chief Executive Officer Bob Gannicott and President Responsible for Human Resources and External Affairs Brendan Bell.

5.2 Community Engagement Plan

DDEC undertakes numerous community engagement activities on a routine basis as part of its management of the Ekati Mine. The engagement activities range from formal IBA meetings with leadership from each of the Ekati Mine IBA groups to site-based activities wherein leadership, elders and youth are invited to visit the Ekati Mine for site visits or to take part in the environmental monitoring programs. There are also a number of routine report submissions to the WLWB, all of which are posted to the Board's public registry where any party can provide comment or questions. Under the terms of the newly renewed Water Licence for the Ekati Mine, DDEC will provide a 'Community Engagement Plan' to the WLWB by January 2014 that describes DDEC's community engagement activities in the manner described in recently-issued Board Guidelines.

On-going engagement on the Jay-Cardinal Project will be incorporated into the already well-established and on-going engagement activities of the Ekati Mine. This is an effective means of approaching a project that is a direct extension of the mining activities that have been undertaken at the Ekati Mine for the past 15 years. This approach is also an efficient use of all parties' resources and capacity.

The environmental assessment and regulatory permitting processes that will be undertaken for the Jay-Cardinal Project also provide for community engagement specific to the Project. DDEC anticipates that there will be written exchange of comments, technical workshop(s), a Public Hearing, and possibly other forms of engagement that comprise the Project review. These engagements will form the basis of the 'evidence' heard by the WLWB in their decision-making and, so, constitutes critically important engagement for the Project that DDEC will fully support.

In addition to the Boards' engagement/review process, throughout the regulatory review of the Project DDEC will conduct engagement meetings on its own initiative. These are likely to involve all communities and agencies at certain times, and would be for the purpose of discussing Project-related topics that are outside of the WLWB's mandate or pursuing Project-specific details that are of most interest to certain parties.

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The key engagement activities that will be used to incorporate on-going engagement about the Project are as follows:

- environmental assessment and regulatory permitting processes led by the WLWB;
- additional Jay-Cardinal Project engagement meetings throughout the WLWB's regulatory review process;
- IBA meetings with IBA community leadership;
- annual community presentations on environmental monitoring programs;
- twice yearly routine implementation meetings with the IEMA, plus other ad hoc meetings throughout the year (typically four to five meetings);
- annual Elder/youth site visits for environmental monitoring programs (typically 2-3 site visits);
- Water Licence and Environmental Agreement Annual Report, which is provided in plain language and which is circulated to all parties and communities for comment;
- quarterly meetings of the Ekati Mine Inter Agency Coordinating Team, one of which is typically held at the Ekati Mine;
- site inspections and reports of the AANDC Water Inspector, which are carried out on behalf of the WLWB and which are posted to the Board's public registry; and
- annual site visit by the WLWB.

These engagement activities equally involve all of the Ekati Mine IBA groups and other parties. Past environmental assessment processes and the Environmental Agreement document the Company's commitment to continue work on Traditional Knowledge (TK) projects and to work hard to incorporate TK into environmental management.

The recent focus of the Ekati Mine's TK programs has been Aboriginal engagement in the environmental programs at the Ekati site, and the continuation of community-based TK and community engagement projects. The overall intent of these programs is to demonstrate and provide hands-on-experience for community members (Elders, adults, and youth) in gaining a general awareness as active participants on how the Ekati Mine Environment Department conducts its day-to-day environmental monitoring programs. Additionally, over the past two years, with support from the Ekati Mine, local community organizations have initiated and facilitated successful community TK projects to preserve, share and promote their TK and to provide a lasting, meaningful benefit to their communities.

The goal for Dominion going forwards is to strengthen relationships with local Aboriginal groups through on-going community engagement and enhanced TK programs that respect values, beliefs, knowledge, and experiences, and that build on the on-going success of the community environmental engagement programs.

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6.0 ENVIRONMENTAL RISKS

6.1 Introduction

This section identifies, at a conceptual level, potential Jay-Cardinal Project interactions and describes the approach that will be used to assess potential Project interactions and corresponding potential effects to Valued Components (VCs). The section considers factors including information from baseline studies, effects predictions from previous assessments (BHP and Dia Met 1995; BHP 2012), results from existing monitoring and follow-up programs, the Project Description (Section 4), and existing conditions in the DDEC Ekati claim block. Although all potential Project-environment interactions will be evaluated, the intent is to focus on those interactions with the greatest potential to result in residual effects to VCs of the biophysical and socio-economic environments.

The general approach to the design of the Project is to make use of existing Ekati Mine facilities to the extent practical, thereby limiting the introduction of new environmental risks and reducing costs. The new facilities that are required for mining of the Jay and Cardinal kimberlite pipes are:

- aggregate quarry (i.e., borrow source) for granite construction material;
- local access roads and power line to the Jay and Cardinal pipes and to the water management structures;
- construction of three dikes and a diversion structure to isolate the portion of Lac du Sauvage containing the Jay and Cardinal kimberlite pipes;
- two WRSAs;
- local small support buildings;
- Lac du Sauvage pumping systems; and,
- excavation of the Jay and Cardinal open pits and underground developments (with ore haulage to the existing process plant).

Some components and activities associated with the proposed Jay-Cardinal Project have already been subject to environmental assessment (BHP and Dia Met 1995; BHP 2012). For example, new processing facilities or camp facilities are not required as part of the Jay-Cardinal Project. The socio-economic benefits of the Ekati Mine will be maintained with Jay-Cardinal Project approval.

All pit construction and operations activities have been completed at other locations at the Ekati Mine. In addition, multiple monitoring programs are currently in place for the Ekati Mine and adaptive management has been applied to address effects that were different from original predictions or those not anticipated in the original assessment. Existing plans and monitoring programs for the Ekati Mine that will be extended to include the Jay-Cardinal Project are listed and explained in Section 6.3.

6.2 Valued Components

6.2.1 Selection of Valued Components

Valued components represent physical, biological, cultural, social, and economic properties of the environment that are considered to be important or of concern by the proponent, government agencies, Aboriginal peoples, and the public. The value of a component not only relates to its role in the ecosystem,

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but also to the value placed on it by humans. The concept of using VCs as a fundamental aspect of environmental assessment in Canada, and elsewhere, was established approximately 30 years ago (Beanlands and Duinker 1983). Examples of physical properties that can be considered VCs include air quality, groundwater, hydrology, and soil. Aquatic and terrestrial biota represent biological properties that can be considered VCs. Traditional and non-traditional uses of plants and wildlife and other biophysical properties (e.g., ecological services or resources) can be VCs of the cultural and socio-economic environment.

A number of biophysical VCs have been defined and used for previous assessments (BHP and Dia Met 1995; BHP 2012) and will be used for the assessment of effects for the Jay-Cardinal Project. Human VCs are also defined for the Jay-Cardinal Project. The final list of VCs for the Jay-Cardinal Project and rationale for the selection of these VCs is provided in Table 6.2-1.

Table 6.2-1 Valued Components Selected for the Project

Category	Valued Component	Rationale for Selection
Air	Air quality	• used in previous assessments • close link between air quality and other VCs (i.e., surface water quality, fish habitat, soils, vegetation, wildlife, and people)
Water	Surface Hydrology	• used in previous assessments • changes to surface hydrology can affect other VCs (i.e., fish, vegetation/wildlife habitat, wildlife, and surface water quality)
	Water Quality and Aquatic Life Other than Fish	• used in previous assessments • the distribution, abundance, and productivity of the invertebrates that make up a large proportion of the prey of fish and the algae they depend on are influenced by changes to water quality • changes to water quality can affect other biophysical and socio-economic VCs that depend on suitable surface water quality (i.e., fish, vegetation, wildlife, human health)
	Fish	• used in previous assessments • a subsistence food, a source of recreation for local communities • have historical cultural value • important indicators of the health of aquatic ecosystems as they are at the top of the food chain in aquatic environments and are a food source for some large wildlife • a vital part of traditional life in the region and continue to be prepared for consumption based on local cultural practices
Land	Groundwater	• used in previous assessments • local thawing of the permafrost layer due to the Jay-Cardinal Project can result in movement of water and an interaction with the sub-permafrost groundwater aquifer • changes to groundwater can affect quantity and quality of surface water, which can subsequently affect the aquatic and terrestrial environments and people that use these resources
	Permafrost	• used in previous assessments • the Project footprint may cause local disturbances to the permafrost layer resulting in changes in hydrological patterns and terrain stability

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Table 6.2-1 Valued Components Selected for the Project

Category	Valued Component	Rationale for Selection
	Physical/Terrestrial Environment (Soils and Vegetation)	• used in previous assessments • includes the physical loss of land (soils and vegetation) • close links between soils and other VCs (i.e., vegetation/wildlife habitat, wildlife, and surface water quality) • vegetation provides food and habitat for wildlife • protection of listed (rare) plant species designated by federal and NWT legislation • some plant species are used for traditional and economic purposes
	Archaeology (Heritage Studies)	• used in previous assessments • important for revealing past and present land use, cultural identity, and relationships with other cultures and the social and biophysical environments
Wildlife	Caribou	• used in previous assessments • important subsistence, cultural, and economic species • migratory species with extensive range requirements • primary prey species for large carnivores in northern environments
	Carnivores	• used in previous assessments • include grizzly bears, wolves, and wolverine • grizzly bears have cultural value and are listed as of Special Concern by the Committee on the Status of Endangered Wildlife in Canada (COSEWIC 2013) • wolves have cultural and commercial value, and are ecologically important because they are the main predator of caribou • wolverine are generally not migratory, but long distance movements are made by transient individuals; they have a large home range, can be attracted to human disturbance, and are listed as Special Concern by COSEWIC (2013)
	Breeding Birds	• used in previous assessments • upland breeding birds may be affected by habitat loss because of small territory size • migratory birds are susceptible to population declines as a result of changing environmental conditions on breeding and overwintering habitats • waterbirds may be affected by loss of shoreline habitat for breeding • can be sensitive to noise disturbance and human activity • some species of waterbirds are important for subsistence hunting • include some federally listed species (e.g., common nighthawk, rusty blackbird, horned grebe, peregrine falcon)
Human	Land Use	• several fish, plant, and wildlife species are considered to be VCs by local Aboriginal people for hunting, trapping, fishing, and gathering for domestic and commercial use • traditional Aboriginal use sites
	Employment and Economy	• socio-economic and employment opportunities
	Human Health	• The livability of the environment and aesthetics can affect quality of life • changes in household incomes can influence patterns of family life

6.2.2 Measurement Indicators and Assessment Endpoints

The definitions of the measurable indicators of change (i.e., measurement indicator) and the aspect or key properties of the VC that requires protection to be sustainable (i.e., assessment endpoint), help to

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focus baseline studies and screening of Project interactions, but are also important for predicting the significance of residual effects and for monitoring and managing these effects (Noble 2010). Assessment endpoints are typically qualitative expressions used to assess effects on VCs (e.g., ability of a wildlife VC to remain self-sustaining and ecologically effective). Assessment endpoints are general statements about what is being protected and represent the key properties of the VC that reflect its ecological status or societal value. An assessment endpoint may or may not be directly measurable, but a measurement indicator is measurable and should be related to an assessment endpoint.

Measurement indicators (biophysical or socio-economic indicators of change) represent properties of the environment, population, or system that, when changed, could result in, or contribute to, an effect on an assessment endpoint. Measurement indicators may be quantitative (e.g., concentrations of metals in surface water) or qualitative (e.g., movement and behaviour of wildlife from disturbance). Effects to long-term social, cultural, and economic values are predicted through analysis of changes to measurement indicators such as employment and income, education and training, and capacity for traditional and recreational land use. Measurement indicators also provide the primary factors for discussions concerning the uncertainty of effects to VCs and are the key variables for study in monitoring and follow-up programs.

Some VCs (i.e., air quality, groundwater, surface hydrology, and soils) are measurement indicators for other VCs, and do not have an assessment endpoint. For example, changes in air quality may result in effects to the maintenance of self-sustaining plant communities and populations (i.e., vegetation assessment endpoint). Consequently, not every environmental component is carried through the residual effects classification and determination of significance; rather, the results of the residual effects analyses are provided to support the effects assessment for other VCs.

The significance of effects from the Jay-Cardinal Project on VCs is evaluated by linking changes in measurement indicators to effects on an assessment endpoint. For example, changes in habitat quantity and quality (measurement indicators) are used to assess the significance of effects from the Jay-Cardinal Project on the ability of a wildlife population to remain self-sustaining and ecologically effective (an assessment endpoint). Valued components, assessment endpoints, and measurement indicators used for the above purposes are presented in Table 6.2-2.

Table 6.2-2 Valued Components, Associated Assessment Endpoints and Measurement Indicators

Valued Component	Assessment Endpoint	Measurement Indicator
Air Quality	• No assessment endpoint. Results of the assessment are used in the effects analysis for other VCs	• particulate matter ($PM_{2.5}$) and total suspended particulates • oxides of sulphur, oxides of nitrogen • deposition rates
Surface Hydrology	• No assessment endpoint. Results of the assessment are used in the effects analysis for other VCs	• flow rate and the spatial and temporal distribution of water • surface topography, drainage boundaries, and waterbodies (e.g., streams, lakes, and drainages) • water level, waterbody volume, flow rates, and watershed area

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Table 6.2-2 Valued Components, Associated Assessment Endpoints and Measurement Indicators

Valued Component	Assessment Endpoint	Measurement Indicator
Water Quality and Aquatic Life Other than Fish	• Protection of surface water quality for aquatic and terrestrial ecosystems, and human use	• physical analytes (e.g., pH, conductivity, turbidity, sediment quality, temperature) • dissolved oxygen • major ions and nutrients • total and dissolved metals (including metalloids and non-metals)
Fish	• Maintenance of self-sustaining fish populations (including listed species).	• habitat quantity • habitat quality • relative abundance and distribution of fish species • survival, growth, and reproduction
Groundwater	• No assessment endpoint. Results of the assessment are used in the effects analysis for other VCs	• changes to groundwater levels and amount available for human use • physical analytes (e.g., pH, conductivity, turbidity) • major ions and nutrients • total and dissolved metals
Permafrost	• No assessment endpoint. Results of the assessment are used in the effects analysis for other VCs	• permafrost distribution • terrain and slope stability
Physical/Terrestrial Environment (Soils and Vegetation)	• No assessment endpoint for soils. Results of the assessment are used in the effects analysis for other VCs	• soil quality, quantity, and distribution
	• Maintenance of a self-sustaining plant population and community (including listed species)	• plant community diversity • plant community health • relative abundance and distribution of plant species • habitat fragmentation
Archaeology (Heritage Studies)	• Protection and preservation of heritage resources	• value and quantity of archaeological and sacred sites
Caribou	• Maintenance of self-sustaining wildlife populations (including listed species)	• changes in habitat quality and quantity • habitat fragmentation • movement and behaviour • relative abundance and distribution of wildlife species • survival, growth, and reproduction
Carnivores		
Breeding Birds		
Land Use	• Continued opportunity for traditional and non-traditional activities such as hunting, fishing, trapping, and plant and berry gathering	• relative abundance and distribution of fish species • relative abundance and distribution of plant species • relative abundance and distribution of wildlife species
Employment and Economy	• Continued opportunity for employment	• employment and income • education, training, and opportunities for youth • capacity of labour pool • capacity for traditional and recreational land use • tourism potential

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Table 6.2-2 Valued Components, Associated Assessment Endpoints and Measurement Indicators

Valued Component	Assessment Endpoint	Measurement Indicator
Human Health	• Protection of human health and maintenance of quality of life	• livability of the environment (e.g., effects to people from Project-related changes to air and water quality, noise levels, and aesthetics of the environment) • long-term social, cultural, and economic sustainability

Existing Programs and Plans

This section outlines existing monitoring programs and plans at Ekati, which are relevant to the Jay-Cardinal Project.

6.2.3 Environmental Management Plans and Monitoring Programs

Multiple monitoring programs are in place for the Ekati Mine, and adaptive management has been applied to address effects that were different from original predictions or those not anticipated in the original assessment. Plans and monitoring programs for the Ekati Mine that will be extended to include the Jay-Cardinal Project are:

- Waste Rock and Ore Storage Management Plan;
- Wastewater and Processed Kimberlite Management Plan (WPKMP);
- Interim Closure and Reclamation Plan (ICRP);
- Air Quality Monitoring Program (AQMP);
- Aquatic Effects Monitoring Program (AEMP); and,
- Wildlife Effects Monitoring Program (WEMP).

6.2.3.1 Waste Rock and Ore Storage Management Plan

Version 3 of the Waste Rock and Ore Storage Management Plan was submitted to the Wek'èezhìi Land and Water Board (WLWB) December 2012. The plan incorporates updates of the acid/alkaline rock drainage and geochemical characterization and management plan. The Waste Rock and Ore Storage Management Plan will be updated to incorporate the Jay-Cardinal Project, a revision that will document the new WRSAs for placement of rock mined from the Jay and Cardinal open pits.

The Waste Rock and Ore Storage Management Plan contain information on:

- the current conditions at Ekati including geology, production history including tonnages, and descriptions of the existing waste storage facilities;
- existing geochemical characterization of waste rock and coarse kimberlite rejects including acid/alkaline drainage potential;
- current temperature trends in WRSAs; and,

- existing drainage management and seepage monitoring methods.

6.2.3.2 Wastewater and Processed Kimberlite Management Plan

Version 3 of the WPKMP was submitted to the WLWB in July 2012. The plan describes the processes, plans, and monitoring for the management of wastewater and fine processed kimberlite tailings at the Ekati Mine. The information includes the geochemical characterization of the fine processed kimberlite. The WPKMP will be updated to incorporate the Jay-Cardinal Project, a revision that will document:

- the incorporation of the fine processed kimberlite into the management plan resulting from processing of the Jay and Cardinal kimberlite; and,
- the incorporation of the minewater pipeline from Jay and Cardinal pits to Desperation Pond at the Misery site.

6.2.3.3 Interim Closure and Reclamation Plan

DDEC is required under the Ekati Mine Water Licence to have in place an approved ICRP during active mining operations. This plan is updated as required and a revision will be made to incorporate the Jay-Cardinal Project. The current version of the ICRP (Version 2.4) was approved by the WLWB November 2011. A Final Closure and Reclamation Plan will be required two years prior to mine closure.

The ICRP has been developed with input from IBA communities and regulatory agencies, and incorporates specific reclamation activities and objectives detailed in conformance documents that include water licences, the Environmental Agreement, land use permits, land leases, and fisheries agreements. Contributions have come from Aboriginal communities (Inuit of Kugluktuk, Łutselk'e Dene First Nation, Yellowknives Dene First Nation, the Tłįchǫ Government, and the North Slave Métis Alliance), and from representatives of the various government agencies:

- AANDC;
- WLWB;
- GNWT;
- Environment Canada; and,
- DFO.

Reclamation of the mine site is guided by the reclamation goal to return the Ekati Mine site to viable, and wherever practicable, self-sustaining ecosystems that are compatible with a healthy environment, human activities, and the surrounding environment. The ICRP includes reclamation research plans that address key uncertainties related to mine closure, such as water quality, wildlife safety, and sustainability of vegetation cover. Monitoring programs are in place to evaluate whether reclamation work has been successful, or whether there is a need for further reclamation work.

The Jay-Cardinal Project introduces some necessary changes to the Ekati Mine ICRP, primarily new reclamation activities at Lac du Sauvage and a new pit flooding approach for the Panda and Koala open pits. The ICRP and accompanying reclamation security can be readily amended to address those

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changes. Additional information regarding closure and reclamation for the Jay-Cardinal Project is provided in Section 4.9.

6.2.3.4 Air Quality Monitoring Program

The Ekati AQMP has the following components:

- air emissions and greenhouse gas calculations;
- total suspended particulate (TSP) matter measurements through high volume air sampling;
- continuous ambient air sampling of oxides of nitrogen (NO_x), oxides of sulphur (SO_x), TSP and particulate matter ($PM_{2.5}$);
- snow sampling; and,
- lichen sampling.

Emissions calculations and high volume air sampling is completed annually; snow and lichen sampling is completed every three years. Results from the AQMP indicate that environmental design features and mitigation measures implemented at Ekati are effective at mitigating the effects of the mine on air quality. The AQMP provides information for the Ekati Mine and will be amended to incorporate the Jay-Cardinal Project.

6.2.3.5 Aquatic Effects Monitoring Program

Aquatic effects are monitored every year at 14 lake and 8 stream sites as part of the AEMP. The AEMP evaluates the physical, chemical, and biological components of the aquatic ecosystem:

- hydrology;
- physical limnology;
- lake and stream water quality;
- phytoplankton, zooplankton, sediment quality;
- lake and stream benthos; and,
- fish (3 and 6 year cycles).

Meteorological data are also reported in the AEMP because of their relationship to site hydrology.

The Koala Watershed contains the majority of the existing Ekati infrastructure including the main camp, the process plant, the Panda, Koala, Koala North, Fox, and Beartooth pits and associated WRSAs, the LLCF, and the airstrip. In the Koala Watershed, the AEMP examines waters downstream of the LLCF including the LLCF discharge (SNP station 1616-30), Leslie Lake, Leslie–Moose Stream, Moose Lake, Moose–Nero Stream, Nema Lake, Nema–Martine Stream, Slipper Lake, and Slipper–Lac de Gras Stream. The northern bay of Lac de Gras near the inflow from Slipper Lake is also monitored.

The internal-watershed reference area (Vulture Lake, Vulture-Polar Stream) is located 5 km upstream of the Ekati camp at the north end of the Koala Watershed. Although the Lower Panda diversion channel,

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Kodiak Lake, and Kodiak–Little Stream are not downstream of the LLCF, they are monitored and evaluated as part of the AEMP because of their proximity to mine operations. Grizzly Lake is the source of potable water for the Ekati main camp, and was added to the AEMP in 2009.

The King–Cujo Watershed contains the Misery Camp, Misery Pit and associated WRSAs, and the King Pond settling facility. In the King–Cujo Watershed, monitored locations include the King Pond settling facility discharge (SNP station 1616-43), Cujo Lake, Cujo Outflow Stream, and Christine–Lac du Sauvage Stream. The western bay of Lac du Sauvage near the inflow from Christine Lake is also monitored.

Sampling for the AEMP also includes two external watershed reference lakes and streams (Nanuq and Counts lakes and their outflows) that are located outside of the zone of influence (ZOI) of mine activities. Nanuq Lake is located in the northeast corner of the Ekati claim block approximately 26 km from the mine. Counts Lake is located southeast of Ekati camp, approximately halfway between the camp and Misery Lake and is approximately 5 km from the closest reach of Misery Road.

The AEMP will be revised to incorporate the Jay-Cardinal Project.

6.2.3.6 Wildlife Effects Monitoring Program (WEMP)

A number of VCs are monitored as part of Ekati Mine approval: caribou, wolves, wolverines, fox, grizzly bears, and falcons. The WEMP is completed annually. The WEMP is used to document wildlife effects resulting from mining activities and to assess the effectiveness of wildlife mitigation and management efforts. In addition, it contributes to adaptive management for reducing the potential for wildlife-related safety concerns for employees, and to mitigate any potential effects of mine activities on wildlife. The WEMP is focused on changes to wildlife habitat and wildlife species of greatest interest (i.e., caribou, grizzly bear, wolverine, wolf, fox and falcons).

The main components of the WEMP involve wildlife incidents, caribou monitoring, grizzly bear monitoring, wolf and fox monitoring, and wolverine monitoring. Monitoring techniques involve incidental observations of wildlife sign and visual observations, ground - based surveys, and behaviour observations. The WEMP is also used to test new monitoring techniques.

Wildlife incidents documented at Ekati include any interaction with wildlife can has or has potential to compromise the safety of wildlife, humans, or both, and include incidents related to wildlife-vehicle interactions, attraction to the Ekati Mine, and physical hazards (e.g., fencing). Documentation also includes observations of wildlife and wildlife sign in close proximity to the mine and associated developments so that management can be applied to minimized risks to wildlife and Ekati staff.

The WEMP will be revised to incorporate the Jay-Cardinal Project.

6.2.4 Adaptive Management and Operational Experience

The inherent unpredictability of natural ecosystems requires the practice of adaptive management. Adaptive management is defined as a systematic approach for continually improving management policies and practices by learning from the outcomes of operational programs. In practice, it is an iterative process of anticipating potential environmental effects (based on trends observed as a result of environmental monitoring programs), developing appropriate mitigation strategies to stop and/or reverse

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those trends, monitoring the success or failure of the strategies, and then using this information to improve operational management.

Adaptive management has been applied to environmental issues at Ekati since inception. Examples were summarized in the 2012 environmental impact report (EIR; BHP 2012) and are provided below in Table 6.3-1.

Table 6.3-1 Adaptive Management of a Selection of Environmental Issues at Ekati

Valued Component	Issue	Adaptive Management Actions
Caribou	Limit disturbance to caribou	• Observations of caribou crossing Misery Road were used to shape design of berms around Misery and Beartooth pits • Traditional knowledge study led to the installation of inokhoks as deterrents to caribou approaching the mine site. Elders Advisory Committee established to study other means of preventing disturbance to caribou • Identification of caribou crossings with road signage • Speed limits established on all roads to prevent wildlife-vehicle collisions • Radio communication among drivers and main camp staff to alert drivers to caribou sightings on or near the road • Construction of caribou crossing at Misery Road in areas of high usage
Permafrost	Reduce disturbance of permafrost layer	• Winter construction in permafrost areas where lakes and streams are potentially affected by sedimentation (dams, dykes, culverts, and bridges) • Drawdown of water levels of lakes during winter • Capping of exposed permafrost to reduce thermal degradation and erosion
Groundwater, Physical/ Terrestrial Environment	Reduce seepage from waste rock piles and kimberlite stockpiles	• Build toe berms to prevent seepage • Build granite pad underneath Fox kimberlite stockpile to prevent interaction between kimberlite and tundra and reduce seepage • Refine engineering design to encourage convective super-cooling of the margins of the waste rock pile and the development of permafrost within the piles • Monitor for seepage twice each year • Initiation of long-term field reactivity test for various rock types • Relocation of metasediment rock from perimeter to central area of Misery Waste Rock Storage Area • Detailed scientific study of SEEP 018/019 area, as a follow-up to unusual monitoring results
Physical/ Terrestrial Environment	Reclamation	• Complete progressive revegetation research on Long Lake Containment Facility (LLCF) kimberlite surfaces • Ecological risk assessments of the potential for metal uptake from vegetated LLCF cover to wildlife and humans • Progressive development of the long-term re-vegetation program based on research results and Wek'èzhìı Land and Water Board-approved objectives
Water Quality	Water quality downstream of LLCF	• Addition of flocculent to Fox Lake during dewatering to reduce total suspended solids in the LLCF • Use of water from underground operations for processing of Fox kimberlite (fine particles associated with this kimberlite) to enhance settling of fine particles and reduce the amount of chloride added in the process plant • Withheld discharge into the LLCF in spring 2008 while studying the potential effects of nitrate • Completed an intensive sampling variability study to verify that the Aquatic Effects Monitoring Program was providing valid results

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Table 6.3-1 Adaptive Management of a Selection of Environmental Issues at Ekati

Valued Component	Issue	Adaptive Management Actions
Fish	Limit loss of habitat	• Constructed and operated the Panda Diversion Channel to compensate for lost stream habitat • Tested fish habitat structures provided in the Panda Diversion Channel • Implemented Panda Diversion Channel Management Plan: surveys to document channel stability, construction of culvert covers, spring surveys of snow thickness and grading, removal of snow in early spring, and daily monitoring of water levels during spring melt

6.2.5 Environmental Agreement

The Environmental Agreement was signed January 1997 and amended April 2003. This Agreement is between DDEC, the Government of Canada (as represented by the Minister of Aboriginal Affairs and Northern Development Canada, formerly the Minister of Indian Affairs and Northern Development) and the GNWT (represented by the Minister of Environment and Natural Resources, formerly Resources, Wildlife and Economic Development). It remains in effect until the full and final reclamation of the Ekati Mine site.

The Environmental Agreement requires:

- environmental management plans for construction and operation;
- plans for closure and reclamation;
- research in archaeology and traditional knowledge;
- annual reporting on environmental compliance, monitoring programs, research, present operations and future activities, and remedial and mitigative actions. These reports are subject to review by government, Aboriginal organizations, and other stakeholders;
- an EIR every three years beginning in April 2000;
- reclamation security and corporate guarantee to be drawn upon in instances where DDEC does not comply with requirements in the Environmental Agreement; and,
- compliance procedures and mechanisms for enforcement and dispute resolution.

The Environmental Agreement also provides for the IEMA. The IEMA was established as a non-profit Society in the Northwest Territories. The IEMA directors work together to review environmental reports and management plans for the Ekati Mine. The IEMA also listens to concerns from Aboriginal communities and the general public. It makes recommendations to DDEC and various government regulators regarding protecting the environment around the mine, as part of the mandate of the Environmental Agreement.

6.2.6 Socio-economic Agreement and Impact and Benefit Agreements

A Socio-economic Agreement (SEA) was established in 1996 with the Government of the Northwest Territories. This Agreement addresses the economic benefits and social impacts of the Ekati operation on the Northwest Territories, and establishes Northern and Northern-Aboriginal hiring targets and Northern business spending targets. The Agreement also provides a means for joint industry-government community training and northern recruitment programs. DDEC provides financial support for the development of long-term sustainable community initiatives including:

- physical projects such as community centres;
- cultural programs such as sharing of traditional knowledge; and,
- community social support programs such as women's transitional housing programs and at-risk youth programs.

DDEC incorporates the use of traditional knowledge in monitoring programs by involving communities in the programs and having Elders teach the environmental staff the traditional way of the land. DDEC hosts visits by Elders and youth to the Ekati Mine site. In addition, DDEC hosts traditional knowledge oriented community outreach events including:

- community visits;
- cultural workshops at the Ekati Mine;
- funding for community programs, such as Breakfast for Learning and youth career programs; and,
- funding for community events such as:
  - cultural program in N'dilo;
  - education programs in Dettah; and,
  - the Tłįchǫ Annual Gathering, the Łutselk'e Annual Spiritual Gathering, and the Kugluktuk Annual Fishing Derby.

Impact and Benefit Agreements (IBAs) were established with the four Aboriginal communities (Tłįchǫ, Akaitcho Treaty 8, North Slave Métis, and the Inuit of Kugluktuk), prior to the commencement of mining. The IBAs establish requirements for funding, training, preferential hiring, business opportunities, and communications. The IBAs extend over the life of mine.

6.3 Project-Environment Interactions and Mitigation

6.3.1 Screening of Project Interactions

Interactions or linkages between Jay-Cardinal Project components or activities, and the corresponding potential changes to measurement indicators of the environment are identified through a screening process. This screening step is largely a qualitative assessment, to focus the residual effects analysis on interactions that will require a more comprehensive assessment of effects on VCs (i.e., those interactions that may result in residual effects after mitigation).

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The screening process is completed to remove Project interactions that are predicted to have no linkage to residual effects or are expected to result in minor changes to measurement indicators and a negligible effect on the assessment endpoint, after applying mitigation. Interactions are evaluated using scientific knowledge, experience with similar developments and with developments at the Ekati Mine, and the effectiveness of mitigation. This screening step focuses the residual effects analysis on Project interactions that have potential to result in significant residual effects on VCs.

The first part of the screening step is to produce a list of all potential interactions for the Jay-Cardinal Project. Each interaction is initially considered to have a linkage to potential effects on environmental components. This step is followed by the application of environmental design features and mitigation that can be incorporated into the Project to remove an interaction or limit (mitigate) effects to environmental components. Environmental design features involve Project design elements, environmental best practices, management policies and procedures, and social programs. Environmental design features are developed through an iterative process between the Project's engineering and environmental teams to avoid or mitigate effects.

Knowledge of the environmental design features and mitigation is then applied to each of the interactions to determine the expected amount of Project-related changes to the environment and any associated residual effects (i.e., effects after mitigation) on VCs. Changes to the environment can alter physical measurement indicators (e.g., water and soil chemistry, amount of habitat) and biological measurement indicators (e.g., animal behaviour, movement, survival). For a residual effect to occur there has to be a source (Project component or activity) that results in a measurable environmental change and a correspondent residual effect on VCs.

Project activity → measurable environmental change → residual effect on a VC

Interactions are determined to be primary, secondary (minor), or as having no linkage using scientific knowledge, and experience with similar Project activities at the Ekati Mine and environmental design features. Each potential interaction related to the Jay-Cardinal Project has been assessed and described as follows:

- no linkage – interaction is removed by environmental design features and mitigation so that the Project results in no detectable (measurable) change and no residual effect to a VC relative to background/baseline or guideline values;
- secondary - interaction could result in a minor change, but would have a negligible residual effect on a VC relative to background/baseline or guideline values; or,
- primary - interaction is likely to result in a measurable change that could contribute to significant residual effects on a VC relative to baseline or guideline values. Quantitative analyses could indicate that the interaction is negligible; however, the initial screening assessment is conservative and thus protective.

Primary interactions are those that are anticipated to result in a residual effect to the assessment endpoint, and therefore require further analysis (residual effects analysis), a classification of the residual effect, and a determination of the significance of the residual effect. For those VCs with no assessment endpoints, the classification of residual effects and the determination of the significance are not

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completed. Interactions with no linkage to a change or changes that are considered minor (secondary) are not analyzed further or classified because environmental design features will remove the interaction (no linkage) or residual effects can be determined to be negligible through a relatively simple qualitative or quantitative evaluation. Interactions determined to have no linkage to VCs or those that are considered secondary are not predicted to result in significant effects to VCs.

Project interactions to the biological and socio-economic environment that could result during the construction, operation, and reclamation phases of the Project are outlined in Table 6.4-1, and include mitigation that will be implemented. The proposed Jay-Cardinal Project activities and the proven mitigation practices already implemented at the Ekati Mine were taken into consideration in the classification of the Jay-Cardinal Project interactions.

6.3.2 Key Lines of Inquiry and Subjects of Note

As described in Section 2.3, based on the scope of the diversion and drawdown activities at Lac du Sauvage, and the expected level of public concern, an environmental assessment (EA) conducted by MVEIRB would likely be considered the appropriate level of regulatory review.

A key component of the EA process is to identify and focus on the issues that are of greatest concern to stakeholders and regulatory agencies. It is expected that the Terms of Reference for the EA will include Key Lines of Inquiry and Subjects of Note in order to focus the EA on the issues of public concern. Key Lines of Inquiry are areas of concern identified as requiring a comprehensive, detailed analysis so that public concern is adequately addressed. Subjects of Note are also identified based on expressed public concern and require thorough assessment. A draft Terms of Reference for the EA is provided in Appendix 2a.

The issues identified as Key Lines of Inquiry and/or Subjects of Note based on public concern will generally be identified and included in the primary or secondary interactions based on scientific understanding of the Project and its potential interactions with the environment. However, some of the interactions identified as no linkage or secondary may be incorporated into a Key Line of Inquiry or a Subject of Note based on public concern. Incorporating the screening of interactions into the Key Lines of Inquiry and Subjects of Note in the EA provides for assessment that meets the needs of all interested parties.

The identification of VCs will also incorporate stakeholder concerns. For example, if public concern warrants it, the assessment can also examine potential effects to a VC not considered scientifically sensitive, but identified as important through public opinion.

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Table 6.4-1 Jay-Cardinal Project Activities, Potential Project Interactions, Mitigation and Environmental Design Features, and Interaction Classification

Jay-Cardinal Project Component/Activity	Potential Interaction	Valued Component	Jay-Cardinal Project Mitigation and Environmental Design Features	Interaction Classification
• Physical Disturbance from Project Footprint – Construction or development of site access roads, pits, waste rock storage areas, quarries, support building	• Changes to local hydrology (surface water flows, drainage patterns, and lake levels) from the Project footprint and possible effects to water quality	Surface Hydrology • Water Quality and Aquatic Life other than Fish • Fish • Physical/Terrestrial Environment (Soils and Vegetation) • Caribou, Carnivores, and Breeding Birds • Land Use	• The footprint disturbance area will be limited to the extent practical • Where possible, construction will take place during the winter to minimize disturbance to soils and vegetation, and runoff to local waterbodies • Standard erosion and sediment control measures (e.g., silt curtains, runoff management) will also be used during construction around areas to be disturbed, where appropriate • Runoff and seepage from Project facilities will be managed where appropriate • Culverts will be installed or upgraded along site access roads, as necessary, to maintain drainage • The road route alignment will minimize stream crossings and avoids sensitive habitat as feasible	Primary
	• Changes to permafrost conditions from the Project footprint	Permafrost • Groundwater • Surface Hydrology • Physical/Terrestrial Environment (Soils and Vegetation) • Land Use	• Design of the Jay-Cardinal Project minimizes the construction of new buildings, roads, pads, or excavations that might have an effect on permafrost • The footprint disturbance area will be limited to the extent possible, while maintaining safe construction and operation practices • Footprints of the WRSAs and other structures will be optimized to limit surface disturbance to the extent practical • Buildings will be insulated to minimize heat loss, and will be dismantled as part of reclamation activities, which will allow for a return to pre-development conditions	Secondary
	• Seepage from waste rock piles, kimberlite stockpiles can cause changes in groundwater	Groundwater Water Quality and Aquatic Life other than Fish • Fish • Caribou, Carnivores, and Breeding Birds • Land Use • Human Health	• All of the rock mined from the Cardinal open pit will be granite (i.e., non-acid generating and non-metal leaching) rock • Metasediment rock mined from the Jay open pit will be encapsulated within a thermally protective cover layer of granite such that metasediment is frozen into permafrost; this continues the approach successfully established at the Ekati Mine for the Misery WRSA • Monitoring Programs and the Waste Rock and Ore Storage Management Plan are implemented at the Ekati Mine • The Waste Rock and Ore Storage Management Plan will be amended and submitted for approval by the WLWB • Seepage management continues to be addressed as described in the Waste Rock and Ore Storage Management Plan • The Wastewater and Processed Kimberlite Management Plan (WPKMP) will be amended to incorporate the Jay-Cardinal Project	No Linkage
	• Direct loss and fragmentation of plant communities and wildlife habitat from the Project footprint (pit, dams/dikes and waste rock storage areas, access road)	Physical/Terrestrial Environment • Caribou, Carnivores, and Breeding Birds • Land Use	• The Wildlife Effects Monitoring Program implemented at the Ekati Mine will include the Jay-Cardinal Project • The site access road route follows existing roads and/or trails to the extent possible, to limit land clearing • Existing trails will be stabilized as necessary to avoid encroachment problems and to protect adjacent habitat • Banks and vegetated areas will be stabilized, if disturbed • The esker will be sloped to allow for continued use for movement by caribou • Stockpiled growth medium (e.g., organic materials) and lake bottom sediments will be used during reclamation projects, as practical • Engagement of the Ekati Mine IBA groups	Secondary [will be evaluated further in the EA; see Section 6.4.4]
	• Site preparation and construction can result in the destruction of nests, eggs, and individuals of migratory birds (incidental take)	Breeding Birds • Land Use	• The Wildlife Effects Monitoring Program implemented at the Ekati Mine will include the Jay-Cardinal Project • Project activities will be completed in accordance with the *Migratory Bird Convention Act* • Vegetation clearing will take place outside of the migratory bird season, as practical • If site clearing activities are completed during the migratory bird breeding season, then vegetation removal will be completed prior to the nesting season or nest searches will be completed prior to construction • If nests are found during nest searches, mitigation will be applied to avoid incidental take of nesting individuals	Secondary
	• Direct loss or alteration of fish habitat from the Project footprint	Fish • Land Use	• An offsetting plan will be developed with Fisheries and Oceans Canada (DFO) and with engagement of the Ekati Mine IBA groups • A Fish-Out will occur according to DFO guidance and with engagement of the Ekati IBA groups • The Interim Closure and Reclamation plan will be expanded to encompass the Project site	Primary
	• Release of sediment during construction of the dikes in Lac du Sauvage	Water Quality and Aquatic Life Other than Fish • Fish	• Detailed dike construction plan will be developed and implemented • Sediment control measures will be implemented during dike construction where appropriate (e.g., installation of silt curtains for turbidity control)	Secondary
	• Impingement and entrainment of fish in intake pumps during construction activities (i.e., dike construction) may cause injury and mortality to fish	Fish	• During pumping of water from areas that contain fish, appropriately sized fish screens that meet DFO guidelines will be fitted to pumps to limit fish impingement and entrainment	Secondary

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Table 6.4-1 Jay-Cardinal Project Activities, Potential Project Interactions, Mitigation and Environmental Design Features, and Interaction Classification

	• Construction of the Project may cause disturbance or destruction of heritage resources	Archaeology (Heritage Studies)	• Archaeological surveys have been completed at the site and documentation is ongoing • Management practices for the avoidance or preservation of for archaeological and/or heritage materials discovered during mine activities are in place at the Ekati Mine • Engagement of the Ekati Mine IBA groups	No Linkage [but, based on expected levels of concern, will be evaluated further in the EA; see Section 6.4.3]
• Site Water Management – Drawdown of Lac du Sauvage – Diversions	• Discharges from the drawdown of Lac du Sauvage may change flows, water levels, and channel/bank stability in downstream waterbodies, and potential physical effects on fish, other biota, and habitat	Surface Hydrology • Water Quality and Aquatic Life Other than Fish • Fish • Land Use	• A Lac du Sauvage Drawdown Plan will be prepared for the WLWB that will include flow rates and locations • Direct discharge flow rates will be developed and maintained to eliminate erosion concerns	Primary
	• Discharges from the drawdown of Lac du Sauvage may change water quality (e.g., suspended sediments, metals, nutrients) in receiving waterbodies	Water Quality and Aquatic Life Other than Fish • Fish • Land Use	• A Lac du Sauvage Drawdown Plan will be prepared for the WLWB that will include locations and water quality monitoring to meet regulatory requirements • • Discharge water will be regularly sampled and monitoring as part of the Drawdown Plan • If suspended solids concentrations are too high for the direct release of water to the natural environment, the water will be pumped to the North Arm Water Management Area • The Aquatic Effects Monitoring Program implemented at the Ekati Mine will include the Jay-Cardinal Project	Primary
	• Removal of lake water in Lac du Sauvage may cause changes to permafrost conditions within the exposed lake bed and groundwater flow	Permafrost Groundwater • Surface Hydrology • Physical/Terrestrial Environment (Soils and Vegetation) • Land Use	• Refilling of Lac du Sauvage at the end of operations should allow for a return to pre-development permafrost conditions	Secondary [will be evaluated further in the EA; see Section 6.4.4]
	• Changes in surface water flow paths from diversions may change flows, water levels, and channel/bank stability in downstream waterbodies	Surface Hydrology • Water Quality and Aquatic Life Other than Fish • Fish • Land Use	• Diversions will be designed to manage flows and minimize potential for erosion and bank instability • Diversions will be designed to take into account fish movement	Primary
	• Changes in surface water flow paths from diversions may change water quality in receiving waterbodies (e.g., suspended sediments, metals, nutrients)	Water Quality and Aquatic Life Other than Fish • Fish • Physical/Terrestrial Environment (Soils and Vegetation) • Caribou, Carnivores, and Breeding Birds • Land Use	• Diversions will be designed to manage flows and minimize potential for suspended sediment generation from bed and bank erosion • The Aquatic Effects Monitoring Program implemented at the Ekati Mine will include the Jay-Cardinal Project	Secondary [effects on surface water flow paths will be evaluated further in the EA; see Section 6.4.4]
	• Increase in water levels in surrounding waterbodies from diversions may result in release or generation of suspended sediments, nutrients, mercury or other substances from flooded sediments and vegetation	Water Quality and Aquatic Life Other than Fish • Fish • Physical/Terrestrial Environment (Soils and Vegetation) • Caribou, Carnivores, and Breeding Birds • Land Use	• Lake shorelines will be assessed for erosion potential, and mitigation will be applied for areas identified with high potential for erosion / generation of suspended sediments / contaminant release • The Aquatic Effects Monitoring Program implemented at the Ekati Mine will include the Jay-Cardinal Project	Secondary
	• Increase in water levels in surrounding waterbodies from drawing down Lac du Sauvage or diversions may result in destruction of nests, eggs, and individuals of migratory birds (incidental take)	Breeding Birds • Land Use	• The Wildlife Effects Monitoring Program implemented at the Ekati Mine will include the Jay-Cardinal Project • Project activities will be completed in accordance with the *Migratory Bird Convention Act* • If lake water level increases are to occur during the migratory bird breeding season, then vegetation removal will be completed prior to the nesting season or nest searches will be completed prior to construction. • If nests are found during nest searches, mitigation will be applied to avoid incidental take of nesting individuals • •	Secondary

Table 6.4-1 Jay-Cardinal Project Activities, Potential Project Interactions, Mitigation and Environmental Design Features, and Interaction Classification

	• Drawdown of Lac du Savage may result in newly established vegetation on the exposed lakebed sediments and increase habitat quantity.	• Physical/Terrestrial Environment • Caribou, Carnivores, and Breeding Birds • Land Use	• Habitat changes will be monitored as part of the Wildlife Effects Monitoring Program	Secondary
	• Alterations in hydrologic conditions from the water supply requirements (mining and potable) for the Project	Surface Hydrology • Water Quality and Aquatic Life Other than Fish • Fish • Land Use	• Use of existing potable water system at site, demand is not anticipated to increase • Freshwater for Ekati operations is permitted to be drawn from Grizzly Lake, Little Lake, Thinner Lake (Misery Camp); the Long Lake Containment Facility provides recycled water for operation of the process plant • Potable water is trucked from Ekati to Misery Camp • Raw water required for process plant operations is taken from the Long Lake Containment Facility, where the fine tailings have settled and clear water is available • Site water management system is designed to recycle water, where applicable, and reduce requirements for water withdrawal	No Linkage
	• Operational discharge may affect water quality in receiving waterbodies	Water Quality and Aquatic Life other than Fish • Fish • Caribou, Carnivores, and Breeding Birds • Land Use • Human Health	• Operational discharge will meet water quality discharge criteria • Discharge water is regularly sampled and monitoring as part of the Water Licence Surveillance Network Program • The Aquatic Effects Monitoring Program implemented at the Ekati Mine will include the Jay-Cardinal Project	Secondary [will be evaluated further in the EA; see Section 6.4.4]
• General Construction and Operation Activities – Mining of the kimberlite pipes (pit development) – Operation of surface infrastructure and support facilities – Storage of industrial, domestic, hazardous, and contaminated waste – Vehicle traffic along the access road	• Air and dust emissions can affect air quality, and air and dust emissions and subsequent deposition can cause chemical changes to the environment including water quality	Air Quality • Water Quality and Aquatic Life Other than Fish • Fish • Physical/Terrestrial Environment (Soils and Vegetation) • Caribou, Carnivores, and Breeding Birds • Land Use • Human Health	• The Air Quality Monitoring Program is implemented at the Ekati Mine • Regular maintenance of equipment will continue at the Ekati Mine • Dust suppression measures will be applied as appropriate to haulage roads, airstrip, laydown areas, etc. • Speed limits are established on all roads to reduce production of dust •	Primary
	• Dust deposition may cover terrestrial plant communities	Physical/Terrestrial Environment (Vegetation) • Caribou, Carnivores, and Breeding Birds		Secondary [dust emissions will be evaluated further in the EA; see Section 6.4.4]
	• Sensory effects from the presence of buildings, lights, smells, noise, blasting activity, and traffic may affect wildlife or the quality of life for local land users	Caribou, Carnivores, and Breeding Birds Land Use	• The Wildlife Effects Monitoring Program is implemented at the Ekati Mine • Periodic review of the Wildlife Effects Monitoring Program and engagement of the Ekati Mine IBA groups and GNWT • Regular maintenance of equipment will be continued	Secondary [will be evaluated further in the EA; see Section 6.4.4]
	• The use of explosives near fish-bearing water can cause injury or mortality to fish	Fish	• Blasting operations will adhere to DFO's "Guidelines for the Use of Explosives in or Near Canadian Fisheries Waters" (Wright and Hopky 1998) for setback distances from fish-bearing waterbodies • Blasting and excavation will occur in the drawn-down areas of Lac du Sauvage where no water or fish will be present	No Linkage
	• Saline groundwater inflow from the mine pits during pit development may cause changes to groundwater quantity and quality, and affect surface water quality	Groundwater • Water Quality and Aquatic Life other than Fish • Fish • Caribou, Carnivores, and Breeding Birds • Land Use • Human Health	• A pit minewater management plan will be developed specifically for the Jay and Cardinal pits as an amendment to the Ekati Mine Wastewater and Processed Kimberlite Management Plan • The Aquatic Effects Monitoring Program implemented at the Ekati Mine will include the Jay-Cardinal Project	Secondary [will be evaluated further in the EA; see Section 6.4.4]

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Table 6.4-1 Jay-Cardinal Project Activities, Potential Project Interactions, Mitigation and Environmental Design Features, and Interaction Classification

	• Operational activities (i.e., altered drainage, runoff from facilities including WRSAs, pit inflows) may affect surface water quality	Water Quality and Aquatic Life other than Fish • Fish • Caribou, Carnivores, and Breeding Birds • Land Use • Human Health	• Rock mined from the Jay and Cardinal open pits will be managed according to established procedures (i.e., thermal cover over metasediment rock) • Monitoring Programs and the Waste Rock and Ore Storage Management Plan are implemented at the Ekati Mine • The Waste Rock and Ore Storage Management Plan will be amended and submitted for approval by the WLWB • Seepage management continues to be addressed as described in the Waste Rock and Ore Storage Management Plan	Primary
	• Introduction of non-native plant species can affect vegetation	Physical/Terrestrial Environment (Vegetation)	• • Certified seed will be used for reclamation activities, per the existing Ekati ICRP • Reclamation objectives reflect the local native vegetation communities	No Linkage
	• Physical hazards from the Project (e.g., animals becoming trapped in exposed sediments or in fences) may increase risk of injury or mortality to individual animals	Caribou, Carnivores, and Breeding Birds Land Use	• The Wildlife Effects Monitoring Program is implemented at the Ekati Mine and will be amended to incorporate the Jay-Cardinal Project • Periodic review of the Wildlife Effects Monitoring Program and engagement of the Ekati Mine IBA groups and GNWT • Explosives are stored in designated buildings • Hazards will be fenced to prevent wildlife interaction • Caribou ramps and crossings have been constructed at strategic locations along the Misery road • Measures are currently in place to minimize human-wildlife interactions, including providing awareness training • Pit infrastructure is monitored and mitigation is applied, as required • Final reclamation will be completed so that the landscape is safe for wildlife use	Secondary
	• Attraction to the Project (e.g., food waste, oil products) may increase human-wildlife interactions and mortality risk to individual animals or may increase predator numbers and predation risk, which can affect prey population size	Caribou, Carnivores, and Breeding Birds	• The Wildlife Effects Monitoring Program is implemented at the Ekati Mine and will be amended to incorporate the Jay-Cardinal Project • Periodic review of the Wildlife Effects Monitoring Program and engagement of the Ekati Mine IBA groups and GNWT • No additional sources of attractants will be developed as part of the project • Waste Management practices are in place for the Ekati Mine • Hydrocarbon-contaminated soil is treated at the landfarm • Hydrocarbon-contaminated snow and ice are taken to the Contaminated Snow Containment Facility, a lined containment facility • Food wastes are managed appropriately to limit attraction or effect to wildlife • Littering and feeding of wildlife is prohibited • Deterrent measures will be implemented, as needed • Recyclables and waste hazardous materials are stored in appropriate containers to prevent exposure to wildlife until shipped off-site to an approved facility • Education and reinforcement of proper waste management practices is provided to all workers and visitors to the site • An enclosed sanitary sewage treatment plant that treats all domestic wastewater has both primary and secondary levels of treatment • Sewage generated at remote washroom facilities (e.g., Misery site) is trucked to the main camp waste water treatment facility • Incinerator enclosure and frequent burning of camp waste • Juice boxes are no longer used • Employee education on waste management practices and issues surrounding habituation is provided • Inspections of landfill sites and waste storage areas are completed	No Linkage
	• Traffic along the site access roads may result in wildlife-vehicle collisions	Caribou, Carnivores, and Breeding Birds	• Drivers have standard safety training and are provided with awareness training • Speed limits are established on all roads to reduce or prevent wildlife-vehicle collisions • Radio communication among drivers and main camp staff to alert drivers to caribou sightings on or near the road • Caribou ramps and crossings have been constructed at strategic locations along the Misery road • Appropriate signage is in place to identify caribou crossings and areas of high wildlife use • Road closures during caribou migration throughout the Ekati Mine site	Secondary

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Table 6.4-1 Jay-Cardinal Project Activities, Potential Project Interactions, Mitigation and Environmental Design Features, and Interaction Classification

	• Inhalation of air or ingestion of soil, vegetation or water that has been chemically altered by air and dust emissions, seepage from waste rock piles and kimberlite stockpiles, pit water storage, or in the exposed lakebed areas of Lac du Sauvage	Caribou, Carnivores, and Breeding Birds Human Health	• Monitoring Programs and the Waste Rock and Ore Storage Management Plan are implemented at the Ekati Mine • The Waste Rock and Ore Storage Management Plan will be amended and submitted for approval by the WLWB • Seepage management continues to be addressed as described in the Waste Rock and Ore Storage Management Plan • Pit water will be managed through the North Arm Water Management Area • The WPKMP will be amended to incorporate the Jay-Cardinal Project	Secondary [will be evaluated further in the EA; see Section 6.4.4]
• General Construction and Operation Activities – Mining of the kimberlite pipes and operation of surface infrastructure and support facilities	• The project may impact Population	Employment and Economy	• Funding, training, preferential hiring of individuals from local communities under the IBAs • Hiring practices are in place to encourage employment for Northern residents and Northern-Aboriginal residents • The Project will contribute to workforce stability • Northern and Northern Aboriginal Contractor procurement policies • Worker training /on-the-job training/ employment training programs • Corporate investments in education and training programs in the region • Corporate social responsibility initiatives	Primary
	• The project may impact Economy (Revenues and Procurement)	Employment and Economy		Primary
	• The project may impact Labour force (Employment, Training, and Education)	Employment and Economy		Primary
	• The project may impact Communities (IBAs, SEAs, and Community Structure)	Employment and Economy		Secondary
	• The project may impact Infrastructure, Services, and Land Use	Employment and Economy		Secondary
• General Closure and Decommissioning Activities – Removal of project infrastructure – Removal of dikes and diversions	• Removal of project infrastructure may change flows, water levels, and suspended sediments in the watershed	**Surface Hydrology** • Water Quality and Aquatic Life Other than Fish • Fish • Land Use	• Disturbed areas will be reclaimed and the surface stabilized • Natural drainage patterns will be re-established • Erosion and sediment control measures will be implemented where appropriate • A closure plan will be developed which will include dike removal activities	Primary
• General Closure and Decommissioning Activities – Refilling of Lac du Sauvage (refilling drawn-down areas, seepage from facilities, groundwater inflows, backfilled Jay and Cardinal pits)	• Refilling of Jay and Cardinal pits may affect groundwater quality	Groundwater • Water Quality and Aquatic Life other than Fish • Fish • Caribou, Carnivores, and Breeding Birds • Land Use • Human Health	• During refilling, water flow into the mined-out pits will include surface water and groundwater; refilling will not rely solely on refilling by groundwater • At closure, natural water levels in Lac du Sauvage will be re-established, eliminating potential groundwater flow gradient towards the lake • Water quality monitoring will be conducted during the refilling period	Secondary [will be evaluated further in the EA; see Section 6.4.4]
	• Refilling drawn-down areas may affect water quality in the refilled Lac du Sauvage and downstream, once reconnected	Water Quality and Aquatic Life Other than Fish • Fish • Physical/Terrestrial Environment (Soils and Vegetation) • Caribou, Carnivores, and Breeding Birds • Land Use	• A closure plan will be developed • Refilling will use natural, local water • Water quality monitoring will be conducted during the refilling period	Primary
• Accidents and Malfunctions	• Spills (i.e., fuels, petroleum products, reagents) on site	Groundwater Water Quality and Aquatic Life other than Fish Fish Physical/Terrestrial (Soils and Vegetation) Environment Caribou, Carnivores, and Breeding Birds Land Use Human Health	• A Spill Contingency Plan is in place for the Ekati Mine • Regular equipment maintenance (e.g., regular checks for leaks) • Drip trays and/or absorbent pads are used during servicing and refuelling • All hazardous substances are stored and handled on site in accordance with applicable regulations • Fuel is stored at central bulk fuel farms and fuel tanks are housed within bermed areas • The Project will follow Ekati's standard policies in the event of a spill; spill response training is provided and updated • Hydrocarbon impacted material will continue to be handled in accordance with the approved management plan	No Linkage

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6.3.3 Interactions with No Linkage to Effects

An interaction may have no linkage to effects if the activity does not occur (e.g., site runoff is not released), or if the interaction is removed by mitigation and/or environmental design features so that the Project results in no detectable change in measurement endpoints. Subsequently, no residual effect is expected. The following interactions are anticipated to have no linkage to effects to VCs for reasons outlined in Table 6.4-1 and described in more detail below, and have not been carried through to the assessment of primary interactions and residual risks (Section 6.5):

Physical Disturbance from Project Footprint

- Seepage from waste rock piles, kimberlite stockpiles can cause changes in groundwater
- Construction of the Project may cause disturbance or destruction of heritage resources

Site Water Management

- Alterations in hydrologic conditions from the water supply requirements (mining and potable) for the Project

General Construction and Operation Activities

- The use of explosives near fish-bearing water can cause injury or mortality to fish
- Introduction of non-native plant species can affect vegetation
- Attraction to the Project (e.g., food waste, oil products) may increase human-wildlife interactions and mortality risk to individual animals or may increase predator numbers and predation risk, which can affect prey population size

Seepage from waste rock piles or kimberlite stockpiles can cause changes in groundwater

It is possible that seepage from the WRSAs and kimberlite stockpiles could cause changes in groundwater and surface water quality, which could affect soil and vegetation. Ingestion of water, soil, or vegetation that has been chemically altered by seepage could cause effects to fish, caribou, carnivores, breeding birds, land use, and human health. There are no groundwater inflows into the existing WRSA at the Ekati Mine. Additionally, as a condition of Water Licence W2009L2-0001, DDEC is required to monitor WRSA seepage quality and characterize waste rock at Ekati. Findings of these monitoring programs are reported annually. The Waste Rock and Ore Storage Management Plan will be amended to include the additional WRSAs and submitted for approval by the WLWB, and seepage management will continue to be addressed in this plan. The WPKMP will also be amended to incorporate the Jay-Cardinal Project.

Changes to groundwater are not expected with the continued use of mitigation and monitoring programs currently in place for the Ekati Mine. Therefore, these interactions were determined to have no linkage to effects to water quality, fish, soil, vegetation, caribou, carnivores, breeding birds, land use, and human health.

Construction of the Project may cause disturbance or destruction of heritage resources

The Archaeological Monitoring Program was initiated as part of the Ekati Mine‘s commitment to protect archaeological and heritage sites. Archaeological surveys have been completed at the site and documentation is ongoing. Archaeological assessments or investigations were completed annually from 1994 through 2007 at Ekati in conjunction with ongoing mine development and exploration. Archaeological investigations have typically involved a combination of aerial examination using a helicopter and ground reconnaissance. Areas with moderate to high archaeological potential are searched on foot, and exposures and bedrock outcrops within the development areas are closely examined. Areas with low archaeological potential are generally eliminated from further consideration during the helicopter reconnaissance survey.

Archaeological investigation of the Project area was conducted between 1994 and 1997, as well as in 2001 (Section 3.2.2); there are recorded archaeological sites within the proposed Jay-Cardinal Project. The areas along the esker on the west side of Lac du Sauvage are known to be important archaeological sites. DDEC has designed the Jay-Cardinal Project with knowledge of these sites and will accommodate them appropriately. Additional archaeological surveys specific to the Jay-Cardinal Project were completed in 2013.

Mitigation, preservation or protection of known artifacts or heritage resources is required. The Archaeological Sites Regulations outlines the importance of the identification, protection, and conservation of archaeology sites. The Ekati Mine implements a standard for the protection of any archaeological and heritage resources that may be encountered and identified during field operations; this standard will apply to the Jay-Cardinal Project. Although there are archaeological sites within the Jay-Cardinal Project area, there are mitigation practices in place to avoid or preserve heritage resources that may be identified during mine operations. As a result, this interaction was determined to have no linkage to effects on archaeology. However, due to areas at the outlet of Lac du Sauvage into Lac de Gras and the esker on the west side of Lac du Sauvage being known important traditional use and cultural sites, and expected concern from Aboriginal communities and others, it is expected that a more detailed evaluation of this interaction will be developed in the EA.

Alterations in hydrologic conditions from the water supply requirements (mining and potable) for the Project

Alterations in hydrologic conditions from the water supply requirements (mining and potable) for the Project could affect soils, vegetation, fish, caribou, carnivores, breeding birds, and land use. At present, freshwater for Ekati operations is permitted to be drawn from Grizzly Lake, Little Lake, Thinner Lake (Misery Camp). The LLCF is the source of recycle water for process plant operations. An increase in the maximum allowable annual extraction of potable water from Grizzly Lake from 150,000 cubic metres per year (m^3/y) of potable water to 200,000 m^3/y was initiated between 2006 and 2008 (as per the Water Licence). Freshwater extraction from Grizzly Lake for the purpose of potable water has not increased since the inception of the new maximum (BHP 2012).

It is not anticipated that water demand will increase for the Jay-Cardinal Project; therefore, the existing potable water system at site will be used. The site water management system is designed to recycle water, where applicable, and reduce requirements for water withdrawal. For example, raw water required for operations will be taken from the LLCF. Because an increase in water demand is not expected and the current site water management system will continued to be used, no changes in hydrologic conditions from water supply requirements are expected. Therefore, this interaction was determined to have no linkage to effects to fish, soil, vegetation, caribou, carnivores, breeding birds, land use, and human health.

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The use of explosives near fish-bearing water can cause injury or mortality to fish

The use of explosives in or near fish-bearing waters has the potential to injure or kill fish. Detonation of explosives in or near water creates compressive shock waves that rapidly rise to high peak pressures then rapidly decrease to below ambient hydrostatic pressure (Wright and Hopky 1998). The rapid decrease in pressure produced by blasting has the potential to negatively affect fish in the vicinity by damaging the swim bladder and other soft organs (Wright 1982; Keevin et al.1999). Fish eggs in the area affected by pressure waves may also be damaged by the movement of the substrate in which they are embedded (Wright 1982; Faulkner et al. 2006). The severity of effects is related to the type of explosive, weight and pattern of the charge(s), method of detonation, distance from the fish to the point of detonation, water depth, and the species, size, and life stage of fish.

Fish will continue to reside in nearby lakes during operations, but these fish will not be affected by blasting because these lakes are located a considerable distance from the mine pits. Within Lac du Sauvage, all blasting and excavation will occur in the drawn-down areas of the lake where no water or fish will be present. The blasting program will comply with DFO's Guidelines for the Use of Explosives in or Near Canadian Fisheries Waters (Wright and Hopky 1998) which outlines procedures to avoid harming fish. As a result, this interaction was determined to have no linkage to effects to fish.

Introduction of non-native plant species can affect vegetation

Ground disturbance can result in the introduction of weed and invasive plant species because many weed species favour disturbed areas. Weedy plant species have potential to disrupt plant communities and decrease habitat quality (Mack et al. 2000; Carlson and Shepherd 2007; Truscott et al. 2008). Weed species introduced into natural areas have the potential to affect plant community structure and species diversity directly through competition and indirectly through alterations to soil microorganisms, nutrients, and soil moisture (Mack et al. 2000; Truscott et al. 2008).

Vehicles and machinery can serve as dispersal mechanisms for plant propagules (seeds and/or vegetative parts) that can get lodged in tires, the undercarriage, or mud on the surface of the vehicle. New equipment that is required for the Jay-Cardinal Project will be cleaned prior to transportation on site and while at site to avoid the possible introduction of non-native plants. Reclamation objectives in the Ekati Mine ICRP reflect the local native vegetation communities. Therefore, this interaction was determined to have no linkage to effects on vegetation.

Attraction to the Project (e.g., food waste, oil products) may increase human-wildlife interactions and mortality risk to individual animals or may increase predator numbers and predation risk, which can affect prey population size

The goal for managing wildlife incidents at the Ekati Mine is to reduce the potential for wildlife-related safety concerns for employees, and to mitigate any potential effects of mine activities on wildlife (BHP 2012). Natural wildlife activity and ecological processes are left undisturbed unless they could result in harm or risk of harm to mine staff. An incident is defined as an interaction between an animal (or animals) and human (or humans) that has compromised (or is likely to compromise) the safety of either or both the animal(s) and human(s). Incidents also include any action where deterrent measures are deemed necessary. Incidents involving wildlife in close proximity to the mine and associated developments (e.g., roads) are managed to minimize risk to wildlife.

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DDEC practices successive levels of deterrents, starting with avoidance (removing crews from the area), visual monitoring, truck deterrence (including horn), bear bangers, rubber bullets, and helicopters. Dispatching an animal is only applied after successive levels of deterrents do not deter an animal from site and after consultation and approval from the GNWT Environment and Natural Resources (ENR). A decrease in the numbers of wildlife observations (wildlife and wildlife signs) at the Ekati and Misery landfills suggests that waste management practices have been effective (BHP 2012).

The Project will not result in additional sources of attractants, and waste management practices are in place for the Ekati Mine. Littering and feeding of wildlife is prohibited. Recent changes to the waste management practices include an incinerator enclosure and more frequent burning of camp waste, an increase in employee education on waste management practices and issues surrounding habituation, and increased frequency of inspections of landfill sites and waste storage areas.

With current management of waste at the Ekati Mine, the addition of the Jay-Cardinal Project is not expected to increase wildlife attraction to the Project. Therefore, attraction to the Project was expected to have a negligible residual effect to humans, caribou, carnivores, breeding birds, and land use.

6.3.4 Interactions with Secondary Linkages

In some cases, both a source and an interaction exist, but because the change caused by the Project is anticipated to be minor, it is expected to have a negligible residual effect on VCs relative to baseline conditions or values. The following interactions as outlined in Table 6.4-1 and described in more detail below, are expected to be minor and were not carried through to the assessment of primary interactions and residual risks (Section 6.5):

Physical Disturbance from Project Footprint

- Changes to permafrost conditions from the Project footprint
- Direct loss and fragmentation of plant communities and wildlife habitat from the Project footprint (pit, dams/dikes and WRSAs, access road)
- Site preparation and construction can result in the destruction of nests, eggs, and individuals of migratory birds (incidental take)
- Release of sediment during construction of the dikes in Lac du Sauvage
- Impingement and entrainment of fish in intake pumps during construction activities (i.e., dike construction) may cause injury and mortality to fish

Site Water Management

- Removal of lake water in Lac du Sauvage may cause changes to permafrost conditions within the exposed lake bed and groundwater flow
- Changes in surface water flow paths from diversions may change water quality in receiving waterbodies (e.g., suspended sediments, metals, nutrients)
- Increase in water levels in surrounding waterbodies from diversions may result in release or generation of suspended sediments, nutrients, mercury or other substances from flooded sediments and vegetation

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- Increase in water levels in surrounding waterbodies from drawing down Lac du Sauvage or diversions may result in destruction of nests, eggs, and individuals of migratory birds (incidental take)
- Drawdown of Lac du Savage may result in newly established vegetation on the exposed lakebed sediments and increase habitat quantity
- Operational discharge may affect water quality in receiving waterbodies

General Construction and Operations Activities

- Dust deposition may cover terrestrial plant communities
- Sensory effects from the presence of buildings, lights, smells, noise, blasting activity, and traffic may affect wildlife or the quality of life for local land users
- Saline groundwater inflow from the mine pits during pit development may cause changes to groundwater quantity and quality, and affect surface water quality
- Physical hazards from the Project (e.g., animals becoming trapped in exposed sediments or in fences) may increase risk of injury or mortality to individual animals.
- Traffic along the site access roads may result in wildlife-vehicle collisions
- Inhalation of air or ingestion of soil, vegetation, or water that has been chemically altered by air and dust emissions, seepage from waste rock piles and kimberlite stockpiles, pit water storage, or in the exposed lakebed areas of Lac du Sauvage
- The project may impact Communities (IBAs, SEAs, and Community Structure)
- The project may impact Infrastructure, Services, and Land Use

General Closure and Decommissioning Activities

- Refilling of Jay and Cardinal pits may affect groundwater quality

Changes to Permafrost Conditions from the Project Footprint

Loss and alteration of permafrost from the Project footprint has the potential to affect surface hydrology, soils, vegetation, and land use. Freeze-induced displacement of soil (i.e., frost jacking) and thaw-induced displacement (i.e., subsidence) of soil are the main issues related to permafrost degradation (i.e., loss or alteration). Changes to thaw penetration and thickness of the active layer can influence surface stability through thaw settlement, frost heave, and bearing capacity, as well as slope stability (Tarnocai et al. 2004). Changes can also affect hydrology, soil moisture, and nutrient availability, thereby influencing the ecology of an area by affecting vegetation.

Numerous factors affect the magnitude of changes to permafrost areas and influence recovery of an area following disturbance: type of construction activities, site infrastructure, vegetation, soil type, soil texture, density, water content, and snow depth (Lawson 1986; Nolte et al. 1998; Jorgenson et al. 2010). Thaw settlement caused by disturbance and subsequent melting of permafrost can initially lead to water impoundment, decreased albedo, and an increase in heat flux, which in turn causes more thaw settlement (Jorgenson et al. 2010). This can result in a change in surface hydrology that shifts recovery patterns towards new plant communities, further influencing permafrost. The depth of the active layer may

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continue to increase as a result of disturbance (Burgess and Harry 1990; Burn and Smith 1993; Hayhoe and Tarnocai 1993).

The 1995 EIS predicted that local disturbance of the permafrost layer would occur due to mine activities such as the digging of open pits, storage of waste rock, and construction of roads and the LLCF; however, the disturbances were predicted to be local in nature and restricted to the mine footprint. These predictions have been verified. The low relief of the claim block and the implementation of appropriate engineering design and construction practices specific to Arctic areas typically mitigate most of the mine effects on permafrost. Permafrost will also form within the WRSAs as they cool.

Mitigation and environmental design features to reduce the potential for permafrost melting are:

- Design of the Jay-Cardinal Project minimizes the construction of new buildings, roads, pads, or excavations that might have an effect on permafrost;
- Footprints of the WRSAs and other structures will be optimized to limit surface disturbance to the extent practical; and,
- Buildings will be insulated to minimize heat loss, and will be dismantled as part of reclamation activities, which will allow for a return to pre-development conditions.

By implementing mitigation practices, limited, local changes to permafrost within the footprint of the Project are anticipated. Therefore, this interaction was considered to have negligible effects to surface hydrology, soils, vegetation, and land use.

Direct loss and fragmentation of plant communities and wildlife habitat from the Project footprint (pit, dams/dikes and waste rock storage areas, access road)

Direct loss and fragmentation of vegetation ecosystems and plants may occur from the Project footprint. However, mitigation has been included in the Project design and the footprint disturbance area will be limited to the extent possible. The site access road route follows existing roads and/or trails as available to limit land clearing. Existing trails will be stabilized as necessary to avoid encroachment problems and to protect adjacent habitat.

In the EA, effects to vegetation ecosystems and plants may be assessed using Ecological Land Claddification (ELC) information, field survey data, and the Project footprint. This may include ecosystem types or plants considered especially sensitive to disturbance (e.g., wetlands and riparian areas), those with a restricted distribution in the study area (including rare plant communities), plant species listed as being “at risk”, and plant species identified from traditional use studies. However, it is not expected that such anticipated further investigation will reveal major residual effects because of: the limited terrestrial disturbance associated with the footprint of the Project; the expectation that only a small amount of vegetation ecosystems will be removed due to Project infrastructure within the study area; and the fact that the direct effects from the Project footprint on vegetation ecosystems and plants are expected to be localized.

Much of the disturbance associated with the Project footprint will be reversible given sufficient time. Disturbances to Arctic terrestrial ecosystems are largely reversible although, without active reclamation

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activities, the length of time required for recovery could be between 20 and 75 years (Forbes et al. 2001; Walker and Everett 1991). Active reclamation will occur to optimize recovery timelines.

Effects to vegetation ecosystems and plants from the Project may also be associated with potential changes in food quantity and quality for ungulates (e.g., caribou and muskoxen). However, the local-scale effects from the Project on vegetation are expected to have a minor effect on the quality and abundance of food for caribou and other ungulates.

The direct loss and fragmentation of wildlife habitat may also occur from the physical footprint of the Project, which also has the potential to alter wildlife movement and behaviour. The access road may also cause changes to wildlife movement and behaviour, including caribou. For wildlife VCs, the incremental and cumulative direct habitat effects from the Project footprint and other previous, existing, and future developments will be analyzed through changes in the area and spatial configuration of habitat types on the landscape (i.e., landscape metrics). Landscape metrics include total area, number of patches, and mean distance to the nearest similar patch. Overall, the Project is expected to disturb a relatively small amount of terrestrial landscape in the study area, and as a result would be expected to have relatively minor effects on wildlife habitat including caribou seasonal ranges.

Due to the small and localized amount of new disturbance, and the implementation of mitigation, this interaction was considered to have negligible residual effects on the physical/terrestrial environment (vegetation), caribou, carnivores, and breeding birds, and land use. However, due to expected stakeholder concerns regarding potential loss and fragmentation of wildlife habitat, including potential effects on caribou movement through the minesite, a more detailed evaluation of this interaction is expected to be developed in the EA.

Site preparation and construction can result in the destruction of nests, eggs, and individuals of migratory birds (incidental take)

The majority of the site preparation and vegetation removal is expected to include the site access road, WRSAs, support building, quarries, laydown areas, and the shoreline of Lac du Savage (i.e., for dike construction, pumping, and water management activities). The *Migratory Birds Convention Act* prohibits the destruction of migratory bird nests (passerine, waterfowl, and raptor) during the breeding season. In the NWT, the migratory bird breeding season extends from approximately May 15 to July 31.

Project activities will be completed in accordance with the *Migratory Bird Convention Act*. To the extent possible, vegetation clearing will take place outside of the migratory bird season, resulting in little chance of destruction of migratory bird nests. If site clearing activities must be completed during the migratory bird breeding season, vegetation removal will be completed prior to the nesting season or nest searches will be completed prior to construction. If nests are found during nest searches, mitigation will be applied to avoid the incidental take of nesting individuals.

Due to the implementation of mitigation practices, the nesting success of birds from Project site preparation and construction is not expected to change relative to background/baseline conditions as a result of the Project. Therefore, this interaction was considered to have negligible effects on breeding birds and land use.

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Release of sediment during construction of the dikes in Lac du Sauvage

Dikes JP1, JP2, and JP4 will be constructed in Lac du Sauvage to allow for lake drawdown and access to the Jay and Cardinal pits. Detailed plans will be developed and implemented for each of the dikes. The plans will incorporate detailed dike design, a construction plan, and a sediment control plan. Dike construction will preferentially avoid freshet flows, where practical. Sediment control measures will be implemented during dike construction. For example, silt curtains will be installed, as appropriate, for turbidity control and to minimize release of suspended sediments to the receiving environment. The silt curtains will be installed before construction and will be maintained until construction of the dike is completed and suspended sediment concentrations between the dike and silt curtain have been reduced. With this measure in place, sediment re-suspension in the water column is expected to be minor. Silt curtains are a well-established mitigation technique that has been demonstrated to be effective during dike construction at Ekati, as well as at other mines in the NWT. Water quality monitoring will be conducted during dike construction activities.

As a result of mitigation measures, the construction of dikes in Lac du Sauvage is expected to result in a minor change to water quality through increases in total suspended solids (TSS) from the disturbance of the lake bed. The use of sediment and erosion control measures (e.g., silt curtains), and undertaking water quality monitoring programs during construction, will minimize the amount of suspended sediment in the lake, which would be expected to be fairly localized. Therefore, this interaction was considered to have negligible residual effects to water quality and fish.

Impingement and entrainment of fish in intake pumps during construction activities (i.e., dike construction) may cause injury and mortality to fish

Intake pumps will be used as part of construction activities associated with the Project (e.g., during dike construction activities), or as part of water management. Impingement or entrainment of fish may occur at intake pumps used for the Project. However, the intake pumps used for the Project in fish-bearing waters will be appropriately screened to meet regulatory requirements to prevent fish entrainment or impingement (DFO 1995). The appropriate screen mesh size will be determined for the planned pumping rates to limit or prevent fish from entering the pumps. The screens will also be regularly maintained throughout the pumping period.

The implementation of screening measures and maintenance of intake pumps is expected to limit fish mortality resulting from impingement or entrainment. Mortalities of any young life stages smaller than the screen mesh size will occur but will be highly localized and are not anticipated to adversely affect fish populations or recruitment. Therefore, this interaction was considered to have negligible residual effects on fish.

Removal of lake water in Lac du Sauvage may cause changes to permafrost conditions within the exposed lake bed and groundwater flow

A talik exists under Lac du Sauvage. During construction and operations, the main body of the lake will be drawn down, and shoreline areas of the lake will be exposed to cold air temperatures for the duration of mining operations (estimated between 10 and 20 years). The exposure may result in the formation of permafrost in the exposed areas. However, the permafrost aggradation on the exposed lake bed is expected to have limited penetration during the period of exposure, and is expected to result in negligible effects on groundwater flows and on surface water quality. After lake refilling, the permafrost that may

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have formed during the operational life of the Project will slowly degrade over time, because of the insulation and heat provided by the refilled lake. A return to pre-development conditions in the reflooded areas is expected. Thus, this interaction was considered to have negligible effects to groundwater, surface hydrology, and surface water quality.

Changes in surface water flow paths from diversions may change water quality in receiving waterbodies (e.g., suspended sediments, metals, nutrients)

To reduce the amount of natural runoff into the drawn-down areas of Lac du Sauvage, and the amount of water that must be managed by the site water management system, upstream tributary watersheds will be diverted during operations. These diversions will remain in place through mine operations (estimated between 10 and 20 years).

In general, the water quality between neighbouring lakes is similar; therefore, the only effects to water quality from diversions would potentially be through the construction of dikes and through the potential for increased TSS (and associated constituents) from bed and bank erosion due to increased flows.

During the construction of water retention and water diversion dikes in the upper watersheds, erosion and sediment control measures, such as silt curtains, will be used to minimize the release of suspended sediment to the receiving waterbodies. Monitoring will be conducted throughout the construction period. Diversions will also be designed to take into account fish movement.

As a result of the design and mitigation activities, this interaction was considered to have negligible residual effects to surface water quality, fish, physical/terrestrial environment, and land use. However, due to expected stakeholder concerns regarding water quality, a more detailed evaluation of this interaction is expected to be developed in the EA.

Increase in water levels in surrounding waterbodies from diversions may result in release or generation of suspended sediments, nutrients, mercury or other substances from flooded sediments and vegetation

The raising of water levels in surrounding waterbodies has the potential to cause the leaching of minerals and nutrients from the soil and vegetation in the area to be inundated. Following construction of the dikes, some lakes within the diverted watersheds will fill to their new level (estimated to be ≥ 2 m) through natural drainage. The flooding of the riparian habitat may result in a surge in nutrient concentrations. The nutrient surge would occur primarily from the decomposition of the flooded vegetation, and may cause an initial increase in primary (i.e., phytoplankton) and secondary (i.e., zooplankton and benthic invertebrate) production, and a subsequent increase in growth of fish.

The release of metals would primarily be related to increased suspended sediment from erosional processes as the lake established a new level. TSS concentrations will be elevated during spring freshet inflows through the lakes and as a result of wave action. However, any elevation in the concentration of metals associated with TSS from these sources is anticipated to be temporary. Lake shorelines will be assessed for erosion potential, and mitigation will be applied to areas identified with high potential for erosion, generation of suspended sediments, and/or contaminant release.

The inundation of soils and vegetation can also potentially increase the concentration of methylmercury in fish. The availability of methylmercury to aquatic organisms may increase due to the new sources of

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inorganic mercury being introduced to the water from the soil and vegetation, and microbial activity due to increased nutrient additions. Methylmercury generally becomes more concentrated in higher trophic levels, particularly top-predatory fish, such as Lake Trout (Wright and Hamilton 1982; Bodaly and Lesack 1984; Brouard et al. 1990; Hecky et al. 1987, 1991; Kidd et al. 1995).

The effects of flooding on the riparian habitats around lakes to be raised from diversions is expected to be minor due to the following:

- Changes to water quality (i.e., increased turbidity) would be temporary;
- Due to the natural armouring of shorelines, large increases in suspended sediments would not be expected;
- Physico-chemical water quality variations due to flooding are temporary, peak relatively quickly, and subside over time;
- Naturally low nutrient levels in the surface soils and cold temperatures throughout the year limit bacterial production, resulting in lower rates of decomposition and methylation compared to warmer waterbodies where large increases in nutrient releases to the water column and mercury accumulation in fish have been documented; and,
- Mercury concentrations in fish typically peak in 4 to 5 years and then return to pre-impoundment concentrations usually within 10 to 15 years after flooding (Legault et al. 2004; Bodaly et al. 1997).

The raised lakes will also be lowered at the end of operations when the diversions are removed, and the systems are expected to return to pre-development conditions over time. Therefore, this interaction was considered to have negligible residual effects to water quality, fish, physical/terrestrial environment (soils and vegetation), caribou, carnivores, breeding birds, and land use.

Increase in water levels in surrounding waterbodies from drawing down Lac du Sauvage or diversions may result in destruction of nests, eggs, and individuals of migratory birds (incidental take)

Drawing down Lac du Savage may result in temporary fluctuations in water levels in downstream waterbodies. A Lac du Sauvage Drawdown Plan will be prepared for the WLWB. Because the changes in water levels are expected to be small, temporary, and within natural variability, no change to riparian vegetation is anticipated.

The diversions associated with Project will cause shorelines to be raised in some lakes during the period of operations. Alterations to natural water level fluctuations in adjacent waterbodies have the potential to influence riparian vegetation used by migratory birds by changing soil moisture (Nilsson and Svedmark 2002; Leyer 2005). Although riparian vegetation is adapted to thrive at the aquatic/terrestrial boundary, it is sensitive to changes in soil moisture (Nilsson and Svedmark 2002; Leyer 2005). If water levels were to change permanently in adjacent waterbodies, aquatic and terrestrial vegetation in the riparian area would change in relation to the changes in soil moisture (Shafroth et al. 2002). However, permanent change is not expected. As soil moisture levels change as a result of reduction of water level fluctuations, plant species that thrive in more stable soil moisture regimes will out-compete riparian vegetation that relies on these fluctuations (Shafroth et al. 2002; Leyer 2005). However, permanent change is not expected.

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The *Migratory Birds Convention Act* prohibits the destruction of migratory bird nests (passerine, waterfowl, and raptor) during the breeding season. In the NWT, the migratory bird breeding season extends from approximately May 15 to July 31. For the shorelines of lakes to be raised, vegetation removal will be completed prior to the nesting season or nest searches will be completed prior to dike construction and water levels being raised. If nests are found during nest searches, mitigation will be applied to avoid the incidental take of nesting individuals.

The nesting success of birds in the area of the Project is expected not to change appreciably relative to background/baseline conditions from the increases in water levels in local waterbodies. Therefore, this interaction was considered to have negligible effects on breeding birds and land use.

Drawdown of Lac du Savage may result in newly established vegetation on the exposed lakebed sediments and increase habitat quantity

Drawdown of Lac du Savage may result in newly established vegetation in areas of exposed lakebed sediments during the period of exposure. This may increase habitat quantity, which can affect caribou, carnivores, breeding birds, and land use. The development of the Project will require the drawdown of Lac du Savage, resulting in the exposure of a portion of the lakebed and increase the potential for vegetation to establish on the exposed lake-bed sediments. The exposure of bare, nutrient-rich lakebed sediments can provide a substrate that may favour the establishment of rapid colonizing plants (Shafroth et al. 2002). If the substrate remains moist during the initial stages of plant colonization, then riparian plant species may become established on the exposed lake bed. Over time as the substrate becomes drier, the species composition may shift to plants more commonly found in upland areas.

The margin of Lac du Savage is characterized by boulder and cobble substrates, which will likely act as a barrier to vegetative propagation into the lake from surrounding tundra, and limit colonization of the lakebed by terrestrial vegetation. A low rate of seed dispersal and slow vegetative growth currently occurs around margins of the lake. Vegetation is expected to establish slowly and coverage will likely be patchy; colonization by invasive species is unlikely. Colonization by terrestrial species within exposed lake bed areas will be reversible when these areas are reflooded. Therefore, this interaction was considered to have a negligible residual effect in terms of increased terrestrial habitat quality.

Operational discharge may affect water quality in receiving waterbodies

As part of the water management plan, minewater will be discharged during the operations phase. Discharge of this water to receiving waterbodies may potentially affect water quality in the receiving and downstream waterbodies. For example, runoff from facilities may carry high levels of TSS. As well, there may be seepage of nitrogen compounds (i.e., ammonia and/or nitrate) from waste rock excavated using explosives. There may also be elevated metals or nutrient concentrations associated with mine-related sources.

However, the operational discharge will meet water quality discharge criteria. Discharge water is regularly sampled and monitored as part of Ekati's Water Licence Surveillance Network Program. WRSAs will be monitored and reported annually such that any necessary mitigations against risks to the receiving environment can be identified and implemented in a timely manner.

As water will only be discharged when it meets water quality criteria, this interaction was considered to have a negligible residual effect to water quality and aquatic life other than fish, fish, caribou, carnivores,

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and breeding birds, land use, and human health. However, as potential impacts to water quality associated with the operational discharge are likely to be identified as a concern by stakeholders, it is expected that a more detailed evaluation of this interaction will be developed in the EA.

Dust deposition may cover terrestrial plant communities

Dust emissions and subsequent deposition can cover vegetation, which may have a physical or physiological effect on plants. Larger dust particles can cause visible injuries and abrasions (Farmer 1993; Grantz et al. 2003), while smaller dust particles landing on leaves can affect photosynthesis by blocking sunlight and reduce respiration and transpiration by clogging stomata (Farmer 1993; Grantz et al. 2003). Dust on vegetation can also result in a reduction of plant growth and biomass, and may alter species composition (Grantz et al. 2003). Walker and Everett (1987) and Everett (1980) reported that few vascular plant species showed physiological effects from dust, except where vegetation was subject to very high dust loading.

Dust deposition from the Project is not predicted to affect vegetation in areas outside of the immediate vicinity of the footprint. For example, the AQMP has indicated that, for the Ekati Mine, volumes of fugitive dust loadings are small and there is a large gradient in total suspended particulates (TSP) deposition close to sources (i.e., rates of deposition decrease with distance). Dustfall monitoring results indicate that fugitive dust levels adjacent to active haul roads (i.e., high use areas) are elevated immediately adjacent to the road but fall off quickly with distance. Elemental concentrations in two lichens species used for AQMP monitoring indicate that existing mine dust effects decline with distance from the mine site (BHP 2012).

The WEMP will incorporate the Jay-Cardinal Project and will continue to monitor any effects to vegetation through the AQMP. It is expected that dust covering vegetation will have negligible to minor effects to plant communities in close proximity to the Project. Therefore, this interaction was considered to have a negligible residual effect to caribou, carnivores, and breeding birds. However, as dust deposition on vegetation is likely to be identified as a concern by stakeholders, it is expected that a more detailed evaluation of this interaction will be developed in the EA.

Sensory effects from the presence of buildings, lights, smells, noise, blasting activity, and traffic may affect wildlife or the quality of life for local land users

Sensory effects and noise emissions from the Project can cause effects to caribou, carnivores, breeding birds, and land use. Project development may generate sensory disturbances including increased noise levels and visual disturbances from moving vehicles and humans during construction and operations. The area surrounding human activities where sensory disturbances may affect animal behaviour and movement is often referred to as the ZOI. Animals may respond to sensory disturbances by reducing their occupancy and use of habitats within the ZOI, which can lead to local changes in abundance and distribution (Tyler 1991; Fortin and Andruskiw 2003; Bayne et al. 2008; Benítez-López et al. 2010). Effects can vary and responses appear to be species-specific (Dickson and Beier 2002; Habib et al. 2007; Bayne et al. 2008; Fahrig and Rytwinski 2009; Benítez-López et al. 2010). Factors that appear to influence the magnitude of effects include the type of disturbance, the frequency and intensity of the disturbance, and the level of habituation to disturbance (Fortin and Andruskiw 2003; Bayne et al. 2008; Fahrig and Rytwinksi 2009).

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An 11 to 14 km ZOI has been identified for caribou around the Ekati – Diavik Mine area (Boulanger et al. 2012). Nevertheless, numerous (in many years, thousands) of Bathurst caribou are observed to pass through the Ekati Mine area every year during both the northern and southern migrations and during the post-calving period. For example, a group of over 3,000 animals passed through the mine site on October 4, 2010, and over 5,000 animals passed through the mine site on October 12, 2010.

Noise from mine-related activities (i.e., blasting, sirens, haul trucks, etc.) has had a minor effect on caribou behaviour (BHP 2012). As the distance from such activities increased, or if a group did not have calves, there was a reduced likelihood of any response. There was no difference in the frequency of caribou groups exhibiting comfort (e.g., bedding) versus movement (e.g., running, alert) behaviours with increasing distance from mine infrastructure. Non-nursery groups exhibited the greatest responses to stressors, including blasts, humans, and heavy trucks. For nursery groups, there was an increased likelihood of a response when the stressor was closer to the group. Feeding behaviour was not affected by distance from mine infrastructure for both nursery and non-nursery groups. However, behavioural response to vehicles was consistent with other studies that suggest caribou increase vigilance in response to traffic (Wolfe et al. 2000; Dyer et al. 2001).

Roads may act as a potential deterrence or attractant for wildlife (Forman and Alexander 1998; Trombulak and Frissell 2000). Road avoidance or attractant behaviour vary between species and within species such that certain populations, age groups, genders, or individuals react either positively or negatively to roads. In some cases, movement patterns change as a result of wildlife avoiding roads (Klein 1991), while in other cases, wildlife use roads as travel corridors, refuge habitat, or food sources (Forman and Alexander 1998). Mitigation and management strategies have been adopted at Ekati to prevent roads from acting as barriers to caribou movement; however, roads may also be acting as travel corridors for carnivores. For example, wolf presence within the Ekati area has been relatively consistent over the last 11 years (BHP 2012). Family groups including pups have been continually observed within the Ekati study area. The majority of observations occurred relatively close to mine infrastructure (e.g., airport, helipad) or along the Misery and Fox Haul roads.

Results of the WEMP indicate that wildlife have continued to use the area around the Ekati Mine and wildlife in the vicinity of the Ekati Mine may be habituated to current levels of activity. The addition of the Jay-Cardinal Project is expected to result in minor changes to sensory effects from Project components and noise relative to existing conditions at the Ekati Mine. Therefore, this interaction was considered to have negligible residual effects to caribou, carnivores, breeding birds, and land use. However, as sensory effects on wildlife, including caribou, are likely to be identified as a concern by stakeholders, a more detailed evaluation of this interaction is expected to be developed in the EA .

Saline groundwater inflow from the mine pits during pit development may cause changes to groundwater quantity and quality, and affect surface water quality

Creation of the open pits may induce groundwater to flow toward these areas. Groundwater seeping into the open pits will originate from surface waters and from deep bedrock. Groundwater flow originating from deep bedrock will draw high TDS content groundwater to the pits. The TDS content of groundwater flowing into the pits will likely increase as each pit gets deeper.

A minewater management plan will be developed for the Jay and Cardinal pits according to practices established in the WPKMP. As part of the pit water management plan, sumps, dikes, and pumping will be employed to manage water entering the open pits during mining. Groundwater inflows collected in the pits will be pumped out via a pipeline to be incorporated into the minewater management, monitoring, and discharge system at the North Arm Water Management Area.

No measureable reduced water levels in the surrounding lakes is anticipated based on operating experience and data gained at the Ekati Mine over the past 15 years of mine operations. An analysis of projected groundwater inflow rates and associated TDS mass loading rates to the mine pits will be completed for the Project. This interaction is considered, at this time, to have negligible residual effects to groundwater and water quality. However, a more detailed evaluation of this interaction is expected to be developed in the EA to assess the validity of this conclusion.

Physical hazards from the Project (e.g., animals becoming trapped in exposed sediments or in fences) may increase risk of injury or mortality to individual animals

Physical hazards from the Project may increase risk of injury or mortality to caribou, carnivores, breeding birds, and change land use. Project infrastructure may be hazardous to wildlife. Birds are vulnerable to collisions with man-made structures and are common victims of electrocution by power lines (Bevanger 1998; Erickson et al. 2005; Drewitt and Langston 2008). Mammals are more likely to become tangled in fencing or wire laying on the ground that may result in injury.

For example, five caribou mortalities have been reported in annual WEMPs between 2009 and 2010 that were related to fence entanglement (BHP 2012). In response to these incidents, The Ekati Mine developed new strategies to keep caribou off the airstrip and installed a Construction and Safety Barrier Fence in August 2010 to reduce caribou entanglement. There have been no physical hazards that resulted in mortalities of fox, grizzly bears, wolves, or wolverine between 2009 and 2011 (BHP 2012).

The WEMPs provide information that will continue to improve mitigation for reducing hazards to wildlife. The addition of the Jay-Cardinal Project is not expected to increase risk of injury or mortality to individual animals. Therefore, this interaction was considered to have negligible residual effects to caribou, carnivores, breeding birds, and land use.

Traffic along the site access roads may result in wildlife-vehicle collisions

Traffic along the site access roads may result in wildlife-vehicle collisions. During the life of the Ekati Mine to date, there have been no vehicle or aircraft-related caribou deaths as a result of collisions (BHP 2012). Mitigation to reduce potential for collisions with caribou include road closures during migration. For example, during fall migration in 2010, Misery Road was closed to all traffic from October 4 to 8, and from October 12 to 13. Misery Road was restricted to essential traffic between October 13 and 18, when groups of caribou were in the vicinity of the road. Sable Road was also closed from October 13 to 18 of 2010.

One young wolf was killed by a collision with a haul truck in 2001; poor weather conditions and visibility were responsible (BHP 2012). One fox was killed in a vehicle collision in 2002 and one in 2005. One fox was involved in a vehicle collision in 2008. No grizzly bears or wolverines have been involved in vehicle collisions or other accidents at Ekati. Prior to 2006, there were three documented traffic-related wolverine mortalities.

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No vehicle-related mortalities for VC species have occurred between 2009 and 2011. Two fox mortalities were reported at Ekati from October 1, 2008, to September 30, 2009. One fox mortality may have been vehicle-related. The other fox was found deceased between the process plant and the reclaim building, cause of death unknown. In 2010, four fox mortalities were reported. Only one of the four fox was documented to be killed by a landing aircraft.

Several mitigation and management strategies have been adopted at Ekati to prevent wildlife from being injured as a result of collisions with vehicles. For example, drivers have standard safety training and are provided with awareness training and speed limits are established on all roads to reduce or prevent wildlife-vehicle collisions. There is signage is in place to identify caribou crossings and areas of high wildlife use and there is radio communication among drivers and main camp staff to alert drivers to caribou sightings on or near the road. Caribou ramps and crossings have been constructed at strategic locations along the Misery road; additional crossings may potentially be constructed for the Jay-Cardinal Project. As a result of the mitigation and management strategies currently employed at the Ekati Mine site, this interaction was considered to have negligible residual effect to caribou, carnivores, and breeding birds.

Inhalation of air or ingestion of soil, vegetation or water that has been chemically altered by air and dust emissions, seepage from waste rock piles and kimberlite stockpiles, pit water storage, or in the exposed lakebed of Lac du Sauvage

Inhalation of air or ingestion of soil, vegetation, and water that has been chemically altered by air and dust emissions seepage from waste rock piles and kimberlite stockpiles, pit water storage, or in the exposed lakebed of Lac du Sauvage could affect the health of caribou, carnivores, breeding birds, and humans. However, such effects have not occurred over the 16 year life of the Ekati Mine. Results from the AQMP suggest that environmental design features and mitigation measures implemented at Ekati are effective at mitigating the effects of the mine on air quality.

As described in Section 6.5.6, air and dust emissions and subsequent deposition are expected effects are likely to be localized and to result in minor changes to surface water, sediment, soil, and vegetation chemistry. Current monitoring also indicates limited impacts at the existing Ekati Mine site. As described in Section 6.5.7, design, mitigation and management programs are in place for seepage management and pit water management. Therefore, due to Project design and mitigation, this interaction was considered to have negligible residual effect to caribou, carnivores, and breeding birds, and human health. However, a quantitative assessment of air and dust emissions will be completed for the EA. Changes in water quality from air and dust emissions, as well as seepage from facilities, and pit water inflows will also be assessed in the EA.

The Project may impact Communities: IBAs, SEAs, and Community Structure

Project construction and operations will extend IBAs and SEAs. The Project will continue to act as an agent of social change within households and communities via rotational work schedules, population demographics (including the presence of out-of-area workers), and increased incomes. An assessment of this interaction will be completed in the socio-economic section of the EA.

The Project may impact Infrastructure, Services, and Land Use

Project contributions towards existing and new community improvement initiatives will continue. The use of local roads and airports for Project shipping and personnel transportation will continue as a result of

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construction and operations. Project personnel/components will continue to use existing services and infrastructure in the NWT. An assessment of this interaction will be completed in the socio-economic section of the EA.

Refilling of Jay and Cardinal pits may affect groundwater quality

The ingress of groundwater is expected to be slow prior to and during refilling, and is anticipated to approach zero once the pits are flooded beneath Lac du Sauvage. Density stratification will develop in the lower parts of the open pits and underground workings where the lower-density lake water will float on top of the higher-density saline water with no intermixing. At closure, natural water levels in Lac du Sauvage will be re-established, which is expected to eliminate any groundwater flow gradient towards the lake.

This interaction is considered, at this time, to have negligible residual effects to groundwater and water quality. However, a more detailed evaluation of this interaction will be developed in the EA to assess the validity of this conclusion.

6.3.5 Accidents and Malfunctions

Accidents and malfunctions occurring on-site have the potential to cause effects to VCs (Table 6.4-1). The potential for on-site spills was identified as having a potential interaction to water quality, aquatic life other than fish, fish, vegetation, caribou, carnivores, breeding birds, land use, and human health.

Spills (i.e., fuels, petroleum products, reagents) on site

Spills during construction, operations, or decommissioning and reclamation activities have the potential to change water and soil chemistry, which can adversely affect vegetation, water quality, aquatic life other than fish, fish, caribou, carnivores, breeding birds, land use, and human health. Mitigation identified in the Ekati Spill Contingency Plan and environmental design features will be in place to limit the frequency and minimize the extent of spills that have potential to occur during Project activities. Hazardous materials and fuel will continue to be stored according to regulatory requirements to protect the environment and workers. Fuel tanks will continue to be located in lined and bermed containment areas. Individuals working on site and handling hazardous materials will continue to be trained in spill response, and the Ekati Mine's standard policies will be followed.

The implementation of the Ekati Mine Spill Contingency Plan and environmental design features are anticipated to reduce the likelihood and extent of the release or spills of hazardous materials occurring on-site. No detectable changes to surface water and soil quality are expected. Therefore, this interaction was considered to have no linkage to effects on vegetation, water quality, aquatic life other than fish, fish, caribou, carnivores, breeding birds, land use, and human health.

6.3.6 Primary Interactions

The following interactions were determined to be primary and therefore are carried forward to the assessment of primary interactions and residual risks (Section 6.5):

Physical Disturbance from the Project Footprint

- Changes to local hydrology (surface water flows, drainage patterns, and lake levels) and possible effects to water quality
- Direct loss or alteration of fish habitat from the Project footprint

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Site Water Management

- Discharges from the drawdown of Lac du Sauvage may change flows, water levels, and channel/bank stability in downstream waterbodies, and potential physical effects on fish, other biota, and habitat
- Discharges from the drawdown of Lac du Sauvage may change water quality (e.g., suspended sediments, metals, nutrients) in receiving waterbodies
- Changes in surface water flow paths from diversions may change flows, water levels, and channel/bank stability in downstream waterbodies

General Construction and Operations Activities

- Air and dust emissions can affect air quality, and air and dust emissions and subsequent deposition can cause chemical changes to the environment including water quality
- Operational activities (i.e., altered drainage, runoff from facilities including WRSAs, pit inflows) may affect surface water quality
- The project may impact Population
- The project may impact Economy (Revenues and Procurement)
- The project may impact Labour Force (Employment, Training, and Education)

General Closure and Reclamation Activities

- Removal of project infrastructure may change flows, water levels, and suspended sediments in the watershed
- Refilling drawn-down areas may affect water quality in the refilled Lac du Sauvage and downstream, once reconnected

6.4 Assessment of Primary Interactions and Residual Risks

The intent of this section is to identify interactions associated with the Project that may lead to residual effects after implementing mitigation and environmental design features, and to focus the effects assessment for the Jay-Cardinal Project. Assessment of primary interactions and residual risks considers the primary Project interactions that likely result in measureable environmental changes and effects to VCs after implementing environmental design features and mitigation (Table 6.4-1; Section 6.4.5).

6.4.1 Changes to Local Hydrology from the Project footprint (surface water flows, drainage patterns, and lake levels) and possible effects to water quality

The footprint of the Project infrastructure may cause changes to local hydrology (e.g., flows, drainage patterns, lake levels). These changes also have the potential to affect water quality, fish, soils, vegetation, caribou, carnivores, breeding birds, and land use.

For example, localized effects were observed on flow volumes in the Koala Watershed with removal of Airport, Koala, Beartooth, Fox 1, and Panda Lakes, and conversion of Long Lake to the LLCF (BHP 2012). There was an alteration of flow volumes in the King-Cujo Watershed with dewatering of Misery Lake and conversion of King Pond to the King Pond Settling Facility. However, these changes were within natural variability.

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To assess changes in hydrology, a water balance model will be developed for the Project. The water balance for each watershed will consider rainfall and snowmelt runoff, inflow from upstream watersheds, changes in lake storage, lake evaporation, and outflow to downstream watersheds. The model will incorporate runoff coefficients from land surfaces, lake outlet stage-discharge rating curves, and degree-day models for snowmelt and spring ice melt in outlet channels. The model will take into account changes in surface area associated with each component of the Project footprint (e.g., site access roads, WRSAs, quarries, support buildings) and the potential change to the runoff into each subwatershed. This information will then be used to assess effects on flows, water levels, and channel and bank stability.

Mitigation will be applied to minimize potential hydrological and water quality changes from the Project footprint. The footprint disturbance area will be limited to the extent possible. Where possible, construction will take place during the winter to minimize disturbance to soils and vegetation, and runoff to local waterbodies. Standard erosion and sediment control measures (e.g., silt curtains, runoff management) will also be used during construction around areas to be disturbed, where necessary. Runoff and seepage from Project facilities will be managed where necessary.

Culverts will be installed or upgraded along site access roads, as necessary, to maintain drainage. The road route alignment will also minimize stream crossings and avoid sensitive habitat as feasible.

Due to the implementation of mitigation and because monitoring programs have shown that similar activities result in a minor change in local hydrology, it is anticipated that residual effects to surface hydrology, water quality, fish, and land use are not likely to be significant. However, this interaction was conservatively considered to be a primary interaction and will be more fully assessed in the EA.

6.4.2 Direct loss or alteration of fish habitat from the Project footprint

Changes to fish habitat will occur due to the development of the Project, e.g., excavation of the mine pits, diversions, watercourse crossings, placement of facilities, dikes, and other construction activities. The affected habitat areas include portions of Lac du Sauvage and adjacent lakes and streams within the Lac du Sauvage watershed. During the development of the EA, an assessment of all of the potential habitat losses from the Project and effects on fish will be completed. During the permitting stage, a plan will be developed in consultation with DFO to offset the loss of fish habitat associated with the development of the Project, as part of the *Fisheries Act* Authorization for the Project.

For watercourse crossings associated with the Project, appropriate mitigation measures will be used to avoid harm or damage to fish and fish habitat, including construction timing, preferred crossing methods, sediment and erosion control plans, and best management practices during construction. Where culverts are to be installed at fish-bearing watercourses, fish passage will be accommodated where necessary. Operational diversions will be designed to accommodate fish movement and migration.

Development of the Project will require drawing down the main body of Lac du Sauvage to access the Jay and Cardinal pits, resulting in a loss of fish habitat in this portion of the lake during the period of operations. A fish-out will be completed to remove fish prior to and during drawdown. The fish-out will be designed and implemented with engagement with DFO and the Ekati Mine IBA groups, and will follow the General Fish-out Protocol for Lakes and Impoundments in the Northwest Territories and Nunavut (Tyson et al. 2011). The Ekati Mine has experience in completing successful fish-outs for previous pit developments.

At closure, the lake will be allowed to flood with natural surface runoff. The in-lake dikes will be breached at one or more locations. Materials will be placed to extend shallower littoral areas on the sides of the dikes. Once refilled, the lake will be repopulated by natural migration of fish from upstream or downstream. Plankton and benthic invertebrate communities are expected to re-establish quickly once the refilled lake is connected to other waterbodies, forming the basis of the food chain for fish. It is expected that a self-sustaining fish community will be present in Lac du Sauvage post-closure, including the fish species currently in the lake (Lake Trout, Lake Whitefish, Round Whitefish, Burbot).

Water quality during flooding and prior to fish introduction will be monitored and tracked; if there are any substances present at concentrations of potential concern, appropriate adaptive management actions will be taken to provide safe water quality for fish.

This interaction was considered to be primary and will be assessed in the EA. However, implementation of the mitigation measures described above are anticipated to reduce the overall effects to fish and fish habitat. A plan will also be developed in consultation with DFO to offset the loss of fish habitat related to the development of the Project. Although this Project interaction will result in a change to fish and fish habitat, it is expected that this will be offset through compensation arrangements with DFO. Therefore, it is anticipated that residual effects to fish and fish habitat in the Lac du Sauvage watershed are not likely to be significant.

6.4.3 Discharges from the drawdown of Lac du Sauvage may change flows, water levels, and channel/bank stability in downstream waterbodies, and potential physical effects on fish, other biota, and habitat

Discharges from drawing down Lac du Sauvage may affect flows, water levels, and channel/bank stability in receiving waterbodies, as well as downstream waterbodies/watercourses. The discharges may also have physical effects on fish, other biota, and habitat.

As part of the hydrological model to be developed for the EA, a drawdown model will be created. The drawdown model will take into account the proposed pumping schedule, pumping rates, discharge locations, locations, volumes, etc. In the EA, an assessment will be made of the changes to flows and water levels associated with the discharge from drawing down Lac du Sauvage. This information will also be used in the EA to assess potential effects on fish and fish habitat from increased flows or lake levels.

As part of the water management plan, discharges will be located to prevent erosion in the receiving watersheds. This interaction was considered to be a primary interaction and will be assessed in the EA. However, it is anticipated that residual effects to surface hydrology, water quality and aquatic life other than fish, fish, and land use and are not likely to be significant.

6.4.4 Discharges from the drawdown of Lac du Sauvage may change water quality (e.g., suspended sediments, metals, nutrients) in receiving waterbodies

To drawdown Lac du Sauvage to access the mine pits, water will be discharged to receiving waterbodies, During the late stages of drawdown of the lake, a certain amount of the lake bed sediment may become resuspended in the water column.

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A water quality model will be developed to estimate the TSS levels in the lake during the drawdown, as well as potential effects from the discharge to the receiving waterbodies. Water quality monitoring will be conducted.

During drawdown of Lac du Sauvage, if TSS concentrations are too high for the direct release of water to the natural environment, the water will be pumped to the North Arm Water Management Area. A Lac du Sauvage Drawdown Plan will be prepared for the WLWB that will include locations and water quality monitoring. The discharge water will also be regularly sampled and monitoring will be conducted as part of the Drawdown Plan, and to meet regulatory requirements. The Aquatic Effects Monitoring Program implemented at the Ekati Mine will be expanded to include the Jay-Cardinal Project.

This interaction was considered to be a primary interaction and will be assessed in the EA. However, due to mitigation measures described above, it is anticipated that residual effects to surface water quality and aquatic life other than fish, fish, and land use are not likely to be significant.

6.4.5 Changes in surface water flow paths from diversions may change flows, water levels, and channel/bank stability in downstream waterbodies

To reduce the amount of natural runoff into the drawn-down area of Lac du Sauvage, and the amount of water that must be managed by the site water management system, upstream tributary watersheds will be diverted during operations. These diversions will remain in place until the start of refilling.

The water balance model to be developed for the EA will take into account all diversions and dikes associated with the Project. In the EA, an assessment will be made of the changes to flows and water levels associated with the diversions. This information will also be used to assess potential effects on fish and fish habitat from increased flows or lake levels.

As part of the overall Project design and the water management plan, watershed diversions will be designed to accommodate the flow volumes associated with the diversion and to minimize the potential for erosion and bank instability. All diversion channels will be designed and constructed to minimize erosion and sedimentation and to incorporate lessons learned from previous diversions at the Ekati Mine.

As a result of the diversions, water levels will be raised in some lakes. Raising of the water levels in these lakes will create new shorelines at higher elevations than existing shorelines (estimated 2 m). This will expose new soils, often on steeper slopes than the existing shorelines, to wave erosion and potential instability due to permafrost disturbance. New lake shorelines will be assessed for erosion potential, and mitigation will be applied for areas identified with high potential for erosion, and/or generation of suspended sediments.

This interaction was considered to be a primary interaction and will be assessed in the EA. However, it is anticipated that residual effects to surface hydrology, water quality, fish, and land use are not likely to be significant.

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6.4.6 Air and dust emissions can affect air quality, and air and dust emissions and subsequent deposition can cause chemical changes to the environment including water quality

Air and dust emissions and subsequent deposition can cause chemical changes to water and soil quality and cause effects to aquatic life other than fish, fish, vegetation, caribou, carnivores, and breeding birds. The 2012 EIR for Ekati indicated that typically there were low emissions of particulate matter and air quality measures were within applicable guideline values (BHP 2012).

For the EA, the air quality assessment will include Project and regional emission sources, such as the following: exhaust from stationary combustion sources (electrical generators, boilers, heaters, waste incinerators); diesel engine exhaust from mine mobile equipment (excavators, loaders, graders, haul trucks, dozers); fugitive dust from mine pit activities (blasting, drilling, loading/unloading, construction); mine access road grading and transport activities and ore processing; wind-blown lake-bed dust from drained lake areas in Lac du Sauvage; and, diesel engine exhaust from vehicle traffic on the site access road.

Stationary and mobile combustion exhausts are generally the primary sources of SO_2 and NO_X emissions. Particulate matter emissions are associated with mining activities that generate fugitive dust emissions. Polycyclic aromatic hydrocarbon (PAH) and volatile organic compound (VOC) emissions are predominantly from combustion exhausts; metal emissions are associated with all sources but to varying degrees. Air quality will be evaluated by comparison to ambient air quality guidelines that include NWT Air Quality Standards and National Ambient Air Quality Objectives. Results will also be provided to the water quality, vegetation, and human health components for their EA assessments.

All air quality impacts are likely to be local in geographic extent; emissions will cease when Project activities stop. Current activities at the mine are monitored under the AQMP, which will be amended to include the Jay-Cardinal Project. Results from the AQMP indicate that environmental design features and mitigation measures implemented at Ekati are effective at mitigating effects of the mine on air quality.

Diesel fuel is used during the transportation of kimberlite and waste rock, for heat and production of electricity, blasting, and other mine activities. Spatial analysis of 2011 snow chemistry data (the most recent data from this 3-year monitoring cycle) indicated that winter loading of TSS and metals likely associated with fugitive dust and fine particulates were not elevated in a zone directly surrounding the mine footprint and concentrations remained low with distance from mining activity (BHP 2012). Potential effects from dust are typically localized to within 50 m of the source and typically do not extend to the regional area (Grantz et al. 2003). The 2011 results were generally within the range of or lower than those reported for 2008 and 2005. Metals concentrations in lichens indicate that dust that contains metals is confined to a relatively small area, and declines with distance from the mine.

This interaction was considered to be a primary interaction and will be assessed in the EA. However, as the effects are likely to be localized, and monitoring indicates limited impacts at the existing Ekati Mine site, it is anticipated that residual effects to surface water quality, sediment, soil, and vegetation chemistry fish, caribou, carnivores, and breeding birds, land use, and human health are not likely to be significant.

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6.4.7 Operational activities (i.e., altered drainage, runoff from facilities including WRSAs, pit inflows) may affect surface water quality

Water quality models will be developed during the EA to predict water quality during Project operations. In general, the water quality model is a flow and mass-balance model that will be set up to account for all inputs and processes involved in the water management plan during the operational period. The water quality model will predict concentrations for a range of water quality parameters.

The model will take into account all factors associated with mine operations. As the water quality model is based on the Project water balance, it will take into account altered drainage within the watershed. Runoff from site infrastructure and facilities will include loadings from geochemical sources, blasting residues, and suspended sediments. Groundwater inflows from the pits will also be included. Water affected due to mine operations (e.g., dust and air emissions, process water) will also be incorporated, as appropriate. In the EA, the information provided in the water quality assessment will be used by the aquatic and fish health components in their assessments.

WRSA monitoring programs and the Waste Rock and Ore Storage Management Plan implemented at the Ekati Mine will be amended to include the Jay-Cardinal Project. Seepage management continues to be addressed as described in the Waste Rock and Ore Storage Management Plan.

This interaction was considered to be a primary interaction and will be assessed in the EA. However, due to Project design and mitigation, it is anticipated that residual effects to surface water quality and aquatic life other than fish, fish, caribou, carnivores and breeding birds, land use and human health are not likely to be significant.

6.4.8 The Project may impact Population

The Project may need to draw some workers from outside of the NWT, who may choose to reside either temporarily or permanently in the NWT. Many of these workers are expected to be already employed by the existing Ekati operations. An assessment of this interaction will be completed in the socio-economic section of the EA.

6.4.9 The Project may impact Economy: Revenues and Procurement

Project construction and operations will extend taxes and royalties paid to governments. Project contracting, service, equipment and supply requirements will extend opportunities for business activity in Northern communities. An assessment of this interaction will be completed in the socio-economic section of the EA.

6.4.10 The Project may impact Labour force: Employment, Training, and Education

Project workforce requirements will extend employment and related incomes, and create new positions during construction. Project-related training and education will continue to build mining-related labour force capacity. An assessment of this interaction will be completed in the socio-economic section of the EA.

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6.4.11 Removal of project infrastructure may change flows, water levels, and suspended sediments in the watershed

Following the completion of mining, the removal of Project infrastructure removal will occur. Buildings and infrastructure, which also includes roads and pads, will be reclaimed according to the methods described in the Ekati Mine ICRP. This will include removal of the overhead power line and power poles. Drainage patterns will also be re-established as close to pre-operational conditions as possible, with drainage ditches contoured or backfilled as appropriate to remove any hazards to wildlife.

Erosion and sediment control measures will be implemented where appropriate. Where feasible, long-term sediment control will be achieved by revegetation. Rock armouring will be used where appropriate. The removal of the Project facilities is not anticipated to have a measurable influence on surface hydrology and bank/channel integrity within the watershed. Drainage through the reclaimed areas of the Project is not expected to result in measurable changes to water and sediment quality in Lac du Sauvage; however, monitoring will be conducted with adaptive management as necessary.

The three in-lake dikes within Lac du Sauvage (JP1, JP2, and JP4) will be strategically breached, as described in Section 4.9.6. During excavation of the breaches, silt curtains or other sediment/turbidity mitigation measures will be utilized to reduce risks to water quality where necessary.

At closure, once the dikes are breached and the lake is refilled, Lac du Sauvage will once more become a fully functioning ecosystem. There will be a change in the bathymetry of the lake from the presence of the pits and the remaining sections of the in-lake dikes. Once natural water levels have been re-established, the refilled Lac du Sauvage will be reconnected to the downstream watershed, allowing unregulated downstream flow. There may be relatively small changes to the post-closure hydrological regime of the Lac du Sauvage watershed compared to pre-development; however, flows to Lac de Gras and downstream are expected to be similar to baseline conditions.

This interaction was considered to be a primary interaction and will be assessed in the EA. However, due to Project design and mitigation, it is anticipated that residual effects to surface hydrology, water quality, fish, and land use are not likely to be significant.

6.4.12 Refilling drawn-down areas may affect water quality in the refilled Lac du Sauvage and downstream, once reconnected

To facilitate mining of the kimberlite pipes under the lake, the main body of Lac du Sauvage will be drawn down. At closure, the lake will be refilled. Water quality in the refilled lake could affect aquatic life, fish, aquatic health, and wildlife and human health.

A water quality model will be developed during the EA to predict water quality in Lac du Sauvage in the closure phase. The water quality model will be set up to account for all inputs and processes involved in closure. Water quality in the refilled pits will also be considered. This information will be used in the EA by the aquatic health and fish components in their assessments.

A closure plan will be developed for the Project, and will take into account the refilling of Lac du Sauvage and the removal of the dikes.

Plankton and benthic invertebrate communities are expected to re-establish quickly once the refilled lake is connected to other waterbodies, forming the basis of the food chain for fish. The refilled Lac du Sauvage will be repopulated by natural migration of fish from upstream or downstream, including the fish species currently in the lake (Lake Trout, Lake Whitefish, Round Whitefish, Burbot).

This interaction was considered to be a primary interaction and will be assessed in the EA. However, it is anticipated that due to Project design and mitigation, residual effects to surface water quality, aquatic health, fish, and wildlife and human health are not likely to be significant.

6.5 Risk and Mitigation Conclusion

On the basis of the Project information and assessment of effects provided in this Project Description, and on the basis that this Project is an extension of a long-term, stable, and successful mining operation with established permits, management plans, and IBAs, DDEC believes that the Jay-Cardinal Project can be operated in a manner that, taking into account proven environmental design features, mitigation and administrative controls including adaptive management, is not likely to cause significant adverse effects to the biophysical or socio-economic environments. Furthermore, the Project will have a positive effect in terms of workforce stability and opportunities for Northern residents and businesses. As described in Section 6.3, many of the mitigation and monitoring programs are already in place at the Ekati Mine, and have been proven effective.

The requirement for an EA that meets the Terms of Reference for the Jay-Cardinal Project is anticipated. Such an EA will be completed and provided to the MVEIRB for review. The EA will provide additional discussion and supporting information for the assessment of interactions as detailed above. The EA will be completed prior to applications being submitted to the WLWB for the water licence and land use permits. Authorizations from additional agencies such as DFO and Transport Canada will also be obtained during the permitting phase of the Project.

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7.0 GLOSSARY TERMS

Term	Description
Aboriginal Affairs and Northern Development Canada (AANDC)	The federal governmental department responsible for programs that support the needs and interests of First Nations in Canada, and for development in the three Territories.
Active layer	The thin layer of soil or rock that overlies the continuous permafrost layer of the Arctic and which thaws out each summer and re-freezes each winter.
Adaptive management	A formal process of formulating and continually improving resource management policies and practices by learning from the outcomes of operational programs.
Air Quality Effects Monitoring Program (AQMP)	A monitoring program for ambient air quality at the Ekati Mine. The program has been designed and refined since 1998 to assess the effectiveness of air quality management plans in maintaining air quality throughout the life of Ekati mining operations.
Amendment	An addition of materials to existing substrate that modifies texture and nutrient potential, with the intent of encouraging plant growth through improvement of soil condition. Examples of amendments are: compost, sand, peat moss, and fertilizer.
Anthropogenic	Related to human activity.
Aquatic Effects Monitoring Program (AEMP)	A monitoring program designed to determine the short- and long-term effects in the aquatic receiving environment resulting from the mine operations, to evaluate the accuracy of predictions, to assess the effectiveness of planned impact mitigation measures, and to identify additional mitigation measures to reduce or eliminate environmental effects.
Aquatic receiving environment	Downstream waterbodies from the site facilities including, but not limited to, sedimentation ponds and waste rock piles.
Archaeological site	A location exhibiting physical signs of past human use, typically greater than 50 years in age.
Arctic	The Arctic is a geographic region that is circumpolar in extent and generally characterized as being north of the treeline, in an area of continuous permafrost.
Barrenlands	The area of the Northwest Territories east of the Mackenzie River valley and north and east of the tree line characterized by a low rolling tundra landscape, continuous permafrost, and low densities of human settlement.
Baseline studies	Initial scientific investigations that determine the present ecological state of an area and establish a basic reference necessary for further studies once development begins.
Benthic	Pertaining to the bottom region of a water body, such as a lake.
Benthic Invertebrates (Benthos)	Assemblage of organisms living in or on the bottom sediments of a water body and dependent upon the decomposition cycle for most, if not all, of its basic food supply.
Biomass	The total mass of living organisms, usually expressed as a weight per unit area or volume (e.g., grams per cubic meter).
Canadian Water Quality Guidelines	Guidelines based on the most current toxicological data available and provided by the Canadian Council of Ministers of the Environment.
Carnivore	A flesh-eating animal considered a Valued Ecosystem Component. In the context of this report, grizzly bears, wolverines, and wolves.
Chlorophyll *a*	Chlorophyll *a* is a molecule contained in photosynthetic organisms, which is required to carry out photosynthesis. It is an easily detected molecule, and is used as an indicator of phytoplankton biomass at the Ekati site.
Claim block	The Ekati Mineral claim block. The region of the Northwest Territories within which the Ekati Mine exists, for which Dominion had purchased the rights to the minerals.
Committee of the Status of Endangered Wildlife in Canada (COSEWIC)	A committee that produces the official list of Canadian endangered species.
Connate water	Water trapped in the pores of a rock during formation of the rock. The chemistry of connate water can change in composition throughout the history of the rock. Connate water can be dense and saline compared with seawater. Formation water, or interstitial water, in contrast, is simply water found in the pore spaces of a rock, and might not have been present when the rock was formed. Connate water is also described as fossil water.
Drawdown	Water withdrawal resultant in an apparent water levels decrease.

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Term	Description
Fisheries and Oceans Canada (DFO)	The federal governmental department responsible for protecting and maintaining healthy aquatic environments.
Dewatering	Removal of water from a natural waterbody by pumping or draining.
Diatom	Diatoms are a type of phytoplankton and periphyton. They are single- celled algae which photosynthesize and live either free-floating in water or attached to substrates. Diatoms contain a silica shell (called a frustule) outside of their cell membrane.
Diavik Diamond Mines Inc.	A diamond mine located on East Island in Lac de Gras, approximately 30 km southeast of the Ekati main camp and 10 km southwest of the Misery Pit.
Ecosystem	A community of interacting organisms considered together with the chemical and physical factors that make up their environment.
Effect	A change to a Valued Component (VC) due to human activities. An effect is not necessarily a negative impact; an effect may be neutral or even positive. For example, a change in caribou migration routes may not adversely affect the caribou. Replacing one fisheries habitat with another may enhance the fishery.
Ekati Mine	Ekati Diamond Mine, Canada's first diamond mine.
Environment	The components of the Earth including land, water, and air, and all layers of the atmosphere. Also all organic and inorganic matter and living organisms and the interacting natural systems of such, including the cultural, social, and spiritual components.
Environment and Natural Resources (ENR)	Government of Northwest Territories department responsible for the management of environmental and wildlife resources.
Environmental Agreement	An agreement between the governments of Canada and the Northwest Territories and Dominion. It sets forth guidelines and management strategies to protect the environment. The aim of the Environmental Agreement is to: respect and protect land, water and wildlife, and the land-based economy, essential to the way of life and well-being of the aboriginal peoples; facilitate the use of holistic and ecosystem-based approaches for the monitoring of the Project; provide advice to assist in managing the Project consistent with these purposes; maximize the effectiveness and co-ordination of environmental monitoring and regulation of the Project; and, facilitate effective participation of the Aboriginal peoples and the general public in the achievement of the above purposes.
Environmental Assessment Review Process	The process previously used by the federal government to consider the environmental implications of all proposals for which the federal government had decision-making authority. This process reviewed and approved development of the Ekati Mine.
Environmental Impact Statement (EIS)	An assessment document designed to identify, predict, interpret, and communicate information about the impact of an activity on human health and well-being, including the well-being of ecosystems on which human survival depends. Also referred to as a Developer's Assessment Report.
Esker	Sinuous ridge of weakly stratified gravel and sand deposited by a stream flowing in (or beneath) the ice of a retreating glacier, and left behind when the ice melted.
Flocculants	Chemicals that are used to aggregate colloids and other suspended particles in liquids to form a floc in a process called flocculation. Flocculants are used in water treatment processes across Canada to improve the sedimentation or filterability of small particles.
Food chain	The transfer of nutrients and energy from one group of organisms to another, linked together in a series resembling a chain.
Food web	Food chains interconnecting at various levels.
Footprint	The area of structural disturbance created by the mine operations which includes areas lost by construction of roads, dewatering of lakes, and construction of waste rock areas. Habitat Loss areas are those areas of habitat disturbed by the mine footprint.
Geographic Information System (GIS)	A mapping tool that is used to depict large amounts of information in a spatial context.
Geology	The science concerned with the study of the rocks that compose the Earth.
Granite	Coarse-grained, light-coloured, hard igneous rock.

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Term	Description
Groundwater – shallow	Water that occupies pores and crevices in the rock and soil of the active layer above the permafrost layer.
Groundwater – deep	Ancient fossil or connate water that occupies pores and crevices in the bedrock below the permafrost layer.
Habitat	Any area that provides food, water, and/or shelter for an organism.
Herbivore	An animal that feeds on plants.
Holistic	Concerned with wholes rather than analysis or separation into parts.
Hydrology	The study of the properties of water and its movement in relation to land.
Independent Environmental Monitoring Agency (IEMA)	An agency established in 1997 to serve as a public watchdog for environmental management at the Ekati Mine.
Incidental take	The inadvertent harming, killing, disturbance or destruction
Infrastructure	The basic structural installations used for operations (e.g., roads, buildings, water supply and sewage treatment facilities).
Invertebrates	A collective term for all animals without a backbone or spinal column. Includes insects, worms, clams, snails, spiders, etc.
Kimberlite	A rock of igneous origin that is forced to the Earth's surface via volcanic pipes. The name is derived from Kimberley, South Africa, where the rock was first discovered.
Kimberlite pipe	A more or less vertical, cylindrical body of kimberlite that resulted from the forcing of the kimberlite material to the Earth's surface.
Lake dewatering	The gradual draining or removal of water from lakes.
Landfill	An area at the Eakti site used to contain non-hazardous wastes.
Landfarm	An area at the Ekati site used to contain hydrocarbon-contaminated snow, soil, and small aggregate materials (i.e., crushed granite and sand less than 4 cm in diameter). The soil is treated by exposure to air and sun, and may eventually be used as reclamation material if it meets soil criteria. The Ekati landfarm is located at the south end of the Panda/Koala Waste Rock Area.
Lichen	Any plant organism composed of a fungus and an alga in symbiotic association, usually of green, grey, or yellow tint and growing on and colouring rocks, tree trunks, roofs, walls, etc.
Limnology	The study of freshwater lakes, including biological, geological, physical, and chemical aspects.
Lithic scatters	Common type of archaeological site consisting of stone tools and/or flakes (pieces of stone) knocked off in the process of making tools.
Littoral	Region of a lake from the highest water level to the depth at which photosynthesis ceases, usually within the upper 10 m.
Long Lake Containment Facility (LLCF)	The processed kimberlite containment basin(s) and the associated engineering structures that are designed to contain processed kimberlite and that are regulated through the Water Licence. Long Lake has been divided into a series of cells modified to contain processed kimberlite after completion of the diamond extraction process.
Micro	A unit of measurement denoting a factor of one-millionth.
Migration	The seasonal journey of travelling long distances from one habitat to another.
Migratory	Characterized by undergoing period migration.
Mine Design	The detailed engineered designs for all mine components.
Mine Plan	The plan for development of existing diamond bearing kimberlite deposits, including the sequencing of the development.
Mitigation	An activity aimed at avoiding, controlling, or reducing the severity of adverse physical, biological, and/or socioeconomic impacts of a project activity.
Nutrient	Any substance that provides essential nourishment for the maintenance of life.

DOMINION DIAMOND EKATI CORPORATION
1102, 4920-52nd Street, Yellowknife, Canada X1A 3T1 T 1.867.669.6100 F 1.867.669.9292 www.ddcorp.ca

Term	Description
Panda Diversion Channel	A 3.4 kilometre artificial stream that connects the northern basin of Panda Lake to Kodiak Lake to facilitate fish passage and enhance fish habitat. Completed in 1997, this channel provides compensation for fish habitat lost as a result of mine development.
Periphyton	The collective name given to the community of algae that exists attached to underwater surfaces, such as rocks, in lakes and streams.
Permafrost	A soil or rock layer that has been frozen for two or more years.
Photosynthesis	The process by which the energy of sunlight is captured by organisms, especially green plants, and used to manufacture organic tissue by combining the energy with carbon dioxide and water.
Phytoplankton	Phytoplankton are microscopic primary producers which live free-floating in water; single-celled algae that photosynthesize. Some common types of phytoplankton include diatoms and cyanobacteria.
Primary production	Production by photosynthetic organisms.
Primary producers	Photosynthetic organisms
Processed kimberlite (PK)	The residual material left behind when the processing of kimberlite has been completed to extract the diamonds.
Receiving environment	The part of the natural environment that receives effluent from a mine, and which is monitored to detect mine effects.
Reclamation	Any activity aimed at rehabilitating a disturbed site.
Schist	A medium-grained to coarse-grained metamorphic rock composed of laminated, often flaky parallel layers of chiefly micaceous minerals.
Secondary producers	Organisms that consume plants or primary producers.
Significant	Having or expressing a meaning. Having or likely to have a major effect. Important. Fairly large in amount or quantity. Of or relating to observations or occurrences that are too closely correlated to be attributed to chance and therefore indicate a systematic relationship.
Surveillance Network Program (SNP)	A network of water quality monitoring stations to ensure compliance with the Water Licence that regulates the use of water and deposition of waste.
Till	Un-stratified rock material deposited directly by glaciers, consisting of a mixture of clay, silt, sand, gravel, and boulders ranging widely in size and shape.
Total suspended solids	The weight of solids suspended in a known volume of water (e.g., mg/L).
Trend	A relatively consistent change in a measured variable over time.
Trophic levels	A functional classification of organisms in an ecosystem according to feeding relationships, from primary producers through herbivores (secondary producers) and carnivores (tertiary producers).
Tundra	Habitat typically found in the Arctic, north of the treeline that is adapted to cold temperatures, a short growing season, and low precipitation. Typical tundra vegetation includes moss, lichen, Labrador tea, and small shrubs.
Ungulate	Group of diverse large mammals with hooves
Valued Component (VC)	An environmental attribute or component having scientific, social, cultural, economic or aesthetic value. For instance, caribou are a VC, as are fish and water quality.
Waste rock	Barren rock or rock too low in grade to be mined or processed economically, and which is not used for construction.
Watershed	An entire geographic area that contributes surface and groundwater to a particular lake, river, or stream.
Wetland	A swamp, marsh, or other land that is usually water-saturated.
Wildlife Effects Monitoring Program (WEMP)	A program established to investigate and monitor for the potential effects of mining activities on wildlife within the Ekati study boundaries.
Zooplankton	Small floating or weakly swimming organism found in lakes and other waterbodies.

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