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EKATI Diamond Mine

2012 Environmental Impact Report

October 2012

BHP Billiton Canada Inc.
Operator of the EKATI Diamond Mine

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10 October 2012

Attn: Distribution list

Re: 2012 Environmental Impact Report, EKATI Diamond Mine

Dear All:

BHP Billiton Canada Inc. (BBCI) is pleased to submit the 2012 Environmental Impact Report (EIR) to the recipients identified in the attached distribution list.

The Environmental Impact Report (EIR) is a requirement of the Environmental Agreement signed in 1997 between BHP Diamonds Inc. (now BHP Billiton Canada Inc.) and the governments of Canada and the Northwest Territories. As required by the Environmental Agreement, the EIR compares the results of environmental monitoring activities conducted by BBCI at the EKATI Diamond Mine (EKATI) between the current reporting period (2009 and 2011) with the predictions of the 1995 Environmental Impact Statement (EIS).

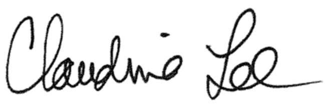
As part of the primary objective of the EIR, the results of monitoring valued ecosystem components (VECs) in each of the Air, Land, Water, and Wildlife categories between 2009 and 2011 are reported. Long-term predictions or results, based on EKATI's long-term monitoring programs and modelling, are discussed for each of the relevant VEC categories. Environmental risks for each of the VEC categories and BHP Billiton's management of the risks is provided. The key environmental risks and management of the risks (both during the 2009 to 2011 reporting period and in the future) are the focus of this EIR, whereas in previous editions of the EIR the comparison of predicted and observed effect ratings was the focus. This change is the result of comments on the 2009 EIR as well as comments and discussions during meetings held in December 2010 and 2011 and the 2012 EIR Technical Session to address the challenges with the EIR process.

BHP Billiton trusts that the information in this letter and in the attached report is clear. Please contact the undersigned, Claudine Lee, Environment Superintendent – Operations, at 880-2232 if you have any questions.

◎ Table of Contents

Sincerely,

BHP Billiton Canada Inc.



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EKATI DIAMOND MINE
2012 ENVIRONMENTAL IMPACT REPORT

October 2012
Project #0648-121-01

Prepared by:

bhpbilliton
resourcing the future

BHP Billiton Canada Inc.
Yellowknife, Northwest Territories

Executive Summary

Executive Summary

The Environmental Impact Report (EIR) is a requirement of the Environmental Agreement signed in 1997 between BHP Diamonds Inc. (now BHP Billiton Canada Inc.; hereafter referred to as BHP Billiton) and the governments of Canada and the Northwest Territories. As required by the Environmental Agreement, the EIR compares the results of environmental monitoring activities conducted by BHP Billiton at the EKATI Diamond Mine (EKATI) between the current reporting period (2009 and 2011) with the predictions of the 1995 Environmental Impact Statement (EIS). To better understand the environmental monitoring management policies and programs, a background description of the EKATI environment and mine operations is provided. Descriptions of the environmental management policies including the integration of traditional knowledge (TK) and adaptive management practices also are provided. Environmental programs conducted at EKATI are described and changes to the programs over the last three years as a result of both internal and independent review are indicated.

As part of the primary objective of the EIR, the results of monitoring valued ecosystem components (VECs) in each of the Air, Land, Water, and Wildlife categories between 2009 and 2011 are reported. Long-term predictions or results, based on EKATI's long-term monitoring programs and modelling, are discussed for each of the relevant VEC categories. Environmental risks for each of the VEC categories and BHP Billiton's management of the risks is provided. The key environmental risks and management of the risks (both during the 2009 to 2011 reporting period and in the future) are the focus of this EIR, whereas in previous editions of the EIR the comparison of predicted and observed effect ratings was the focus. This change is the result of comments on the 2009 EIR as well as comments and discussions during meetings held in December 2010 and 2011 to address the challenges with the EIR process.

Prior to finalizing the 2012 EIR, technical sessions were held with stakeholders and regulators as a requirement for consultation. The environmental risks identified by BHP Billiton were presented at the technical sessions for discussion and comments received during the discussion were incorporated in the final report, where appropriate.

The 22 key environmental risks identified within the VEC categories (Air, Land, Water, and Wildlife) were ranked in order of importance for BHP Billiton's future management, as identified by stakeholders and regulators during the EIR technical sessions and EKATI Environment Department Environment Advisors:

1. The aquatic receiving environment downstream of the Long Lake Containment Facility (LLCF) and King Pond Settling Facility (KPSF).
2. Caribou migration routes.
3. Caribou interaction with roads.
4. Ability to detect changes in carnivore populations.
5. Caribou interactions with mine activities and infrastructure (other than roads).
6. Fish biology.
7. Permafrost exposure.
8. Groundwater quality and quantity.
9. The physical or terrestrial environment.
10. Habituation of carnivores.
11. Low under-ice dissolved oxygen.

12. Water quality of waste rock seepage.
13. Water quality associated with Misery Pit "push-back".
14. Water quality and quantity associated with Pigeon Pit development.
15. Particulate emissions.
16. Fugitive dust.
17. Hydrocarbon contamination downstream of the LLCF and KPSF.
18. Ability to detect changes in ambient air quality.
19. Disturbance of archaeology sites.
20. Breeding bird interactions with mine activities and infrastructure.
21. Long-term performance of the Panda Diversion Channel.
22. Fay Bay water quality and aquatic life.

For each of the listed key environmental risk issues, management practices conducted historically and during the 2009 to 2011 reporting period are provided. Management practices include mitigation activities, best practices, and adaptive management to address the risk issue. For the top risk—the aquatic receiving environment downstream of the LLCF and KPSF—management practices included identification of long-term water quality trends and models to predict future water quality trends downstream of the LLCF. In addition, BHP Billiton has focused on reducing nitrate (related to blasting) and chloride (from underground mine water) as well as management in response to observed increases in Aquatic Effects Monitoring Program (AEMP) water quality variables (e.g., development of site-specific water quality objectives). However, for each of the 22 identified risk issues, there is remaining environmental risk after management practices have been implemented. For example, the 2011 AEMP identified 16 water quality variables that have increased downstream of the LLCF and 11 water quality variables that have increased downstream of the KPSF as a result of mine activities. Of these water quality variables, nitrate downstream of the LLCF has been identified as the highest risk going forward.

Finally, for each of the key environmental risk issues, future actions were identified to further address the residual risk. These actions include additional management actions or monitoring programs. For example, to address the second top risk issue—caribou migration routes—there were a number of management actions taken however the residual risk remaining is that the mines are affecting the movements of the caribou. Thus management practices to address this environmental risk at EKATI will include the caribou aerial survey that was designed to identify trends in annual caribou abundance in the EKATI study area during mine development and operation. Despite some of the limitations of aerial survey data, it has been possible to identify spatial and temporal trends in the study area. However, to ensure that BHP Billiton's assessments of caribou populations and movement patterns are reflective of the region, EKATI wildlife Advisors have participated in regional government studies and workshops to improve caribou monitoring and examine opportunities to synchronize monitoring with other mines. Community site visits have also been completed on a regular basis to share caribou monitoring knowledge and address improvements to be made to monitoring at EKATI. Going forward BHP Billiton will continue collaborations and knowledge sharing to address this risk issue in the future.

BHP Billiton will strive to achieve that there is "Zero Harm" to the environment at EKATI by maintaining monitoring and management plans that are currently effective, and implementing new management strategies to address emerging risks. As identified in the EIR, BHP Billiton has had several mitigation successes and continues to support a variety of management practices and monitoring programs as part of the long-term plans to return the site to a condition that will be compatible with the original uses of the area.

Table of Contents

EKATI DIAMOND MINE
2012 ENVIRONMENTAL IMPACT REPORT

Table of Contents

◎ **Table of Contents**

List of Figures

List of Tables

List of Plates

List of Appendices

Acronyms, Abbreviations, and Glossary

Acronyms, Abbreviations, and Glossary

ACRONYMS AND ABBREVIATIONS

AANDC	Aboriginal Affairs and Northern Development Canada
AEMP	Aquatic Effects Monitoring Program
ANFO	Ammonium Nitrate and Fuel Oil
AQMP	Air Quality Monitoring Program
BHP Billiton	BHP Billiton Canada Inc.
CAAQO	Canadian Ambient Air Quality Objectives
CAM	Continuous Air Monitoring
CAPMoN	Canadian Air and Precipitation Monitoring
CCME	Canadian Council of Ministers of the Environment
CKR	Coarse Kimberlite Rejects
CKRSA	Coarse Kimberlite Reject Storage Area
CO_2e	Carbon Dioxide Equivalent
COSEWIC	Committee on the Status of Endangered Wildlife in Canada
DFO	Fisheries and Oceans Canada
Diavik	Diavik Diamond Mines Inc.
DO	Dissolved Oxygen
dS	Decisiemens
EC	Electrical Conductivity
EFPK	Extra Fine Processed Kimberlite
EIS	Environmental Impact Statement
EIR	Environmental Impact Report
EKATI	EKATI Diamond Mine
ENR	Environment and Natural Resources
EROD	Ethoxyresorufin-O-deethylase
FPK	Fine Processed Kimberlite
FY	Fiscal Year
GEP	Gravel Enhancement Pad
GHG	Greenhouse Gas
GIS	Geographic Information System

GNWT	Government of the Northwest Territories
ha	Hectares
HHERA	Human Health and Ecological Risk Assessment
HSEC	Health, Safety, Environment, and Community
HVAS	High Volume Air Sampling
ICRP	Interim Closure and Reclamation Plan
IEMA	Independent Environmental Monitoring Agency
ISC	Industrial Source Complex
ISO	International Organization for Standardization
K-B	Kajak-Brinkhurst
KIA	Kitikmeot Inuit Association
KPSF	King Pond Settling Facility
LLCF	Long Lake Containment Facility
masl	Metres Above Sea Level
Mt	Million Tonnes
PAH	Polycyclic Aromatic Hydrocarbon
PK	Processed Kimberlite
PDC	Panda Diversion Channel
PSD	Pigeon Stream Diversion
SNP	Surveillance Network Program
SSWQO	Site Specific Water Quality Objective
t	Tonnes
TK	Traditional Knowledge
tpd	Tonnes per Day
TSM	Towards Sustainable Mining
TSP	Total Suspended Particulates
TSS	Total Suspended Solids
VEC	Valued Ecosystem Component
WLWB	Wek'èezhìi Land and Water Board
WEMP	Wildlife Effects Monitoring Program
WROMP	Waste Rock and Ore Storage Management Plan
WRSA	Waste Rock Storage Area

GLOSSARY

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.
Acid/Alkaline Rock Drainage	The production of acidic or alkaline leachate, seepage or drainage from underground workings, ore piles, waste rock, processed kimberlite (PK), and overburden that can lead to the release of metals to surface water during the life of the mine and after mine closure
Acid deposition	The settling of acidic substances (mainly sulphur and nitrogen oxides, acids, and salts) from the atmosphere to the Earth's surface (e.g., rain, snow, dew)
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 EKATI. 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 significance	A site's potential to provide new knowledge and, specifically, to contribute to the existing archaeological database.
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.
Bacteria	Microscopic unicellular organisms characterized by the lack of a membrane-bound nucleus and membrane-bound organelles.

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 mandatory 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).
CALPUFF	An advanced non-steady-state meteorological and air quality modelling system.
Canadian Ambient Air Quality Objectives (CAAQO)	The objectives and standards for permissible air pollutant concentrations in parts per billion.
Carnivore	A flesh-eating animal considered a VEC. 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 EKATI.
Claim block	The EKATI mineral claim block. The region of the Northwest Territories within which the EKATI Diamond Mine exists, for which BHP Billiton has purchased the rights to the minerals.
Coagulants	Highly-charged cationic chemicals added to wastewater to break emulsions and cause coagulation of particles. Used across Canada in water treatment plants.
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.
Conductivity	The ability of water to carry an electric current. Measured by a conductivity meter and recorded as microsiemens per centimeter (μS/cm).

Contaminated Snow Containment Facility	An area at EKATI set aside to store hydrocarbon-contaminated snow.
Cultivars	Plant material that has been commercially propagated and/or formed.
Fisheries and Oceans Canada (DFO)	The federal governmental department responsible for protecting and maintaining healthy aquatic environments.
Detritus	Unconsolidated material composed of both inorganic and dead and decaying organic material.
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.
Dioxin	Dioxins are a class of chemical contaminants that are formed during combustion processes such as waste incineration, forest fires, and backyard trash burning, as well as during some industrial processes such as paper pulp bleaching and herbicide manufacturing.
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.
Dipteran insects	Two-winged insects such as flies, mosquitoes, and midges.
Diversity Indices	A measure of how varied a community of organisms is. In general, a healthy ecosystem will support a variety of species and have a high diversity index. At EKATI diversity is most often assessed using the Shannon Diversity Index and Simpson's Diversity Index.
Drawdown	The partial removal of water from any natural waterbody by pumping or draining.
Ecology	The study of the interactions between organisms and their environment.
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 Ecosystem Component (VEC) 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.
EFPK	Extra fine processed kimberlite or the mainly silt and clay sized particles of the processed kimberlite.
EKATI	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 BHP Billiton Diamonds Inc. (now BHP Billiton Canada Inc.). 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; to facilitate the use of holistic and ecosystem-based approaches for the monitoring of the Project; to provide advice to BHP Billiton to assist in managing the Project consistent with these purposes; to maximize the effectiveness and co-ordination of environmental monitoring and regulation of the Project; and to 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 Diamond 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.
Ephemeroptera-Plecoptera-Trichoptera	Refers to three insect orders which are all important constituents of stream benthos communities. Common names for the organisms are mayflies, stoneflies, and caddisflies. Many of these insects are very susceptible to changes in water and sediment quality, so their abundance and diversity can be used as an indicator of stream health.
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.
Euphotic Zone	The euphotic zone refers to the upper portion of the water column in which adequate light is present for photosynthesis to occur.
Eutrophic	Nutrient-rich waters with high primary productivity.
Eutrophication	Refers to the process by which changes occur in a lake due to nutrient input. Changes which can occur include increased primary producer biomass, major shifts in the composition of primary producers, increased sediment oxygen demand, and winter dissolved oxygen decline. Eutrophication is a global issue, and is the major reason for the use of phosphorus-free detergents and soaps.
Ferrosilicon	Also called ferrosilicium (FeSi), it is a ferroalloy, an alloy of iron and silicon. It contains a high proportion of iron silicides and it also contains about 1 to 2% of calcium and aluminum. In diamond mining, it is used in the heavy media separation process to prepare a diamond-rich concentrate out of crushed kimberlite ore.

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. This 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.
Forb	Non-grassy herbaceous plants (e.g., Labrador tea).
Freshet	The increased flow of water over a relatively short period of time, usually during spring, caused by snowmelt.
Fugitive dust	Any airborne, uncontrolled particulate matter generated from open sources.
Furan	A chemical compound typically derived by the thermal combustion of pentose-containing materials, cellulosic solids, and especially pine-wood.
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.
Greenhouse effect	The phenomenon describing warming of the Earth's surface by trapping the sun's warmth in the lower atmosphere by "greenhouse gases" (e.g., carbon monoxide, carbon dioxide).
Greenhouse gas	Any of various gases, especially carbon dioxide, that contribute to the greenhouse effect.
Groundwater – surface	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 Diamond Mine.

Index Gillnet	A gillnet of fixed length, depth, and mesh size that provides uniform size selection and thereby allows comparison of fish biological variables among lakes and years.
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.
Juvenile Fish	A fish that has not reached sexual maturity.
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 ore body of kimberlite that resulted from the forcing of the kimberlite material to the Earth's surface.
Lake Benthos	Lake benthos communities are a group of organisms associated with the bottom of lakes. These communities contain a diverse assortment of organisms, which have different mechanisms of feeding. The term lake benthos is used interchangeably with lake benthic macro-invertebrates in this report. Common lake benthos organisms include larval flies and freshwater clams. Lake benthos are an important food source for fish.
Lake dewatering	The gradual draining or removal of water from lakes.
Landfarm	An area at EKATI used to contain hydrocarbon-contaminated snow, soil, and small aggregate materials (i.e., crushed granite and sand that are 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 fresh water 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.

Micron	One-millionth of a meter.
Mine Design	The detailed engineered designs for all mine components.
Mine Plan	The plan for development of existing ore sources, 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.
Panda Diversion Channel (PDC)	A 3.4 kilometer 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. These organisms are single-celled algae and photosynthesize. Some common types of phytoplankton include diatoms and cyanobacteria.
Pigeon Stream Diversion (PSD)	A proposed artificial stream to allow flows from the headwater reaches of the Yamba/Exeter Watershed to enter Fay Bay unaltered, circumventing the proposed Pigeon Pit. Construction and design elements for the PSD were submitted to DFO for approval along with the Pigeon Stream Fish Habitat Compensation and Monitoring Plan and Baseline Data Summary.
Predator	Any organism that consumes other organisms.
Primary production	Production by photosynthetic organisms.
Processed kimberlite (PK)	The residual material left behind when the processing of kimberlite ore has been completed to extract the diamonds.
Protozoa	A large group of single-celled, usually microscopic, eukaryotic organisms, such as amoebas, ciliates, flagellates, and sporozoans. They live as single cells or in simple colonies that show no differentiation into tissues.
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.
Residual effects	Effects that persist after mitigation measures have been applied.

Residual risk	The environmental risk remaining after management practices have been implemented.
Re-vegetation	Introduction of new vegetation on disturbed or barren ground.
Riffle	Shallow areas in a stream or river section characterized by increased habitat heterogeneity, sediment size, stream velocity and slope, and sometimes oxygen content.
Riparian area	The wet soil area that borders a stream, lake, or wetland.
Rotifers	Microscopic aquatic animals of the phylum Rotifera. Rotifers can be found in many freshwater environments and in moist soil, where they inhabit the thin films of water that are formed around soil particles. The habitat of rotifers may include still-water environments, such as lake bottoms, as well as flowing water environments such as rivers or streams.
Schist	A medium-grained to coarse-grained metamorphic rock composed of laminated, often flaky parallel layers of chiefly micaceous minerals.
Secchi Depth	Secchi depth is the depth at which a Secchi disc (standardized white and black disc) can no longer be seen when it is lowered into a lake. Secchi depth can be used to calculate the depth of the euphotic zone.
Secondary productivity	The rate of increase in biomass of organisms that consume plants or primary producers.
Sedge	Any grass-like plant with triangular stems, usually growing in wet areas.
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.
Special Effects Studies	Monitoring programs that address specific effects of mining activities such as the Fay Bay Monitoring Program.
Species Diversity	A measure of the variety and relative abundance of species that occupy a particular area: a function of species richness and evenness (e.g., Simpson's Diversity index).
Species Richness	The number of species.
Species Evenness	Relative abundance of each species in the community.
Surveillance Network Program (SNP)	A network of water quality monitoring stations to ensure compliance with the annual Water Licence that regulates the use of water and deposition of waste.
Thermocline	Layer in a thermally stratified body of water in which temperature changes rapidly relative to the remainder of the water column.
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 particulates (TSP)	Airborne particles with a diameter of less than 30 microns, collected by a high-volume air sampler and recorded as micrograms per cubic meter of air ($\mu g/m^3$).
Total suspended solids (TSS)	The weight of solids suspended in a known volume of water (e.g., mg/L).
Toxicity	The inherent potential or capacity of a material to cause adverse effects in a living organism.
Trap Nets	A fish sampling device similar to a fyke net, in which frames made of netting are square or rectangular and one to four guides (long vertical net) lead fish into an enclosure.
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.
Turbidity	A condition of reduced transparency in water caused by suspended colloidal or particulate material; measured by a turbidimeter and recorded as nephelometric turbidity units (NTU).
Valued Ecosystem Component (VEC)	An environmental attribute or component having scientific, social, cultural, economic or aesthetic value. For instance, caribou are a VEC, 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 fresh and marine waters.

◎ Table of Contents

1. Introduction

1. Introduction

1.1 PURPOSE

The purpose of the Environmental Impact Report (EIR) is to satisfy the requirements of the Environmental Agreement that was signed in 1997 between BHP Diamonds Inc. (now BHP Billiton Canada Inc.; hereafter referred to as BHP Billiton) and the governments of Canada and the Northwest Territories. Under Clause 5.2 of that agreement, BHP Billiton is required every three years (beginning on April 30, 2000) to:

> *…report on longer term effects of the Project and the results of environmental monitoring programs and the actual performance of the Project in comparison to the results predicted in the Impact Statement and to evaluate how BHP's adaptive environmental management has performed to date of such report…*

Additional requirements of the EIR include (but are not limited to):

- *a summary of operational activities during the reporting period;*
- *actions taken or planned to address impacts or compliance programs which are set out in the EIR;*
- *a summary of operational activities for the next reporting period; and*
- *a list and abstract of all Environmental Plans and Programs*.

The four previous editions of the EIR concluded that the effects of EKATI Diamond Mine (EKATI) on the environment have been of relatively minor significance and that the mine has left a manageable footprint on the EKATI claim block (BHP Billiton 2000, 2003, 2006b, 2009). However, the 2009 EIR also indicated a case of a moderate effects as a result of the change in the structure of the lake trout and round whitefish populations in EKATI lakes (BHP Billiton 2010b). Similar to the previous editions of the EIR, the 2012 EIR will play a large role in informing the public about environmental activities at EKATI. Reviews and subsequent modifications of the environmental programs outlined in the report are completed on a regular basis to ensure that study designs are providing a valid assessment. The Aquatic Effects Monitoring Program (AEMP), for example, undergoes program review and modification every three years as a requirement of Water Licence W2009L2-0001.

Following review of the 2009 EIR, comments were provided and responded to by BHP Billiton. A meeting was also held in December 2009 with BHP Billiton, stakeholders, and regulators to discuss the EIR process and general comments received on the 2009 EIR. Two additional reports were submitted following this meeting:

- *Environmental Impact Report 2009, Technical Addendum* (February 2010; Report 23) to provide updates to the technical report; and
- *Environmental Impact Report 2009, Close-out Report* (February 2010; Report 24) to provide an updated summary of the 2009 assessment (included all final technical changes) and was written in a report structure to be followed in the 2012 EIR. The report also included a proposed conceptual process for the 2012 EIR.

The 2012 EIR process was also discussed with BHP Billiton staff, stakeholders, and regulators in December 2011, where the following key topics were discussed:

- the consultation process;
- tracking stakeholder and regulator comments on the EIR;
- the focus of the 2012 EIR as discussed in *Building Consensus: Towards a Shared Understanding on the EKATI Environmental Impact Report* (IEMA 2011);
- level of detail required for reporting on monitoring programs; and
- the 2012 EIR reporting schedule.

The 2012 EIR was written to reflect the requirements of the Environmental Agreement, comments on the 2009 EIR, as well as comments and discussion during each of the December 2010 and 2011 meetings (see IEMA 2011).

The focus of the 2012 EIR is on the current environmental risk at the EKATI site and the BHP Billiton management actions to address these risks. The new focus came about because one of the key messages in the comments and discussion from the December meetings was that the residual effect ratings were either rated too low (e.g., was rated as a minor effect instead of a moderate effect) or that it was unclear how or why BHP Billiton assigned the residual environmental effect. In previous versions of the EIR, the observed residual effects were rated using the same methodology described in the 1995 Environmental Impact Statement (EIS; BHP and Dia Met 1995a) and presented as a summary table (e.g., BHP Billiton 2009). A summary scorecard of the two sets of effect ratings (e.g., 1995 EIS and 2009 EIR) were previously provided in a plain language summary.

Thus for the 2012 EIR, BHP Billiton felt that making comparisons of predicted and observed significance of effects is not as meaningful in determining the environmental risks related to the operation at EKATI. The EKATI monitoring programs have become more sophisticated with the accumulation of long-term datasets and advances in science and technology. Thus, some of the spatial definitions and basis for the 1995 defined significance ratings are of a lesser interest.

Another key point raised following the 2009 EIR submission was the lack of consultation with stakeholders and regulators prior to submission of the final EIR (IEMA 2011). Thus, the technical information sessions were conducted from July 9 to 11, 2012 following submission of the document *2012 Environmental Impact Report—Information for the Environmental Impact Report Technical Session*. The technical sessions served to address a requirement of the EIR:

> *…to both ensuring that an opportunity is provided for early disclosure and discussion of problems and that each Environmental Impact Report meets the requirements of this Agreement, BHP shall consult with representatives of the Minister, the GNWT and the Monitoring Agency as BHP compiles the information and data to be included in such Environmental Impact Report…*

The technical sessions were attended by representatives from the following regulators and stakeholders: Aboriginal Affairs and Northern Development Canada (AANDC), Fisheries and Oceans Canada (DFO), Government of Northwest Territories (GNWT), Independent Environmental Monitoring Agency (IEMA), Environment Canada, Environment and Natural Resources (ENR), Lutsel'Ke Dene First Nation, Yellowknives Dene First Nation, and the Wek'èezhìi Land and Water Board (WLWB). The comments and suggestions provided by those that attended the sessions were incorporated into this report, where appropriate.

1.2 CONTENTS

The contents of the 2012 EIR are divided into nine main sections, including this introduction.

- Section 1 (Introduction) - General introduction and purpose of the EIR.
- Section 2 (Background) – Applicable background information on the mine, mining methods, the EKATI environment, and the northern community.
- Section 3 (Summary of Mine Operations)– Includes details of the mine operations since mining operations were initiated in 1997, as well as mine operations projected between 2012 and 2015 (the next EIR reporting period).
- Section 4 (Environmental Management Framework) – Provides the environmental management framework including BHP Billiton guidance (e.g., Health, Safety, Environment, and Community [HSEC]) as well as the regulator instruments and contractual agreements (e.g., Water Licence and Fisheries Authorizations). A description of BHP Billiton's adaptive management procedures and key examples are provided.
- Sections 5 to 8 (Air, Land, Water and Wildlife) - Provides summaries of the monitoring programs for each of the VEC categories (Air, Land, Water, and Wildlife), as well as effects predicted in 1995 and observed effects for the 2009 to 2011 reporting period. Long-term predictions or results based on results of EKATI's long-term monitoring programs and modelling is discussed for each of the relevant VEC categories. Environmental risks for each of the VEC categories and BHP Billiton's management of the risks is provided in detail in text as well as summarized in a table of Key Environmental Risks as outlined in Table 1.2-1.
- Section 9 (Summary and Conclusions) – Includes a summary of the key environmental risks and quantifies the risks in order of importance for BHP Billiton's management in the future.

Table 1.2-1. Description of Information Provided in a Key Environmental Risk Table

Environmental Risk Issue
Management • A summary of mitigation activities, best practices, and adaptive management to address the risk issue.
Residual Risk • The environmental risk remaining after management practices have been implemented.
Future Actions • Actions planned to further address the residual risk, which may include additional management actions or additional monitoring programs.

In addition to the nine main sections, there is a list of acronyms and abbreviations as well as a glossary of terms preceding the Introduction. There are six appendices associated with this report, the first of which provides comments on the 2009 EIR (Appendix A). Appendix B provides the presentation given at the December 2011 EIR Process Meeting, as well as the meeting notes. An annotated bibliography of all reports published and available to the public between April 2009 and April 2012 is provided in Appendix C. Each report listed in Appendix C is numbered and where applicable the report number is referred to in the text of this document (e.g., Report 1 refers to the 2008 Aquatic Effects Monitoring Program). A list and brief description of independent scientific research that has been conducted at EKATI (and published between April 2009 and April 2012) is provided in Appendix D. Although construction activities occurring between the 2009 and 2011 are summarized in Section 3.1.3 of this report, a more detailed list is provided in Appendix E. The *EKATI Traditional Knowledge Strategy* is provided in Appendix F and provides an overview of BHP Billiton's documented approach to Traditional Knowledge (TK) programs at or supported by EKATI. Finally as indicated in Section 1.1 above the comments and suggestions provided by those that attended the July 2012 technical sessions are provided in Appendix G.

2. Background

2. Background

2.1 THE MINE

2.1.1 Mine History

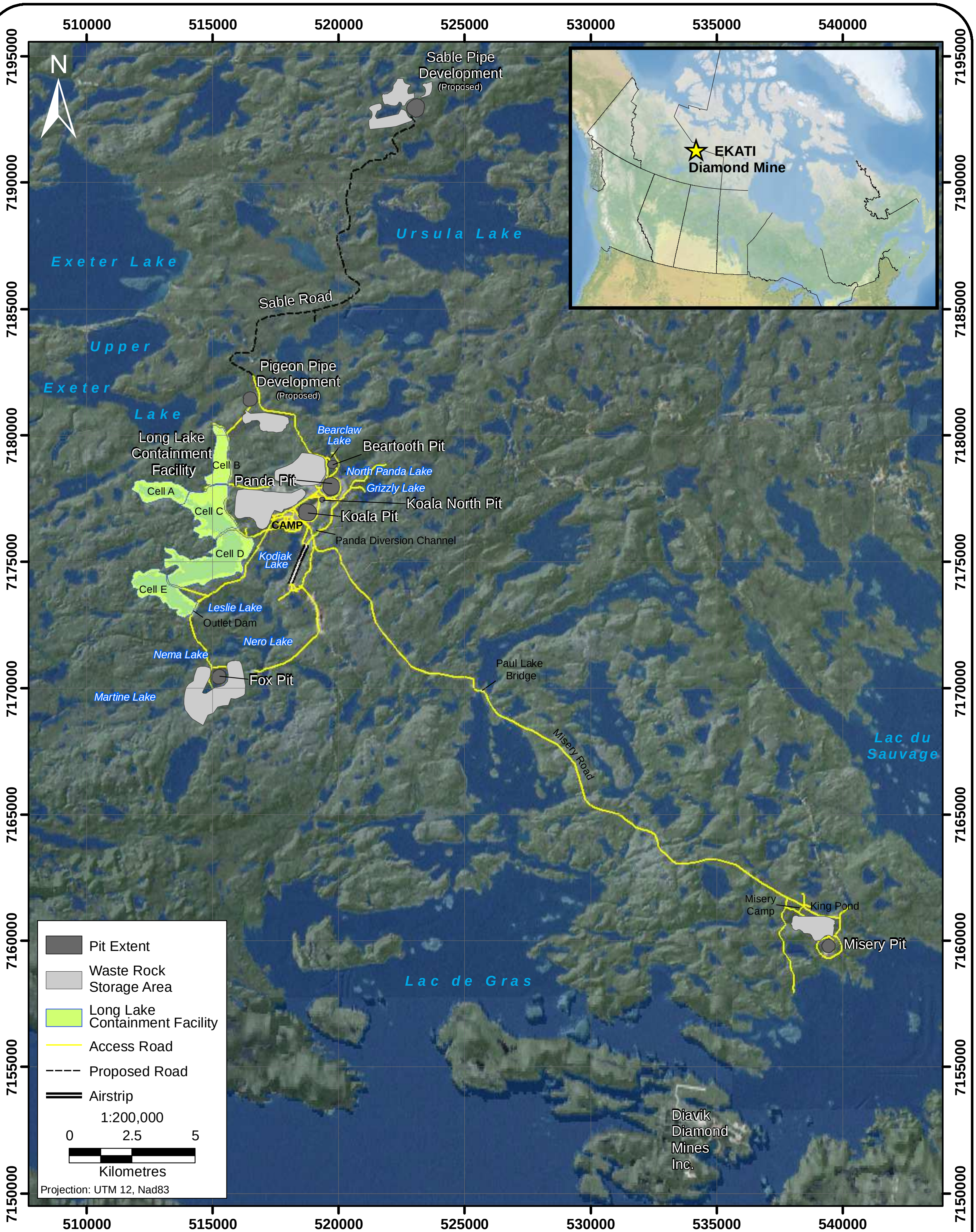
EKATI is a joint venture of BHP Billiton (80%) and geologists Charles E. Fipke and Dr. Stewart E. Blusson (10% each). The mine is operated by BHP Billiton.

EKATI and its surrounding claim block are located approximately 200 km south of the Arctic Circle and 300 km northeast of Yellowknife, NT, Canada (Figure 2.1-1). The mine is situated within the Lac de Gras watershed at the headwaters of the Coppermine River drainage basin, which flows north to the Arctic Ocean.

In 1989, kimberlite indicator minerals were discovered in the Lac de Gras area. Under a joint venture agreement that made BHP Billiton (and its predecessors) the Project operator, the first diamonds were discovered by drilling near Pointe Lake in the fall of 1991 (Pointe Lake is a few kilometres northeast of Misery Pit). EKATI was first proposed by BHP Billiton in that same year. At that time, it was known as the “NWT Diamonds Project.” EKATI is a Dene word meaning “fat lake” (which is also the literal meaning of *Lac de Gras*) because the white quartz layers found in the bedrock around Lac de Gras look like marbled caribou fat (Banci et al. 2003). An exploration camp with a bulk sample processing plant and a 120-person camp with associated infrastructure (fuel storage facility, power generating station, water supply and sewage treatment facilities) was opened in the fall of 1993. This camp is now known as Old Camp (Figure 2.1-2). The main airstrip was subsequently constructed in 1994 and 1995 to provide improved access (Figure 2.1-2).

Baseline environmental data were collected from 1993 to 1995 and continued through 1996 so that the baseline database would be current when monitoring started during construction in 1997. An eight-volume EIS was completed in 1995 and was submitted to the BHP Diamond Mine Environmental Assessment Panel in 1996 (BHP and Dia Met 1995a). That panel was convened under the provisions of the *Canadian Environmental Assessment Act* (1992) to recommend to the Minister of Indian Affairs and Northern Development whether the NWT Diamonds Project should proceed. Public hearings were held in 1996. After hearings by the federal Environmental Assessment Review Panel, approval was granted by the federal cabinet for the mine to proceed in November 1996 (Couch 2001). The permitting process followed soon thereafter and by October 1998 the mine was in production.

In 1996, the EKATI mine plan included five open pits: Panda, Koala, Fox, and Leslie pits in the Koala Watershed, and Misery Pit in the King-Cujo Watershed (Figure 2.1-2). However, early in the mine life, Leslie Pit was removed from the plan (because of low anticipated economic return). In April 2000 an Environmental Assessment Report was prepared by BHP Billiton as part of the approval process for the Sable, Pigeon, and Beartooth Expansion Project to incorporate the three named kimberlite pipes into the operation—Beartooth in the Koala Watershed, Pigeon in the Pigeon Watershed, and Sable in the Horseshoe Watershed (Figure 2.1-1; BHP and Dia Met 2000).



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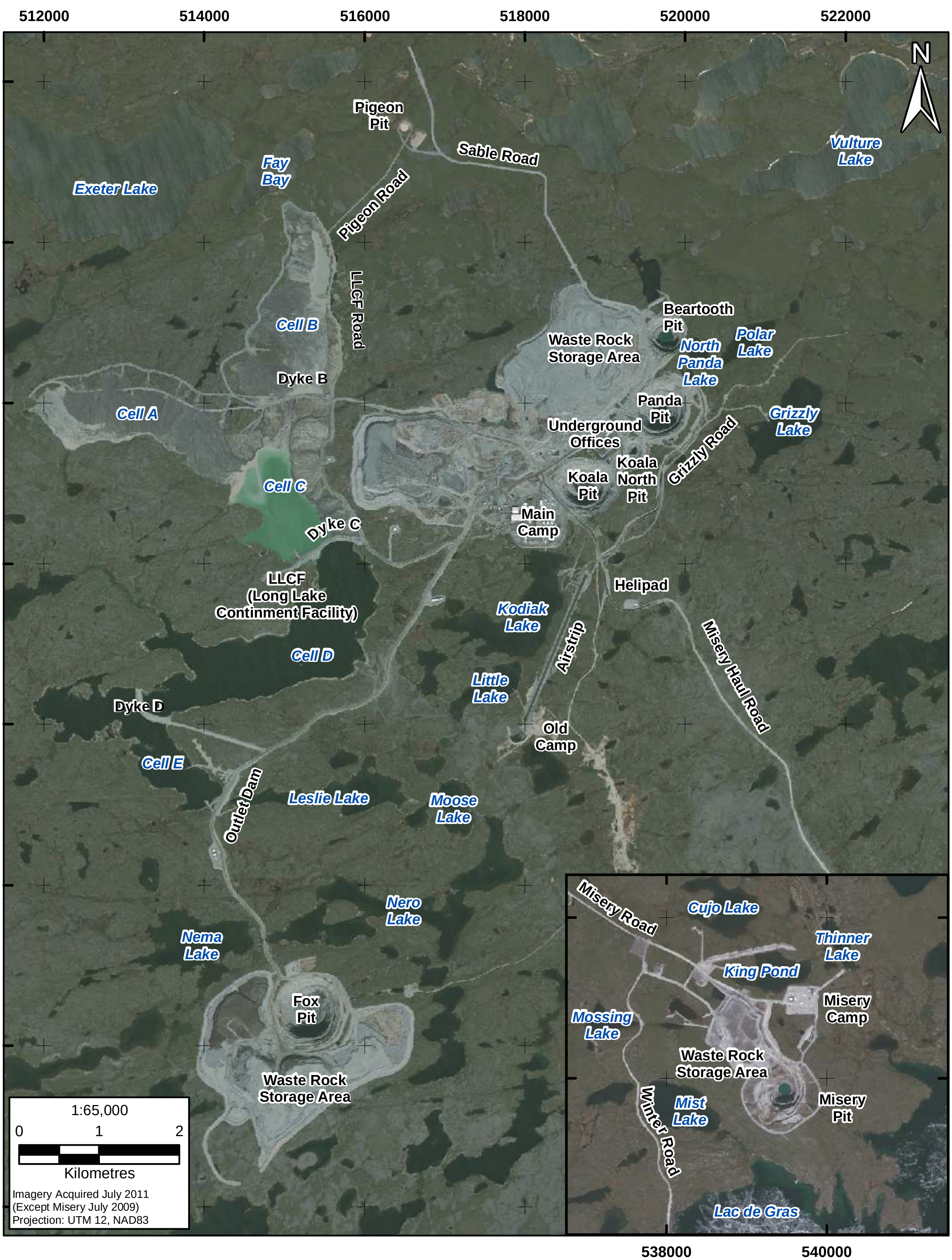
The EKATI Diamond Mine

FIGURE 2.1-1

◎ Table of Contents



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EKATI Diamond Mine
Satellite Imagery, July 2011

FIGURE 2.1-2

◎ Table of Contents

2.1.2 Mine Operations and Construction

Construction of EKATI began in 1997 with the erection of a 375-room accommodation complex and associated infrastructure including power, heat, water, sewage treatment, and communications systems just north of Kodiak Lake. This infrastructure was completed and operational by April 1997, at which time the Old Camp was retained as overflow housing until it was closed in 1999. Construction of the truck shop, power generation facility, coarse ore storage building, process plant, and main fuel storage area continued through the latter half of 1997 and into 1998. The mine was officially opened on October 14, 1998 (Plate 2.1-1).

Plate 2.1-1. Main EKATI Camp with Kodiak Lake in foreground, July 2009.

Beartooth, Panda, and Koala pits are located adjacent to the Main Camp (Figure 2.1-2). Fox Pit is located approximately 7 km south of the Main Camp, and Misery Pit is located about 27 km southeast of the Main Camp, adjacent to Lac de Gras (Figure 2.1-2). A Pigeon Test Pit was constructed in 2010 and is located about 4.5 km northwest of Panda Pit (Figure 2.1-2). In 2011 construction activities were initiated in the Misery area to facilitate the re-opening of the camp in 2012 (Misery Pit was operational between 2001 and 2005). BHP Billiton resumed mining operations at Misery Pit in 2011 through a "push-back" (enlargement) of the open pit using conventional open pit mining methods. The granite waste rock excavated from the pits is used in part for construction (e.g., roads, dams, and dikes), while the remainder is stored in the Waste Rock Storage Areas (WRSAs) adjacent to each of the respective open pits. Some of this stored rock will be used in closure for capping facilities.

To prepare for mining, the Panda Diversion Channel (PDC) was completed in 1997 (Figure 2.1-1). The PDC was designed to divert water from North Panda Lake around the Panda Pit to Kodiak Lake and to provide stream fish habitat to compensate for loss of streams that used to connect Panda, Koala, and Kodiak lakes as well as other streams in the EKATI footprint. Once the PDC was completed, the southern half of Panda Lake was fished out and then partially dewatered. Koala Lake was then fished out and dewatered. Water from Panda and Koala lakes was initially discharged to Kodiak Lake. Eventually, the water became turbid as sediments were disturbed by the falling lake surface. At that time, the remaining water was discharged to the Long Lake Containment Facility (LLCF).

In 1997 and 1998, waste rock from Panda Pit was used to construct roads, dikes, dams, building foundation pads and miscellaneous projects around the site. In 1999, most waste rock was used to build the 29 km-long road to Misery Pit. Approximately 11 km of the Misery Road were finished by the end of 1999. The road was completed in 2000. In that same year, BHP Billiton began construction of a 4.2 km-long road to link the Misery Road with the Tibbitt to Contwoyto winter road from Yellowknife.

Between April 1997 and January 1999, treated sewage effluent was discharged from the accommodation complex to Kodiak Lake. In 1999, a pumping station and pipeline were built to redirect the treated sewage effluent to the process plant, where it is now co-mingled with the processed kimberlite (PK) effluent prior to discharge to the LLCF.

The Panda Pit was the first pit to be developed at EKATI (Plate 2.1-2). Waste rock removal began in 1997, mining of ore began in 1998, and the open pit was closed in 2003. Preparation for underground mining below the original Panda open pit began in 2003 and mining of ore from the Panda Underground began in 2005 and was completed in 2010. Waste rock and kimberlite coarse ore rejects from underground were transported to the Panda/Koala WRSA. De-commissioning of the Panda Pit was ongoing at the end of 2011.

Plate 2.1-2. Aerial view of Panda Pit in the foreground, August 2010.

The Koala North Pit (Plate 2.1-3) and the Koala Pit (Plate 2.1-4) began waste rock removal in 2001 and 2000 respectively. Test mining at the Koala North Underground began in 2001 and ended in 2002. Ore production from Koala Pit began in 2003 and ended in 2005 and the Koala Underground (below the original Koala open pit) began development in 2004 with ore production beginning in 2007. Koala North Underground was operational between 2009 and 2011 with waste rock and kimberlite ore rejects being transported to the Panda/Koala WRSA.

Plate 2.1-3. Aerial view of Koala North Pit, August 2010.

Plate 2.1-4. Aerial view of Koala Pit, August 2010.

◎ Table of Contents

Excavation of the Fox Pit began in 2001 and ore production began in 2005 with waste rock being transported to the Fox WRSA (Plate 2.1-5). In preparation for mining of Fox Pit, dewatering of Fox Lake began in 2001. Water from Fox Lake was initially pumped into adjacent lakes, but was re-directed to the LLCF in 2003 once the water became turbid as lake sediments were disturbed. The Nero-Nema Bridge was built in the winter of 2001/2002, allowing the Fox Road to be extended from the Main Camp to Fox Pit.

Plate 2.1-5. Aerial view of Fox Pit, August 2010.

After 2 years of road and camp construction and waste rock removal the Misery Pit began producing ore in 2001 (Plate 2.1-6). Ore production was suspended in April of 2005 and stockpiled ore was trucked to the process plant through 2006 and 2007. During 2005, several procedures were conducted at Misery Camp to ensure safety and protection of the environment including construction of a 1 m-high berm around Misery Pit to deter wildlife access, construction of a barrier across the access ramp leading into Misery Pit, placement of a 5 m-deep granite cap over the Misery WRSA in May and June 2005 to encapsulate all potentially acid-generating rocks, partial removal of stockpiled kimberlite ore to the EKATI process plant in 2005, placement of all mechanical and hydraulic systems of unused machinery in a no-load condition to reduce the possibility of hydraulic hose failure, securing all waste and unused materials or moving them to appropriate locations near the Main Camp, and continuation of all environmental monitoring programs as if the site was still operational. Future mining in the deeper portions of Misery pipe has been evaluated; construction activities at Misery camp were initiated in 2011, and the camp re-opening was conducted early 2012. Construction of the Misery WRSA will re-commence in 2012 for completion of the final open pit.

Beartooth Pit construction started in 2003 and ore production began in 2005. Open pit mining of the Beartooth kimberlite pipe was completed in April 2009 (Plate 2.1-7). Since that time, the pit has been integrated into the mine water management system as a mine water retention pond (see Section 2.4.5.2). A piping system that enables optional pumping of underground mine water to Beartooth Pit was commissioned in December 2009.

Plate 2.1-6. Aerial view of Misery Pit, July 2011.

Plate 2.1-7. Aerial view of Beartooth Pit, August 2010.

Between February and May 2010 a Pigeon Test Pit (Plate 2.1-8) was constructed and further development of Pigeon Pit is expected to continue.

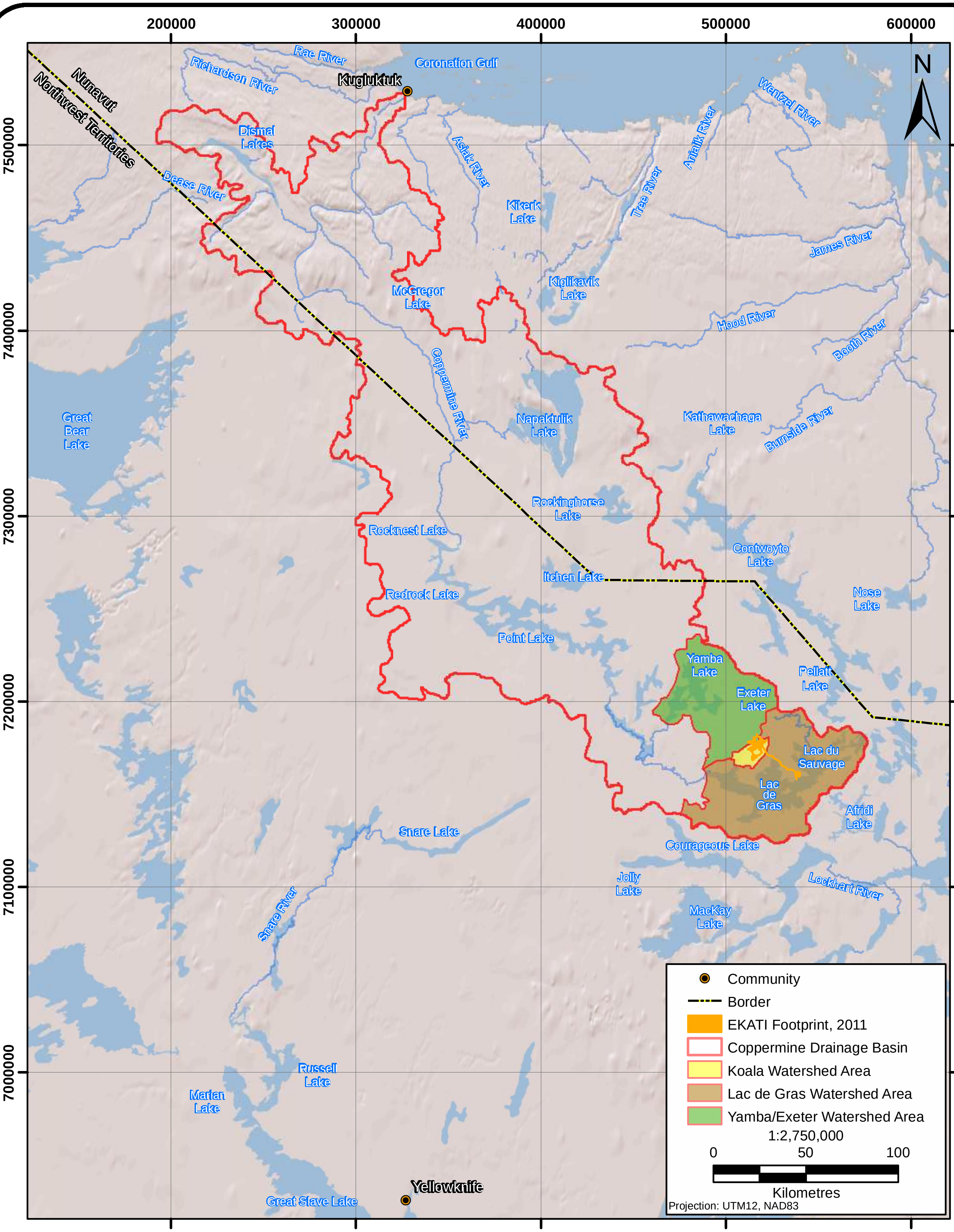
Plate 2.1-8. Aerial view of the Pigeon Test Pit, August 2010.

2.2 THE ENVIRONMENT

The EKATI claim block once covered an area of 3,440 km^2 in the headwaters of the Coppermine River. However the area was subsequently reduced to 2,663 km^2 in 2009, an area that is approximately 7% of the total area of the Coppermine River drainage (Figure 2.2-1). At the end of 2011, the number of mining leases held by BHP Billiton was 282 (Figure 2.2-2). To date, mine development has occurred in only 0.77% of the claim block—primarily in the Koala and King-Cujo watersheds (Figure 2.2-2). The Koala Watershed drains into Lac de Gras, which then discharges into the Coppermine River (Figures 2.2-1 and 2.2-3). The King-Cujo Watershed discharges into Lac du Sauvage, which then flowa into Lac de Gras (Figures 2.2-1 and 2.2-3).

Located 100 km north of the tree line on the sub-Arctic tundra, the local terrain is characterized by boulder fields, tundra, wetlands, and numerous lakes with interconnecting streams. There are more than 8,000 lakes within the 2,663 km^2 claim block. The landscape near EKATI consists of a variety of bedrock and glacial remnants, including extensive boulder fields and sinuous eskers. Surface drainage is poorly developed and because of weak hydraulic gradients, stream and river channels wander extensively. Permafrost is present to an average depth of greater than 300 m and is continuous except under larger lakes and rivers. The seasonal active layer ranges in thickness from up to 1.5 m in organic substrates, to several metres in dark, rocky outcrops. Talik (unfrozen) zones occur beneath waterbodies, and, depending on the thermal storage capacity of the lake (generally a function of its area, depth, and geometry), may fully penetrate the permafrost horizon. Well-drained terrestrial habitats may become quite dry during the growing season, and small streams may only flow during the brief spring freshet period.

Winters are long and extremely cold with daily temperatures that often fall below -30°C. The ice-free season is short (June to September) and cool. Annual precipitation as rain is low, ranging from 22 to 519 mm, with an average of 352 mm (BHP Billiton, unpublished data from the Koala meteorological station, 1994 to 2011). On average, half of the total precipitation falls as rain and half as snow. The average May to October rainfall between 2009 and 2011 was 172 mm and average snowfall in that same time period was 179 mm (measured as a snow water equivalent).



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Coppermine River Drainage Basin

FIGURE 2.2-1

◎ Table of Contents

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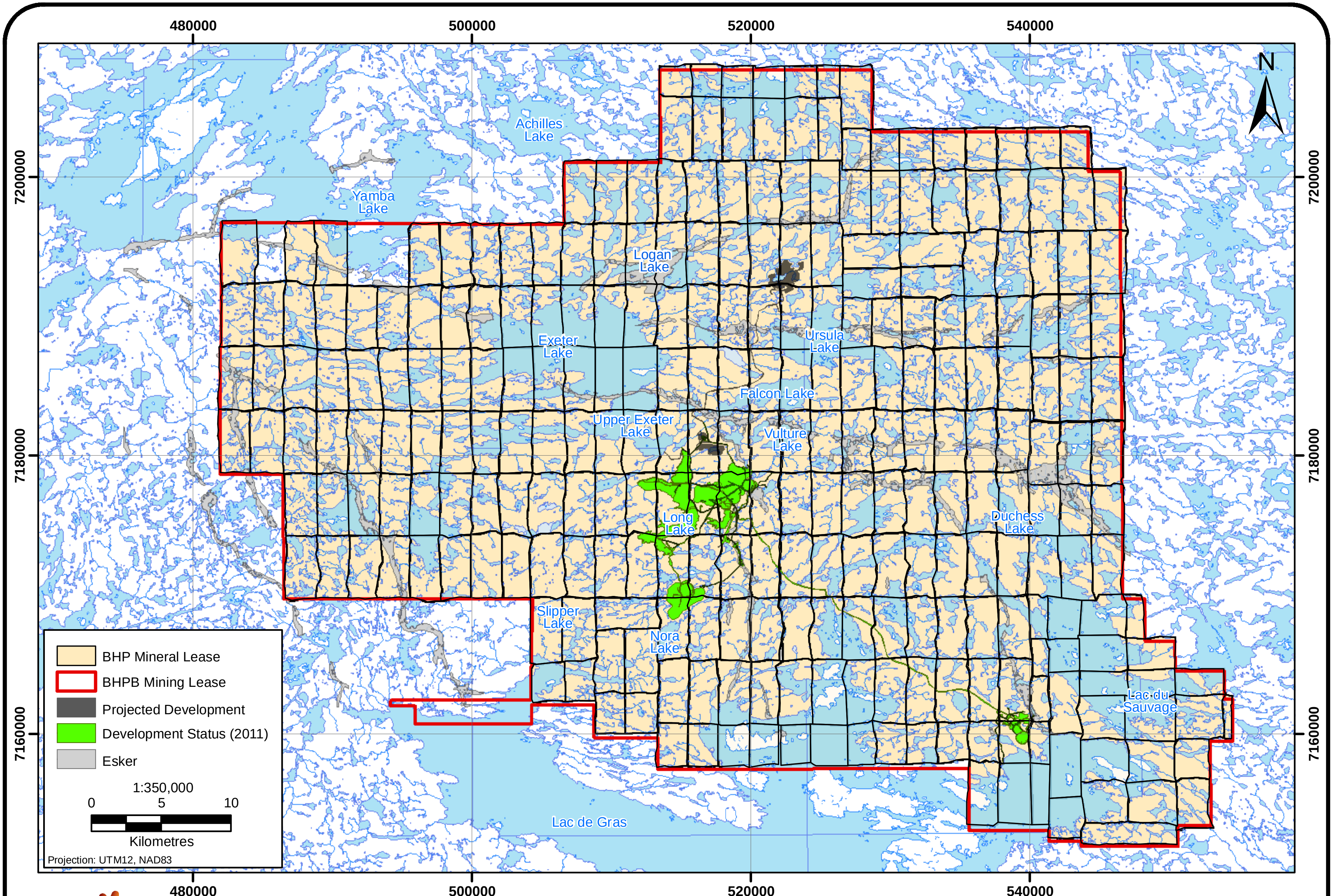

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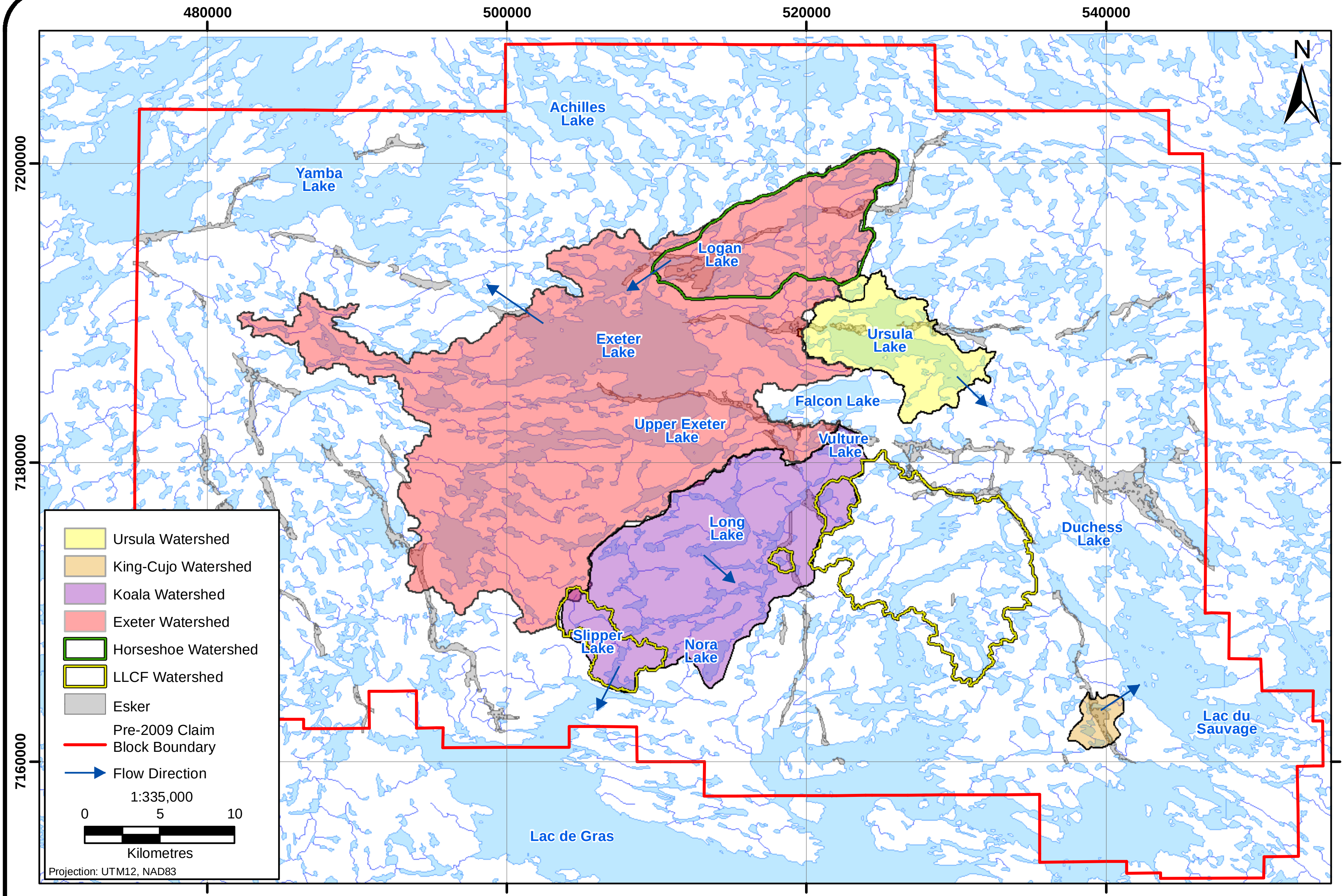
EKATI Diamond Mine Claim Block and Mining Leases

FIGURE 2.2-2

◎ Table of Contents

gis no. EKA-15-097 Job No. 648-121-01 May 31, 2012



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EKATI Watersheds

FIGURE 2.2-3

The presence of permafrost means that surface water does not sink into the soil but remains on the surface as a multitude of shallow, interlinked ponds, lakes, and streams. The low relief of the landscape means that waterbodies form complex drainages with wide, meandering, braided streams connecting chains of shallow ponds and slightly deeper lakes. For the same reason, there are only minor groundwater flows in the active layer during summer. There is, however, very ancient groundwater trapped in fractures in the bedrock below the permafrost layer at depths greater than 300 m. It is called connate water, which means it was trapped in pores in the rock at the time the rock was formed. This fossil water is highly saline and its salinity increases with depth. This water is only encountered in deep open pit and underground mining operations, but its presence has important implications for EKATI's water management strategy.

The presence of permafrost also means that most of the nutrients in the soil 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. Stream flow is highest in spring as the snow cover melts. Stream flows decline steeply over the summer and reach minimum levels in late August (e.g., Figure 2.2-4). Flows typically increase slightly in September in response to autumn rains. Freeze-up occurs in early October. Most streams in the barrenlands freeze to the bottom during winter; therefore, all fish must leave streams in late summer to overwinter in lakes. The presence or absence of lake overwintering habitat is a key determinant of fish biogeography.

EKATI lakes and streams are characterized by clear, soft, low-nutrient waters typical of pristine northern aquatic environments. The biological productivity and biomasses of plants and animals in streams and lakes in the EKATI claim block are low compared to streams and lakes in southern Canada. Lower productivity and biomass in sub-Arctic lakes is well documented (e.g., Pienitz et al. 1997) and occurs as a result of lakes being cold, nutrient poor, and covered with up to 2 m of ice for nine months of the year.

The aquatic ecosystem in the EKATI claim block supports a diverse array of plants and other organisms. Phytoplankton— one-celled plants that float in the water column— are the base of the food chain in lakes (Figure 2.2-5). Phytoplankton are grazed by zooplankton—mainly rotifers and small crustaceans—that float in the water column, and by filter-feeding members of the benthic invertebrate (benthos) community attached to the lake bottom. Zooplankton and benthoss are eaten by a small community of fish. Small-bodied fish such as lake chub (Plate 2.2-1a), slimy sculpin (Plate 2.2-1b) and ninespine stickleback eat zooplankton and benthos, while round whitefish (Plate 2.2-1c) eat mainly benthos. Arctic grayling (Plate 2.2-2) eat a mixture of zooplankton and benthos. Bottom dwelling fish, such as the long nose sucker (Plate 2.2-1d) feed primarily on bottom dwelling invertebrates. Large-bodied fish such as burbot (Plate 2.2-1e) and lake trout (Plate 2.2-1f) eat smaller fish as well as benthos and the larger species of zooplankton.

Food fragments, faeces, and carcasses sink to the bottom of lakes where they are consumed by detritus-eating benthos. Many benthos are aquatic insects, particularly the early life stages of dipteran flies such as midges and mosquitoes. Terrestrial insects that fall on lake surfaces are consumed by surface-striking fish such as Arctic grayling.

Periphyton—dense strands of algae attached to rocks—are the base of the food chain in streams (Figure 2.2-5). Mats of periphyton serve as substrates for bacteria, protozoans, and benthos. Stream drift—a mixture of zooplankton from upstream lakes and insects that release themselves from the stream bottom—is an important component of stream ecology. Arctic grayling is the predominant fish species in streams, followed by slimy sculpin and burbot. Obligate lake dwellers such as lake trout are rarely found in streams, but their juveniles occasionally use streams as refuges and as migration corridors.

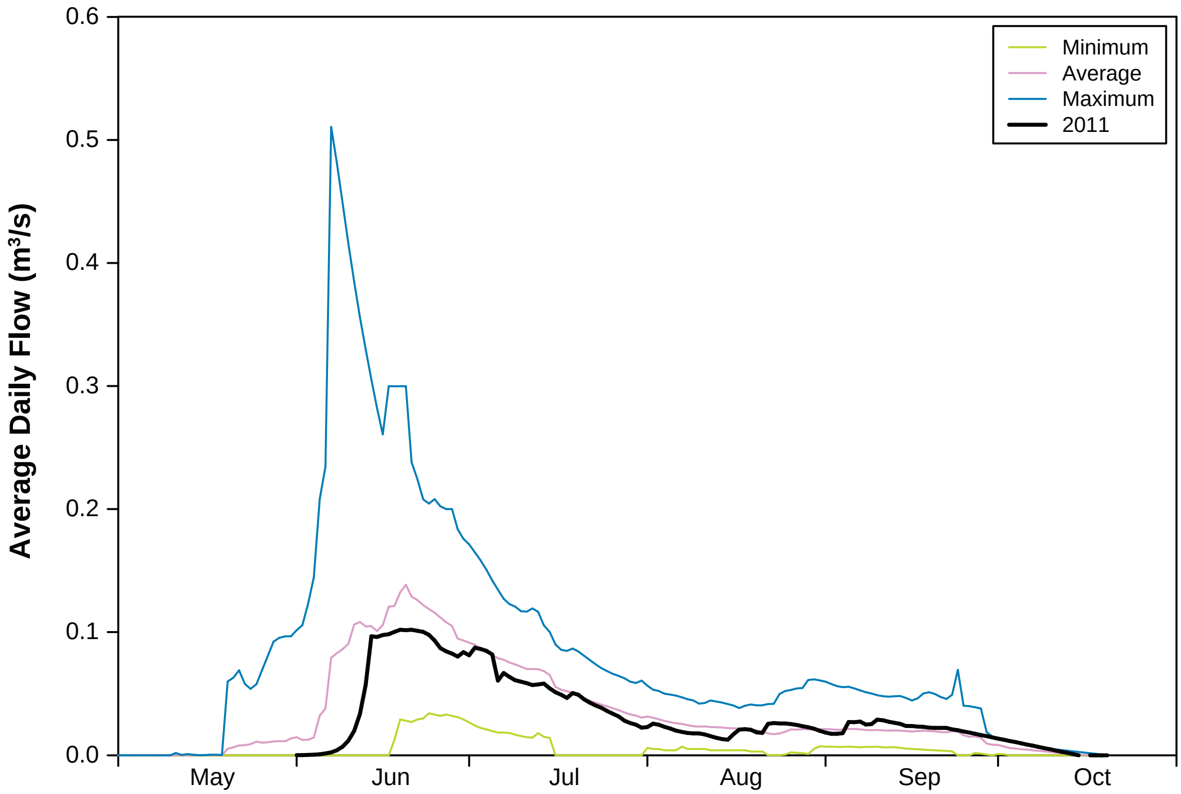

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Figure 2.2-4

Historical Record and 2011 Daily Flows at Counts Lake Outflow

PROJECT # 648-121-01 ILLUSTRATION # a37120f June 1, 2012

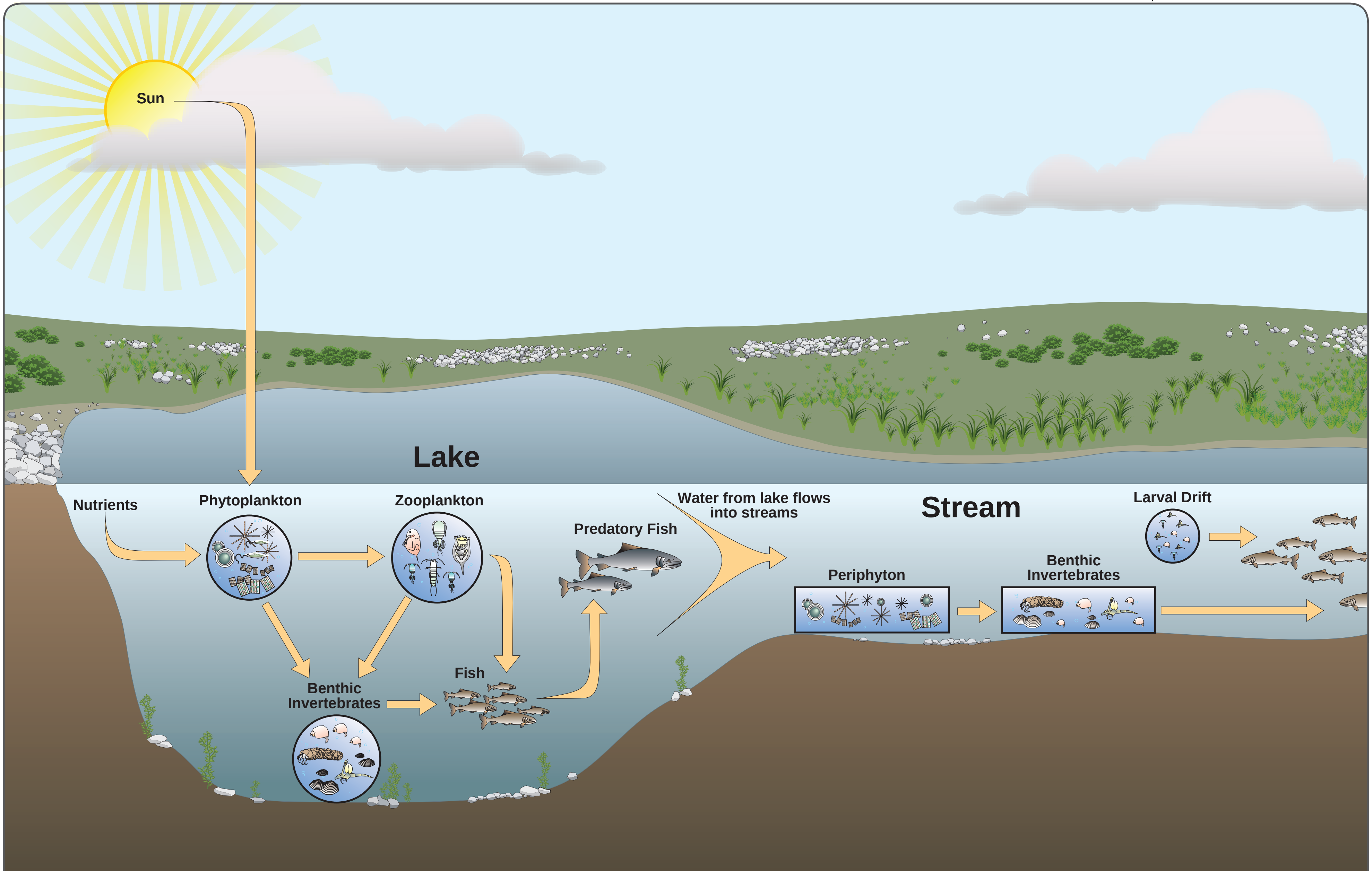

Figure 2.2-5

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Conceptual Model of Lake and Stream Aquatic Ecosystems of the EKATI Claim Block

Figure 2.2-5

◎ Table of Contents

Plate 2.2-1. Examples of (a) lake chub, (b) slimy sculpin, (c) round whitefish, (d) long nose sucker, (e) burbot and (f) lake trout observed at EKATI.

(a)

(b)

(c)

Plate 2.2-2. Examples of Arctic grayling (a) adult, (b) juvenile, and (c) fry observed in the Panda Diversion Channel.

The terrestrial vegetation community is composed of species adapted to freezing temperatures, low nutrients, and localized areas of drought and standing water. The most common communities are mats of low shrubs, including dwarf birch, Labrador tea, crowberry, and bearberry (Figure 2.2-6). Lichen communities are found in areas with very thin layers of soil (Plate 2.2-3). Taller shrubs such as willows and scrub birch are found in sheltered areas such as in ravines, and along streams where there are depressions in the depth of the permafrost. The vegetation surrounding lakes and streams is dominated by weathered lichen-covered boulders interspersed with depressions containing dense, spongy peat mats of moss and lichen. Wetland communities, comprised of water sedges and sedge-willows, exist in poorly drained areas where standing water accumulates. Figure 2.2-7 illustrates the diverse range in habitat types within the EKATI area.

Despite the harsh climate, the EKATI claim block supports numerous species of mammals and birds. Although amphibians are known to occur in the NT, the EKATI area is beyond their known distribution which is generally below the tree line (ENR 2006, 2012b, 2012a). In addition, amphibians have not been observed during the Wildlife Effects Monitoring Program (WEMP) or other biological surveys conducted at EKATI. Many of the mammals and birds observed at EKATI are migratory, including caribou, wolves, hawks, peregrine falcon, owls, geese, ducks, loons, gulls, and sparrows. These animals move onto the barrenlands in spring and summer from southern refugia to take advantage of the large expanse of grazing territory or the abundance of prey under the long days of summer sunshine. They migrate south as winter approaches. Others are non-migratory, including grizzly bear, wolverine, Arctic fox, red fox, Arctic hare, squirrel, lemming, vole, mice, ptarmigan, raven, and gyrfalcon.

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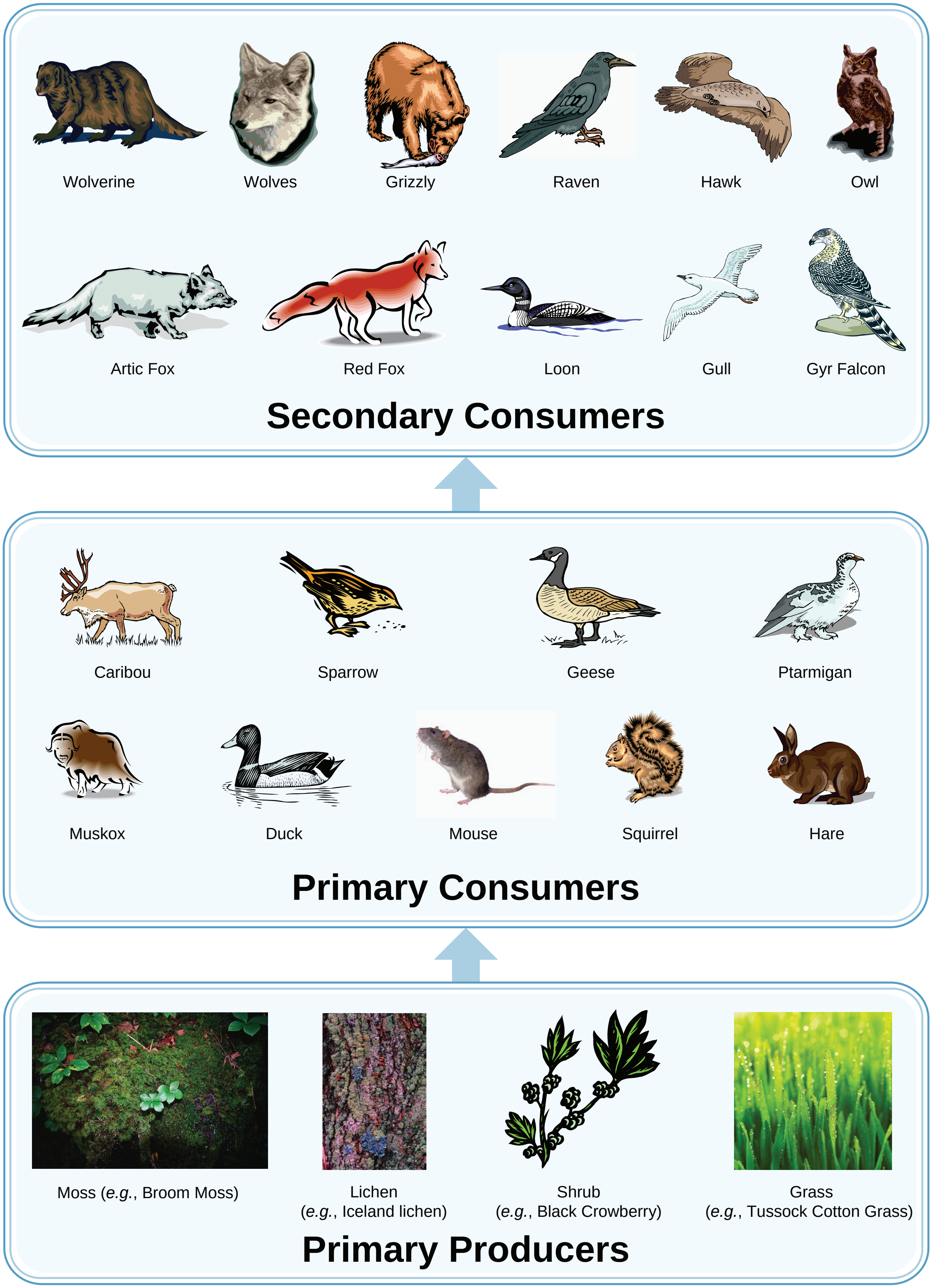

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Figure 2.2-6

Conceptual Model of the Terrestrial Ecosystem of the EKATI Claim Block

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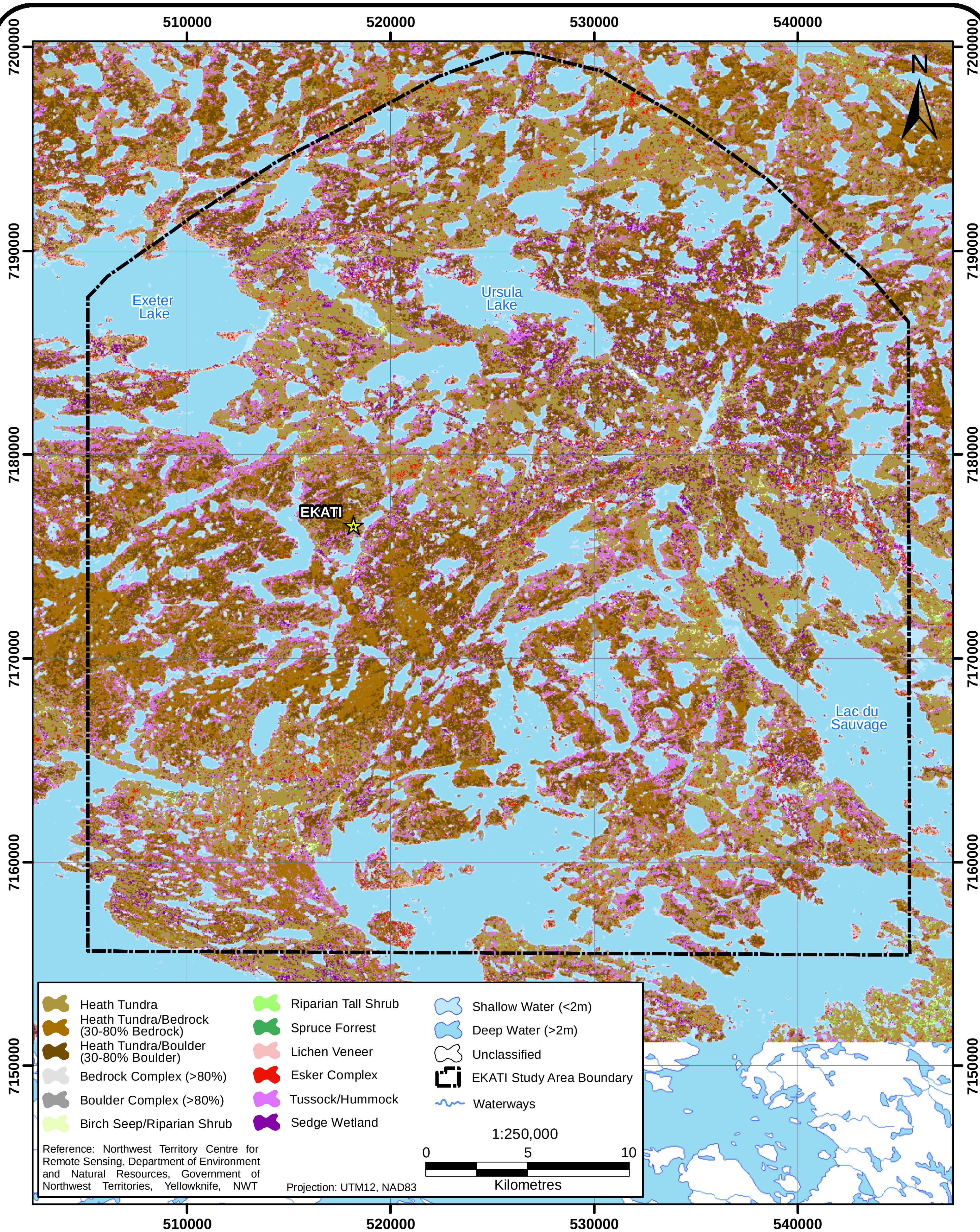

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Habitat Types within and adjacent to the EKATI Study Area

FIGURE 2.2-7

Plate 2.2-3. Example of the lichen Flavocetraria cucullata*, observed at EKATI in August 2011.*

Recent uncommon wildlife sightings at EKATI include two moose that were incidentally photographed by motion detection wildlife cameras deployed at grizzly bear hair snagging stations between June and August 2011 and an adult moose (bull) observation during a caribou aerial survey south of Lac de Gras in 2009 (Plate 2.2-4). These are the second and third moose observations reported during the 13 years of the WEMP, with the first moose observation occurring in 2008 at Exeter Lake. Traditionally, moose range has encompassed habitat south of the treeline throughout the NT. However, reports indicate that moose began extending their range in the early 1900s and have since been seen at numerous locations on the tundra where adequate forage (e.g., lush willow growth) is available (GNWT ENR 2008b). For example, moose have been sighted near Bathurst Inlet, Coronation Gulf, and on the east side of Victoria Island (GNWT ENR 2008b). Suitable forage and snow are considered to influence the northern distribution of moose (Bowyer et al. 2003).

Plate 2.2-4. Moose observed during Caribou Aerial Survey, July 25, 2009.

Also not commonly observed at EKATI, a short-eared owl (Plate 2.2-5a) was observed on May 24, 2010 near Cell B of the LLCF adjacent to the ring road. Six muskox (Plate 2.2-5b) were observed near Fay Bay on June 22, 2010, and they remained in the area for several days. Muskoxen have been historically observed on the northeast side of the claim block but not on a regular basis. These animals follow a wide variety of life history strategies to survive the harsh climate.

Plate 2.2-5. Uncommon wildlife observed near EKATI, a) Short-eared owl on the ring road adjacent to Cell B, May 24, 2010 and b) Muskox near Fay Bay, June 22, 2010.

The aquatic and terrestrial ecosystems on the EKATI claim block are linked together in a complex web of interconnections. Some of these relationships are known and understood but there are also interactions about which environmental scientists are currently unaware. Caution is appropriate when managing Arctic ecosystems and when attempting to predict their response to disturbance.

2.3 THE NORTHERN COMMUNITY

The communities that traditionally used the EKATI claim block reflect diverse Inuit and Dene cultures. The original Aboriginal peoples were highly mobile hunting and gathering societies, shaped by the seasonal cycle of the environment on which they depended. The modern economy is both traditional (hunting, fishing, and gathering) and wage-based (resource extraction, government, and services). Inuit hunters still venture south to hunt and trap near the mine. Modern Aboriginal peoples continue to value the land, water, and resources as their ancestors did, recognizing them as a source of spiritual and cultural well-being.

Archaeological studies have shown that human use of the Lac de Gras area dates back at least 3,500 years (BHP and Dia Met 1995a). The area is in the traditional lands of five Aboriginal groups: Tlicho, Yellowknives, Chipewyan, Métis, and Copper Inuit. Collectively, the Tlicho, Yellowknives and Chipewyan are known as Dene. Many Tlicho reside in the communities of Behcho Ko (formerly Rae-Edzo), Gameti (formerly Rae Lakes), Wha Ti (formerly Lac La Martre) and Wekweti (formerly Snare Lake), and many Yellowknives Dene and Chipewyan reside in the communities of Dettah, N'dilo, and Lutselk'e. Wekweti (population: 150) is the closest community to EKATI and is located approximately 130 km west of the EKATI claim block. Métis live in some of these communities. Copper Inuit live mainly in the Kitikmeot region of Nunavut. The hamlet of Kugluktuk is located 400 km downstream of Lac de Gras at the outlet of the Coppermine River and is the closest Inuit community to EKATI. However, several inland Inuit families maintain an outpost camp at Pellatt Lake less than 100 km to the northeast of EKATI.

Lac de Gras is an important traditional area for northern Aboriginal communities. The caribou crossings at the outlet of Lac du Sauvage into Lac de Gras and at the outlet of Lac de Gras into the Coppermine River were both important traditional hunting areas. These narrows also were significant fishing spots. Presently, there is limited Aboriginal use of the land in the immediate vicinity of the EKATI claim block. However, Aboriginal communities continue to retain strong ties to the Lac de Gras region, and the area is visited annually by a few Inuit hunting parties in search of caribou, wolves, and wolverine.

2.4 ORE PROCESSING AND WASTE MANAGEMENT

In evaluating the environmental activities of EKATI, it is important to remember that processing of kimberlite ore is a physical process rather than a chemical process, unlike the metal mines with which Northerners may be familiar (e.g., Giant Mine, Colomac Mine, Lupin, etc.). This section provides a brief overview of mining, ore processing, and waste storage at EKATI.

2.4.1 Mining Methods

<u>Open Pit Mining</u>

The method of open pit mining is similar for all of the open pits at EKATI. Kimberlite deposits are called pipes because they are typically narrow and deep. They are formed by the explosive surfacing of a tongue of magma from deep in the earth's mantle. Kimberlite is softer than the surrounding bedrock; therefore, the surface of the deposit is easily eroded, forming a basin that fills with water.

All of the kimberlite pipes (with the exception of the proposed Pigeon pit) are located under lakes which require dewatering prior to mining. Pigeon pipe is located on rolling moraine that is partially covered by a small pond. Prior to dewatering, each lake is fished out by Aboriginal fishers and the fish are either distributed to local communities or transferred to other nearby waterbodies. Fish habitat lost through the removal of these lakes is compensated for through *Fisheries Act* (1985) Authorizations (see Section 4.2.3). The Panda, Koala, and Misery pits were dewatered between 1997 and 2000. Fox Lake dewatering began in early 2002 and was completed in 2003. Beartooth Lake was also dewatered in 2003. The development of Pigeon Pit will require the dewatering of Pigeon Pond and approximately 520 m of Pigeon Stream.

The first step in open pit mining is to remove the overburden material—which at EKATI includes beach areas and tundra, lake sediments, and glacial till that lie within the designed pit perimeter—using explosives and standard truck and shovel techniques (Plate 2.4-1). The primary explosive used at EKATI is a 70/30 mixture of emulsion and ammonium nitrate and fuel oil (ANFO). Surface till and waste rock are stored in separate piles. The surface till may be used for progressive reclamation of the mine site. Excavated rock is loaded into large haul trucks with an 85 to 200 tonne capacity and is transported to the appropriate WRSA, temporary ore storage locations, or the process plant.

The design of open pits is similar for all pits at EKATI. Single, double, or triple 10 m-benches are used depending on geological conditions. The majority of the final pit slopes will be in granite host rock.

In comparison to other types of ore deposits, kimberlite pipes are very regular and contacts between kimberlite and the host rock are readily defined. The kimberlite pipe is roughly circular in plan view and lies within competent host rocks. The ore-waste boundary is structural and easily defined on rock type. Figure 2.4-1 shows typical core drilling around a well-defined kimberlite pipe, with the concept for a future open pit in granite. The kimberlite pipes at EKATI have distinct physical characteristics—they are predominantly carrot shaped, resulting in a high stripping ratio, which in turn must be met with a high capacity materials handling fleet. Thus, because of the carrot shape there is a limit to how deep open pits can be excavated. The deeper sections of the kimberlite pipes can only be accessed by underground mining.

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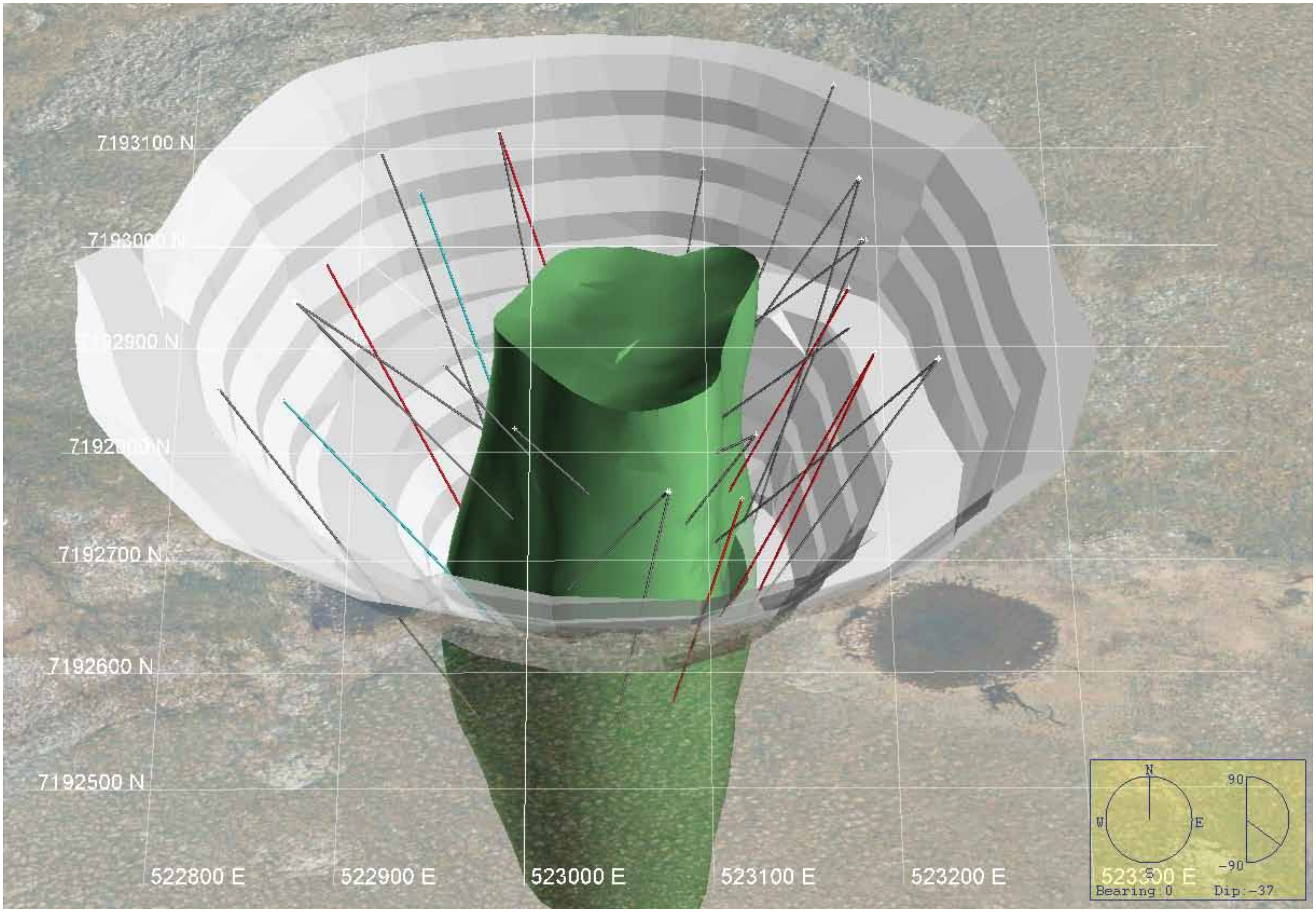

Figure 2.4-1

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Core Drilling at an EKATI Kimberlite Pipe, Showing Concept for Future Open Pit

Figure 2.4-1

Plate 2.4-1. Open pit mining equipment and operation.

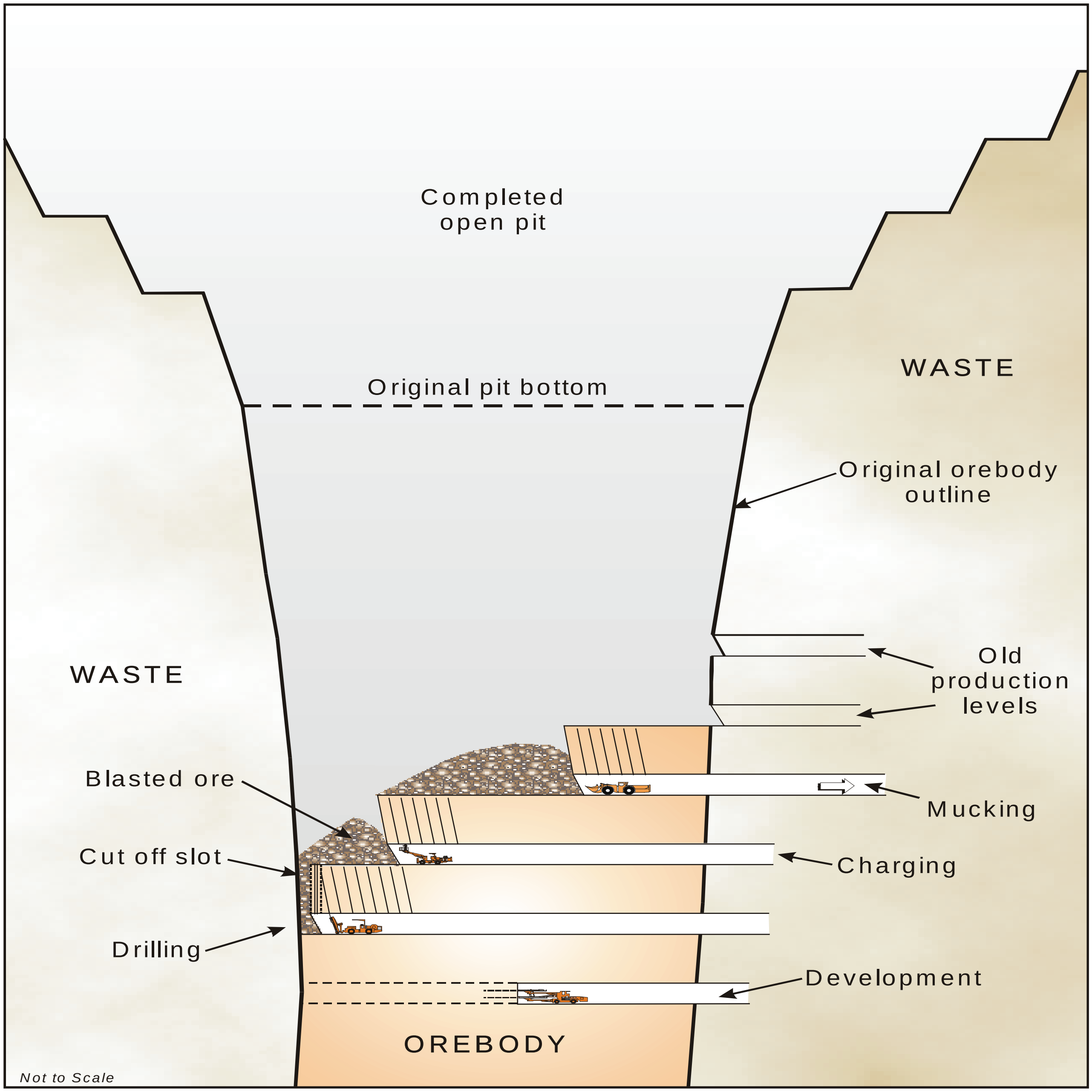
Underground Mining

Underground mining has been completed in the Panda kimberlite and is currently taking place at the Koala North and Koala kimberlites. Underground mining could be completed at Fox Pit in future.

The process of underground mining starts with access development, which involves blasting and excavating tunnels—known as declines—through the granite bedrock to the kimberlite pipe (e.g., Sublevel Retreat Underground Mining). Typically, an underground ramp leading progressively to the top section of the underground kimberlite is constructed as a spiral. Deeper kimberlite sections are accessed by blasting spiral-shaped declines in the bedrock adjacent to the kimberlite pipe. The ore is excavated by cutting horizontally into the kimberlite pipes from the spiral ramps. Ore is transported from the underground developments by a combination of specialized underground haul trucks and conveyors.

Kimberlite ore from the Panda and Koala pipes is extracted from underground using sublevel retreat (Figure 2.4-2) and sublevel cave techniques (Figure 2.4-3), respectively. Sublevel retreat and sublevel caving mining methods are “top down” techniques for regularly shaped ore bodies with weak to strong ore. The ore is drilled and blasted in rings called upholes from multiple drill drifts on each sublevel and extracted in a controlled manner. Production then continues from successive lower sublevels in the kimberlite pipe. The sublevel retreat method is commenced from directly beneath the depleted open pit, while the sublevel cave method is started from beneath a block of low-grade kimberlite. The low-grade kimberlite will be allowed to cave in a controlled manner as the higher value ore is extracted. Both sublevel retreat and sublevel cave are recognized and well-documented mining methods.

A connecting underground conveyor system from Koala to Panda Underground was commissioned in late 2007. A 2.4 km-long conveyor system (commissioned in 2006) transports kimberlite from the Panda Underground crusher to the ore storage area at the process plant. The movement of ore on these conveyor systems is monitored from a control room at the surface.



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Example of Sublevel Retreat Underground Mining Method

Figure 2.4-2

◎ Table of Contents

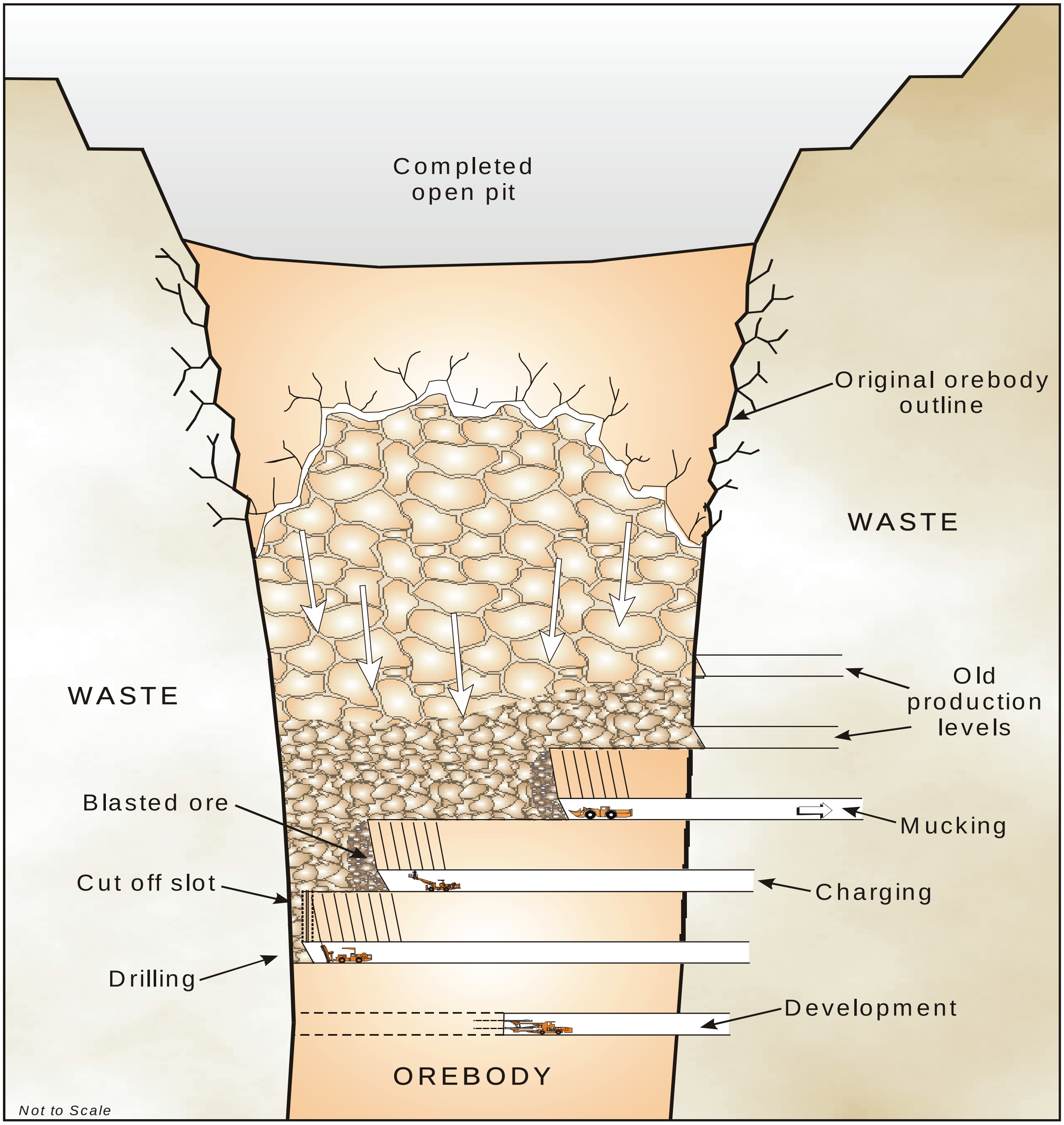

Figure 2.4-3

Example of Sublevel Caving Underground Mining Method

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The Panda, Koala, and Koala North kimberlites are mined as one underground mine with common access from the surface. Ventilation shafts have been sunk to ensure ventilation to all areas of the underground. Other facilities which are wholly underground include an underground maintenance shop, lunch rooms, refuge chambers in case of emergency, and sizing facilities to regulate ore fragmentation size on the conveyor system.

Underground mines require extensive ventilation, dewatering systems, and carefully developed safety and emergency response procedures. Safe areas with independent air supply are located in each of the Panda, Koala North, and Koala Underground to provide refuge for workers in case of a fire or explosion.

Communication systems are also in place to warn workers of potential hazards, and specially trained emergency response teams are always on standby. Other facilities which are wholly underground include an underground maintenance shop, lunch rooms, and sizing facilities to regulate ore fragmentation size on the conveyor system.

2.4.2 Ore Processing and Waste

A single, centralized process plant is located within the permanent Main Camp, southwest of the Koala Pit (Figure 2.1-2). Ore is processing through the plant at an average rate of 13,500 tpd as a continuous operation, 24 hours a day, 365 days a year. Adjacent to the process plant is the primary crusher feeder and a coarse ore storage area.

Figure 2.4-4 provides an overview of the kimberlite ore processing and diamond recovery methodology currently used at EKATI. These processes are generally described by the following areas:

- size reduction, washing (scrubbing), and screening;
- primary concentration; and
- secondary concentration.

2.4.2.1 Size Reduction, Washing (Scrubbing), and Screening

Size reduction involves crushing the kimberlite ore into smaller sized particles to mechanically liberate the diamonds. In this stage of the process, water is used to wash and screen the crushed ore, and also to transport the processed ore (i.e., PK). Waste occurs as:

- wastewater;
- coarse processed kimberlite (0.5 mm to 1.2 mm fraction); and
- fine processed kimberlite (FPK; < 0.5 mm fraction).

The coarse fraction is dewatered and trucked to the Coarse Kimberlite Reject Storage Area (CKRSA) located in the Panda/Koala WRSA. The fine fraction is mixed with treated sewage effluent and pumped as a slurry to the LLCF or, scheduled to begin in late 2012, Beartooth Pit (see Section 2.4.5.2).

Water is either recycled within the process plant or is pumped as FPK slurry to the LLCF. Water is recovered from the LLCF for use in the process plant.

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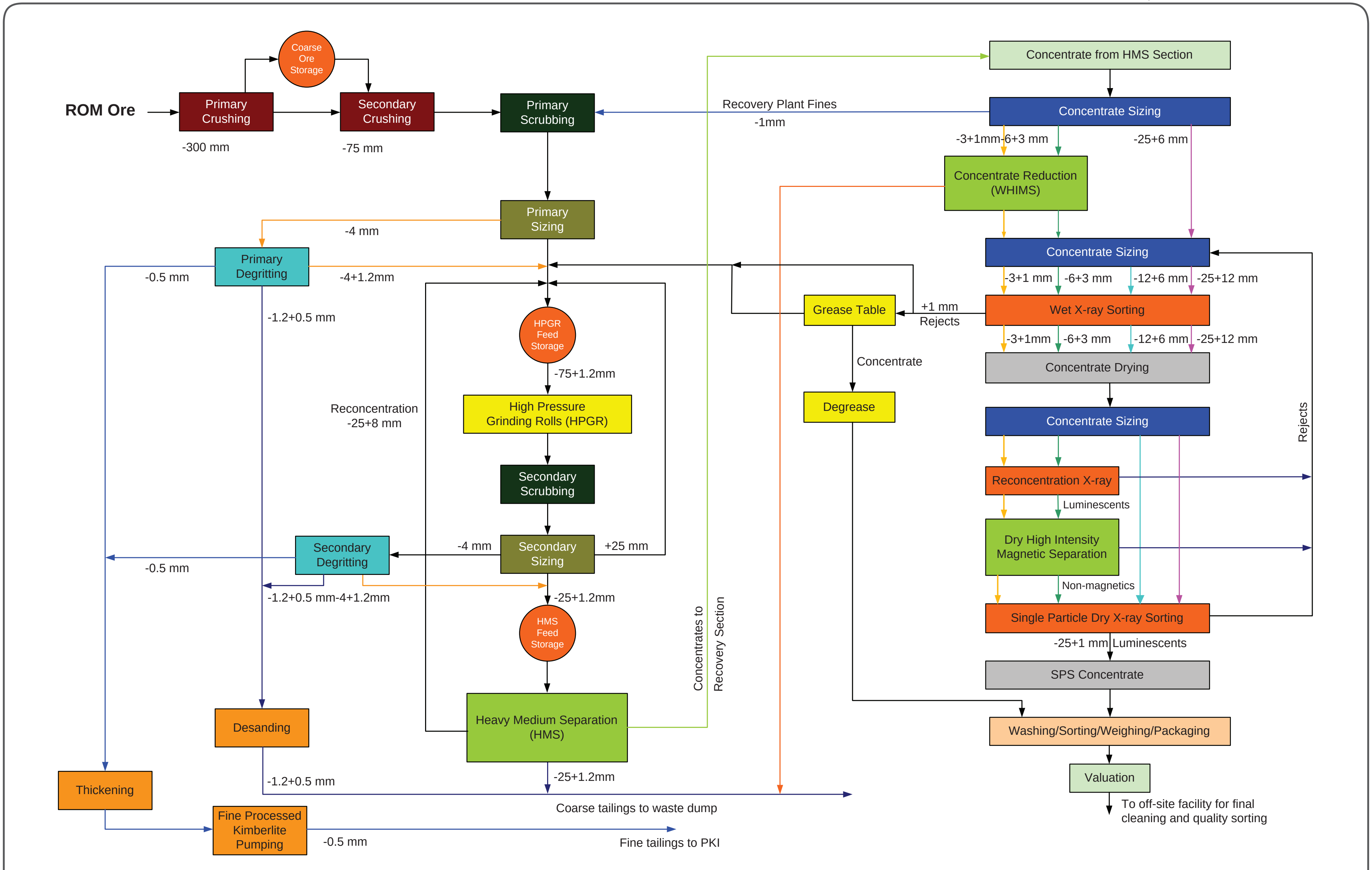

Figure 2.4-4

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Kimberlite Ore Processing and Diamond Recovery Flow Diagram

Figure 2.4-4

2.4.2.2 Primary Concentration

Primary concentration is the first stage of the process that separates the diamonds from the kimberlite ore. Primary concentration involves using Heavy Medium Separation to concentrate the diamonds by physically separating material based on density. Water and ferrosilicon is used in this process as the separation medium (ferrosilicon is recycled based on its magnetic properties). The low density material is screened and the solids are generally routed to the coarse rejects waste stream and trucked to the WRSA. The high density material contains the diamonds and it is rinsed to remove the ferrosilicon and then progresses to the secondary concentration.

Wastewater is treated to recover ferrosilicon and water for recycling within the process plant.

2.4.2.3 Secondary Concentration

The secondary concentration process consists of sorting the material containing the diamonds by magnetism and X-rays. The final stage of separation involves hand-sorting by EKATI personnel. The waste streams from this process are water and coarse rejects that are trucked to the designated area of the Panda/Koala WRSA.

2.4.2.4 Process Water

Water used in the process plant is either recycled from within the process plant or discharged to the LLCF, from where it is then available to be reused.

2.4.2.5 Fine Processed Kimberlite

FPK is generated from the washing and screening of the ore and from the Heavy Medium Separation of the ore. The FPK is de-watered or “thickened” in the process plant to recover process water for recycling within the plant. The FPK slurry contains coagulants and flocculants, which are used to recycle the process water. In some cases saline water or calcium chloride is added to assist with the settling of fines (extraction of water to about 40% solids), after which the remaining slurry is pumped to the LLCF.

The coarser FPK (mainly sand sized particles) settles out first to form well-defined sub-aerial and sub-aqueous beaches. This phase accounts for approximately 88% by mass of the FPK discharge.

Within the FPK there is a fraction of material referred to as extra fine processed kimberlite (EFPK). The EFPK (mainly silt and clay sized particles) that has not settled on the beaches is largely carried into the nearest pond where it settles at the base of the pond as undulating, low-density mass that takes substantially longer to settle.

Cone penetration testing was conducted in October 2010, to investigate the materials in Cell C, including the EFPK. The testing consisted of 13 cone penetration test soundings, 6 ball penetration tests, 1 vane sounding, and 4 soil sample locations. The results found clear water to a depth of about 5 m overlying a soft to firm (7.5 kPa) silt/clay layer, which is interpreted to be EFPK. This layer may have formed during winter as a result of elevated salinity (chloride) in the pool water and relatively low winter water levels. In comparison with bathymetric surveys from previous years, the cone penetration testing data indicates little, if any, EFPK in the upper 5 m of the water column in Cell C.

2.4.2.6 Flocculants

The use of flocculants in the process plant has been previously approved by the Mackenzie Valley Land and Water Board. The purpose and benefit of added flocculant is to enhance the settlement of FPK in the process plant thickeners and to some extent the LLCF. This use of flocculant is part of the routine process plant procedures. Control room operators vary the amount of flocculent and coagulant added, depending on the actual settling characteristics of the kimberlite ore being fed to the plant. The process of coagulation involves the aggregation of typically very fine charged clay particles that, on their own, have very low settling rates. Through the addition of flocculent, these aggregates can combine with other FPK to form “flocs,” larger structures that have higher settling rates and facilitate the recycling of water in the process plant.

The addition of calcium chloride is also approved and is sometimes necessary to facilitate the settlement of fines when ore containing higher clay contents is processed.

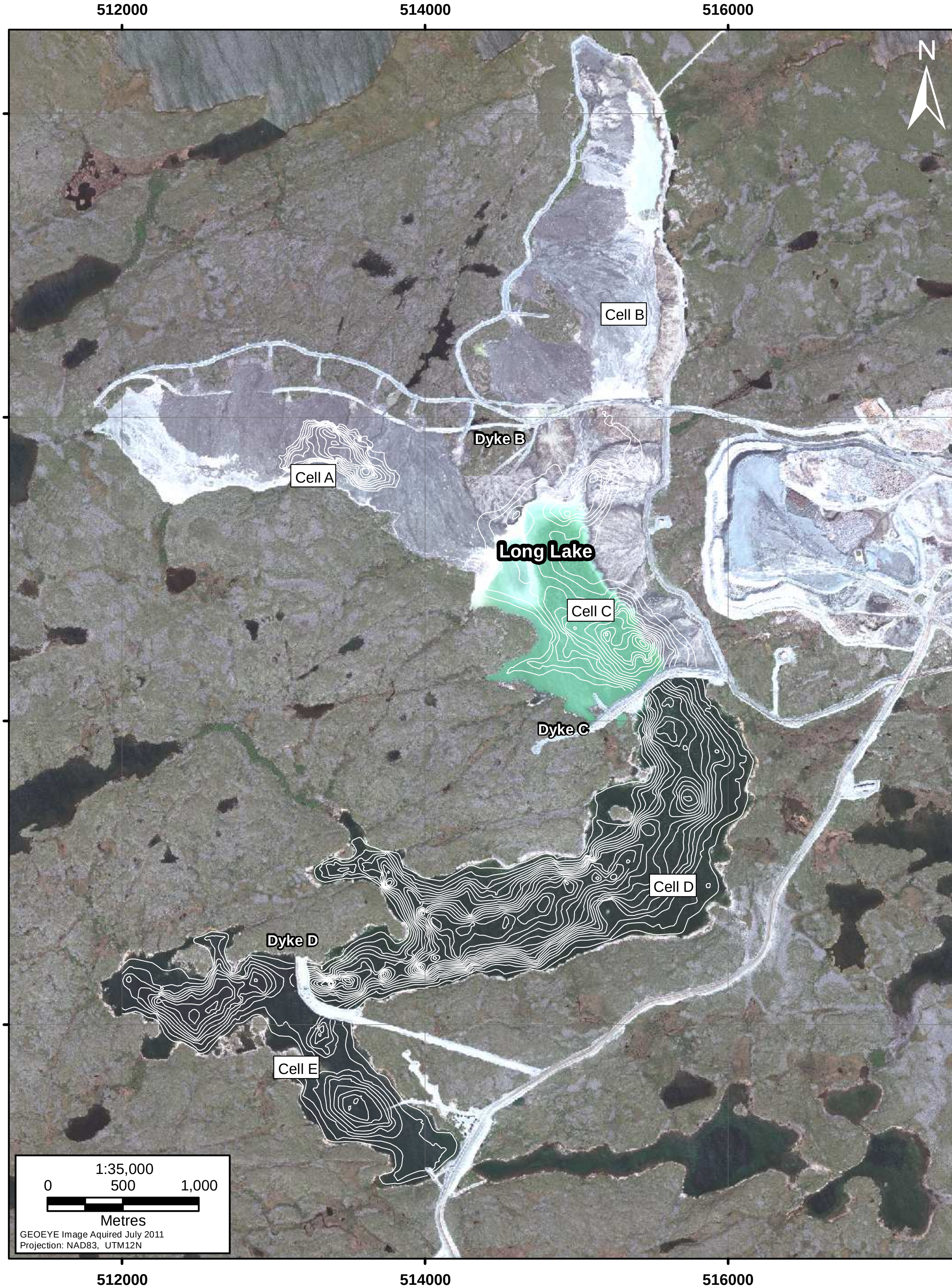
Flocculant can also be added to other mine water sources on an as-needed or contingency basis. The locations where in-line flocculant plants are installed are the mine water pipeline to the LLCF and the mine water pipeline to King Pond. These in-line plants have been used in past years, although neither is currently in use. There are no plans to re-activate these in-line plants in the near future.

However, the in-line plants are an option for contingency responses. As such, there are no pre-defined numerical criteria for their use in this manner. The determination is, by necessity, based on a case-by-case assessment of risks and trends in water quality. For example, if unusually heavy runoff were to generate unusually high concentrations of sediment in the mine water pumped from Waste Rock Dam to King Pond of a magnitude that posed a risk to the effluent quality discharged from King Pond, then the flocculant plant could be activated to reduce that risk. This would be reported to the WLWB in the Environmental Agreement and Water Licence Annual Report. The only chemicals involved in this process are flocculants and coagulants that are added to the effluent to reduce the concentration of total suspended solids (TSS) in the process plant, thereby allowing water to be recycled within the plant. Flocculation also serves to promote settling of fines in the LLCF. Coagulants and flocculants are commonly used in water treatment plants throughout Canada.

2.4.3 Long Lake Containment Facility

The LLCF encompasses Long Lake and the former headwater lakes of Long Lake (Figure 2.4-5). The LLCF is at the headwater of the western Koala Watershed which feeds into the immediate receiving environment starting with Leslie Lake and flowing through Moose, Nero, Nema, Martine, Rennie, and Slipper lakes, ultimately draining into Lac de Gras. The LLCF currently includes the following components:

- Cells – A, B, C, D, and E (Figure 2.4-5). Cells A, B, and C currently receive and store FPK and wastewater. Cell D is used as a polishing pond, and Cell E provides surge water storage capacity for surplus water and acts as a finishing pond prior to pumping and discharging into the receiving environment. Cell E will never receive FPK.
- Dikes – B, C, and D (designation corresponds to upstream subtended cell; Figure 2.4-5). These filter dikes are designed to retain PK solids within the upstream cell but allow water to filter through to the downstream cell. These dikes will provide secure storage of PK in the future. The filtering action of the dikes is anticipated to progressively slow as FPK accumulates on the upstream face. Dike B is considered to be effectively sealed and water transfer from Cell B to C flows through a culvert. Dike C is considered to be partially sealed and water transfer from Cell C to D is augmented by pumping. Dike D is not affected by FPK but water transfer from Cell D to E is augmented by pumping as required to safely manage pond water levels.
- Dams – The outlet dam serves as the downstream water control structure which retains water until sampled, authorized, and pumped to the receiving environment. The Spillway Dam and East Dam (east side of Cell D; Figure 2.4-5) have been assessed and are permitted as water management contingencies but have not been constructed. The East Dam and/or the Spillway Dam would be constructed only if alternative water storage options in the LLCF are not available.



EKATI Long Lake Containment Facility

FIGURE 2.4-5

- 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 (Figure 2.4-5). The reclaim water barge in Cell D pumps water to the process plant. Pumps at Dike D seasonally assist transfer of the water to Cell E. Pumps in Cell E transfer water that meets Water Licence W2009L2-0001 discharge criteria into 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 Cells C and D (Figure 2.4-5). The Fox Pit road extends from the plant to the outlet dam. Roads are planned along the west side of Cell C and the south side of Cell A.
- Powerlines, Pipelines, and Discharge Spigots – These are used for the delivery of the FPK slurry along the access roads from the process plant site. Powerlines have been installed as far as the outlet dam. Electric pumps are used to pump the water from Cell E to Leslie Lake to reduce environmental risks associated with diesel pumps.
- Drainage Channels, Diversion Channels, and Diversion Berms – These have been assessed and permitted, but not constructed. The permitted structures include diversion channels A and B and berm A located on the west side of the LLCF, and the East Diversion Channel located on the east side of the LLCF (Figure 2.4-5). The East Diversion Channel along the external sides of Cell B and C has not been constructed and is part of the Interim Closure and Reclamation Plan (ICRP).

Water levels are maintained with minimum 1.0 m freeboard and in accordance with the current Water Licence.

The LLCF was designed to safely contain the estimated 58 Mt of FPK for the mine and to provide for acceptable water quality and quantity according to operating and environmental protection requirements.

2.4.4 King Pond Settling Facility

At the Misery Site, sump water from Misery Pit and other collection points is pumped into the King Pond Settling Facility (KPSF), which acts as a sedimentation cell. Water from that facility is then pumped into the receiving environment, beginning with Cujo Lake and flowing down to Christine Lake before entering Lac du Sauvage (Figure 2.1-2). Water is only pumped into Cujo Lake if it meets discharge criteria specified in Water Licence W2009L2-0001. Sewage from Misery Camp is trucked to the sewage treatment plant of the Main Camp.

2.4.5 Fine Processed Kimberlite Deposition Management

The FPK Deposition Plan provides for FPK deposition through the remainder of the current life of mine and provides options for future growth (Figure 2.4-6; Report 45). The FPK Deposition Plan is designed to maximize the use of available storage capacity in Cells A, B, and C of the LLCF, and the mined-out Beartooth Pit.

2.4.5.1 LLCF

The FPK Deposition Plan is designed to defer, and possibly eliminate, the use of Cell D of the LLCF for FPK deposition. This preserves the use of Cell D as a large water management area. The selected sequence of options also increases the operational flexibility for FPK deposition over different areas.

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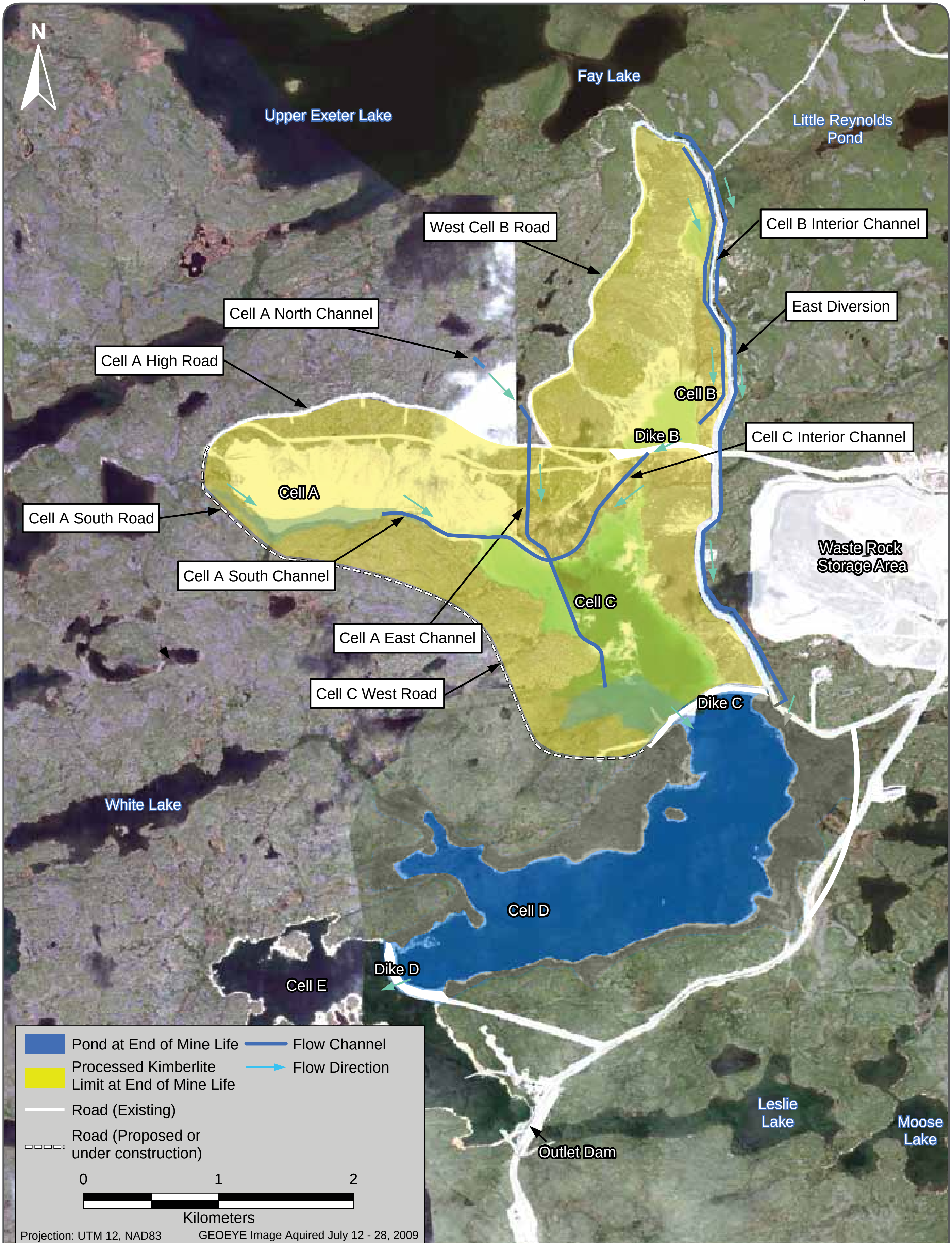

Figure 2.4-6

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Projected Development of the LLCF

Additional management of the LLCF design has been completed in response to mine operations, including in response to an unplanned release of FPK to the shore and ice of Fay Bay adjacent to Cell B that was identified in May 2008 (Rescan 2011b; see also Section 7). Recent changes to the LLCF included:

- connection of the Cell B "east" and "west" access roads, creating a ring road around Cell B;
- installation of a plastic liner against the south bank of the Cell B road at its northern extent (i.e., internal to Cell B); and
- construction of an internal water channel from the uppermost end of Cell B (excavation of PK and placement of coarse, granular PK) to create an internal flowpath that directs runoff water towards the south.

Figure 2.4-6 illustrates the completed LLCF. For a more detailed description of the FPK Deposition Plan, refer to the *Wastewater and Processed Kimberlite Management Plan Version 2.0* (Report 45).

2.4.5.2 Beartooth Pit

Mining was completed in the Beartooth open pit in 2009. Beginning in late 2009, underground mine water and other sources of mine water have been pumped to the mined-out Beartooth Pit as a means of enhancing water quality in the LLCF, particularly regarding chloride. FPK is planned to be deposited into the Beartooth Pit beginning in late 2012 as part of the FPK Deposition Plan.

Figure 2.4-7 illustrates the operating plan for the mined-out Beartooth Pit as outlined below:

- underground mine water is pumped to the mined-out Beartooth Pit throughout the mine life;
- a portion (estimated 33%) of the FPK from the process plant is planned to be pumped to the mined-out Beartooth Pit beginning September 2012; and
- water is withdrawn from the Beartooth Pit for recycle and release to the LLCF, beginning approximately 2016, to maintain the necessary safety freeboard in Beartooth Pit and to enable full use of potential storage capacity for FPK.

2.4.6 Waste Rock Storage Areas

2.4.6.1 General Description

The WRSAs at EKATI are designed to contain the rock excavated from the open pits, which is predominantly granite but also may consist of metasediment, diabase, or barren/low-grade kimberlite. The WRSAs also contain and store other materials including coarse kimberlite rejects (CKR; in the Panda/Koala/Beartooth WRSA), and low grade kimberlite stockpiles (in both the Panda/Koala/Beartooth and Fox WRSA) and metasediments (Misery and Pigeon).

<u>Rock Types</u>

Granite is a coarse-grained, light-coloured, hard igneous rock that does not produce acid rock drainage. Metasediment is a medium-grained to coarse-grained metamorphic rock composed of laminated, often flaky parallel layers of chiefly micaceous minerals that has the potential to produce some acid rock drainage. Diabase is a fine- to coarse-grained dark igneous rock that may produce acid rock drainage. Barren or low-grade kimberlite is a dark heterogeneous rock with little diamond content. Waste granitic rock is used for construction of roads, dikes, dams, and building functions. Otherwise, it is stored in waste rock piles near the pits.

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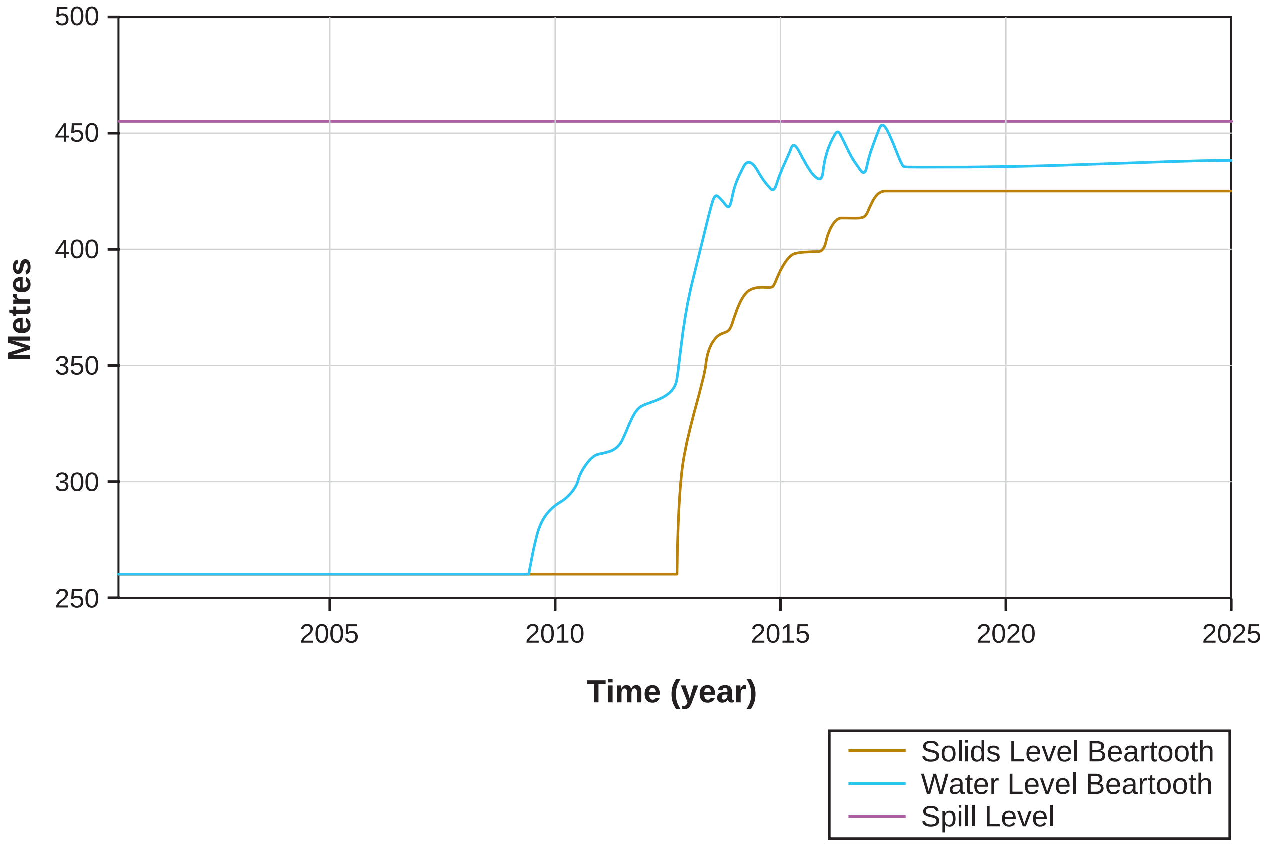

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Conceptual Beartooth Pit Operating Plan

Figure 2.4-7

Construction

The WRSA are constructed by means of inset lifts approximately 10 to 20 m deep with natural rock face repose angles of approximately 35°. The lifts are offset in a manner such that the overall slope angle will be less than or equal to 25°. WRSA heights do not exceed 50 m above the highest topographic point over which the WRSA extends. The WRSAs were all constructed and based on the original approved plans which stated they would remain as permanent structures after mining was completed. The design of the WRSAs enhances the natural process for freezing into permafrost.

For a more detailed description of the EKATI WRSAs and their management see *Waste Rock and Ore Storage Management Plan: Version 3* (Report 46).

2.4.6.2 Panda/Koala/Beartooth Waste Rock Storage Area

Waste materials from the Panda, Koala, Koala North, and Beartooth open pits, and the Panda and Koala underground developments are stored together in the WRSA close to the Main Camp. This WRSA also contains several other waste management facilities including the CKRSA and the Koala and Beartooth Topsoil Storage Areas. The total area covered by the Panda/Koala/Beartooth WRSA (defined as the constructed perimeter berms and all enclosed land, including the uncovered tundra) is 4,281,000 m^2. The current maximum elevation of the WRSA is 520 metres above sea level (masl), 40 m above the local average tundra elevation of 480 masl. The footprint of the WRSA with material locations as of 2011 is shown in Figure 2.4-8.

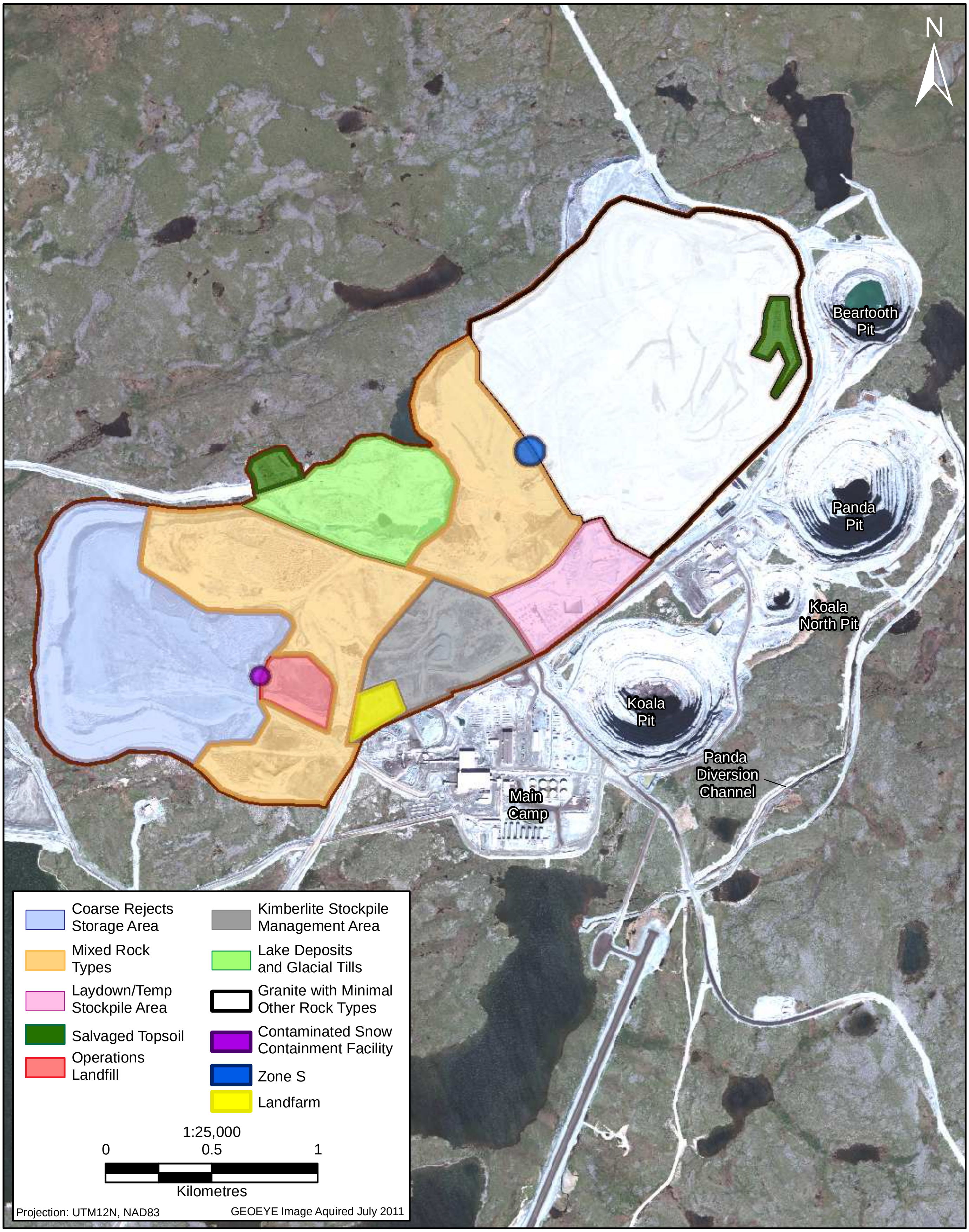
There is relatively little waste rock planned to be placed in this WRSA in the future. Open pit and underground mine development are virtually complete in this area. The coarse kimberlite storage area, however, will continue to receive material from the process plant through the life of mine. The final footprint of the Panda/Koala/Beartooth WRSA is shown in Figure 2.4-9.

Coarse Kimberlite Reject Storage Area

The CKRSA (Figure 2.4-8) has received material from the process plant since 1998. The CKRSA contains PK from all pipes at EKATI. The CKR, are comprised of a mixture of sand to gravel-sized, light, and dense minerals remaining after the diamonds have been recovered from the kimberlite. The grain size distribution is in the range of 0.5 to 25 mm diameter. Finer material (less than 0.5 mm) washed from the kimberlite ore during processing (FPK) is discharged as a slurry to the LLCF.

As the Panda/Koala waste rock storage facilities were the first to be constructed, the CKRSA was built prior to the knowledge that interaction of kimberlite materials with the naturally acidic tundra soils can result in low pH waters resembling acid rock drainage with high solute concentrations, despite the high neutralization potential within the CKR. Thus, early portions of the CKRSA were not built with an underlying granite pad. Subsequently, a granite shell was constructed around the outer edges of the CKRSA to ensure that the CKR remained in permanently frozen portions of the pile. Further expansions of the CKRSA and all newly constructed waste rock storage facilities at all mine components were constructed with a pre-laid granite pad, and operational management procedures are in place to limit accidental disposal of kimberlite in the WRSA.

The CKRSA will continue to receive CKR from processing of kimberlite from all operations. The final footprint of the CKRSA is shown in Figure 2.4-9.



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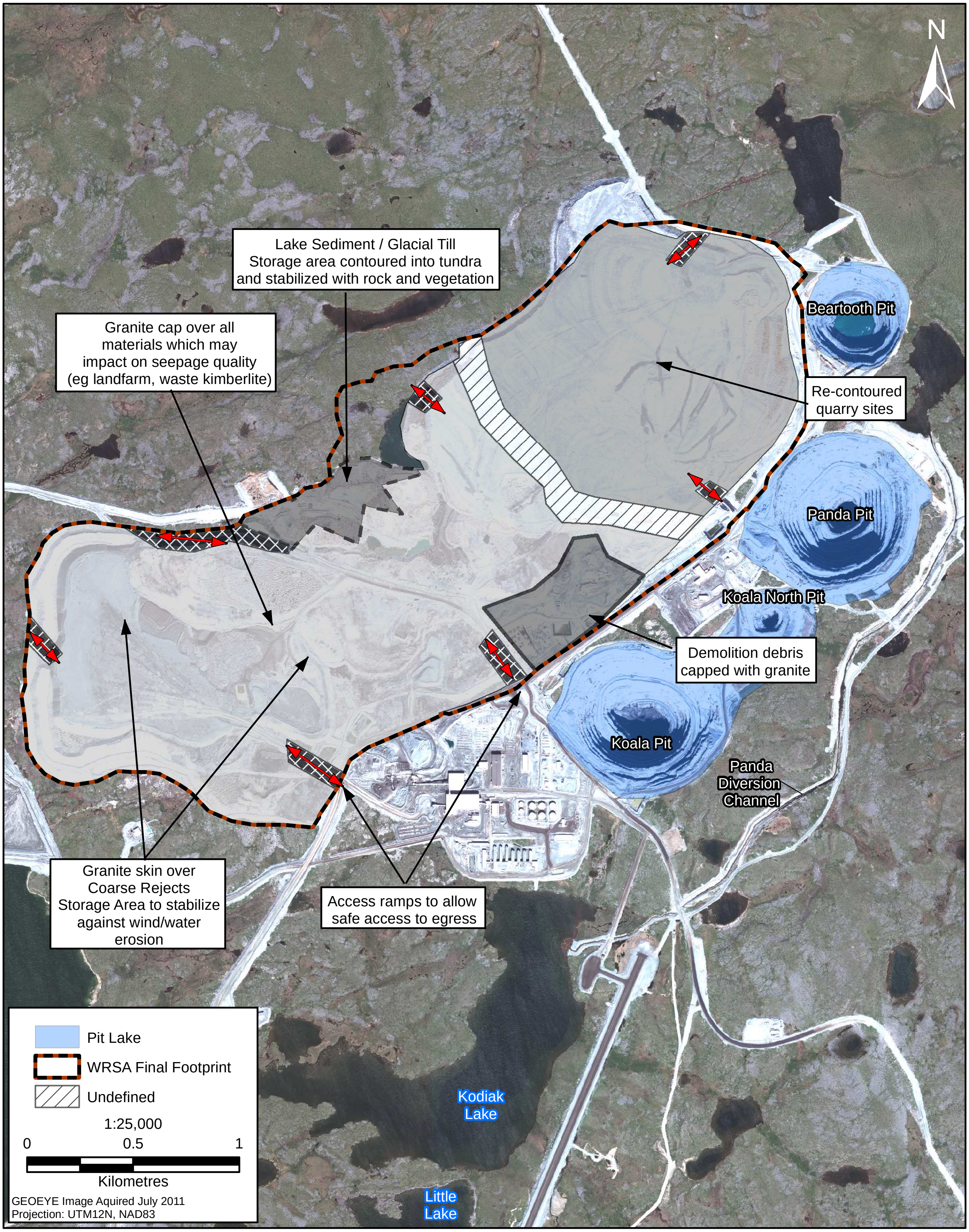
Panda/Koala/Beartooth WRSA Material Locations

FIGURE 2.4-8



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Final Footprint of Panda/Koala/Beartooth WRSA

FIGURE 2.4-9

Lake Deposits and Glacial Tills

The Panda/Koala Lake Deposits and Glacial Till Storage Area (Figure 2.4-8) contains lake-bottom sediments and overburden tills excavated during the development of the Panda and Koala North pits. This material is mixed to a limited degree with waste rock during transportation. Koala and Beartooth lake sediments were also mixed with waste rock in the western portions of the WRSA.

Salvaged Topsoil

Topsoil, salvaged from the original Koala Lake perimeter, has been stockpiled north of the Panda/Koala WRSA. Topsoil from the Beartooth Lake perimeter has been stockpiled on the east end of the WRSA.

Operations Landfill

The Main Camp solid waste landfill was commissioned in July 1998 and is located on the western side of the Panda/Koala/Beartooth WRSA (Figure 2.4-8). The landfill is used for the disposal of inert non-hazardous wastes (wood, metal, cement, cardboard, etc.) generated as part of the operation of the mine.

Contaminated Snow/Ice Containment Facility

The Contaminated Snow/Ice Containment Facility was constructed in 2004 on the CKRSA on the western side of the WRSA (Figure 2.4-8). The Contaminated Snow/Ice Containment Facility is a bermed and lined facility designed for the containment of hydrocarbon-impacted snow and ice that are generated as a result of operational spills (diesel, glycol, gasoline, kerosene, jet fuels, hydraulic oil, transmission fluid, and lube oil). Following the spring melt, the hydrocarbon contaminated sheen floating on the surface of the water is physically removed. The remaining water is removed to the LLCF.

Landfarm

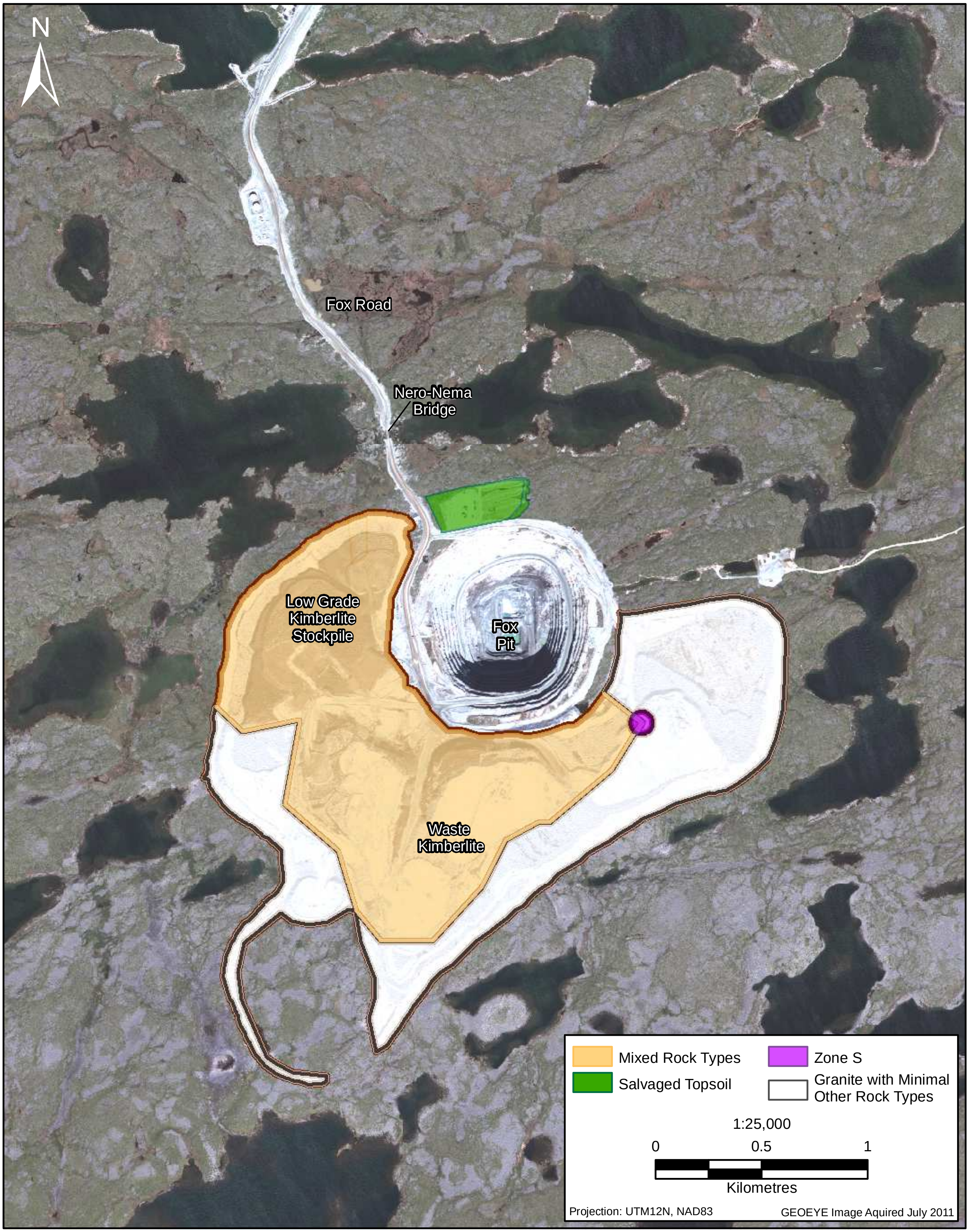
The landfarm (Figure 2.4-8) was constructed in 1998 and is a lined facility designed with a leachate collection system and side berms to control runoff. The landfarm is used for the management of hydrocarbon-impacted soil generated at the site as a result of operational spills (diesel, glycol, gasoline, kerosene, jet fuels, hydraulic oil, transmission fluid, and lube oil). Hydrocarbon-impacted soils with average particle sizes of less than 4 cm are bio-remediated at the landfarm facility. The landfarm may also be used as secure temporary storage for hydrocarbon-impacted material which is unsuitable for bio-remediation, prior to these materials being sent offsite for disposal.

Zone S

Hydrocarbon-impacted soils and rock with average particle sizes of greater than 4 cm are combined with waste rock in Zone S of the Panda/Koala/Beartooth WRSA (Figure 2.4-8) to be encapsulated within the permafrost zone of the WRSA.

2.4.6.3 Fox Waste Rock Storage Area

The Fox WRSA is located in a horseshoe around the Fox Pit and covers the western, southern, and eastern areas immediately adjacent to the pit. The Fox WRSA is the repository for all waste rock from the Fox Pit. The total area covered by the Fox WRSA (defined as the constructed perimeter berms and all enclosed land including the uncovered tundra) is 3,830,000 m^2. The current maximum elevation of the WRSA is 510 masl, 50 m above the local average tundra elevation of 460 masl. The footprint of the Fox WRSA as of 2010 is shown in Figure 2.4-10.



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Fox WRSA Material Location

FIGURE 2.4-10

The Fox WRSA consists of granite co-disposed with minor diabase, lake-bottom sediments, and till. Low-grade kimberlite is segregated and located within the Fox WRSA in a south-central location and along the northwest side (Figure 2.4-10; BHP Billiton 2002). Granite pads were pre-laid to avoid direct contact of low-grade kimberlite with tundra water and to promote freezing in the pile. All of the kimberlite within the WRSA is surrounded by an extensive (approximately 40 m-thick) granite zone. Toe berms that limit seepage flows from the Fox WRSA to the surrounding receiving environment were constructed during the fall and winter of 2003/2004.

Topsoil from the perimeter of the Fox Lake was salvaged during pre-stripping in 2003 and stored north of the Fox Pit (Figure 2.4-10).

Similar to the Panda/Koala/Beartooth WRSA, the Fox WRSA has a Zone S (Figure 2.4-10) where hydrocarbon impacted soils and rock with average particle sizes of greater than 4 cm are combined with waste rock to be encapsulated within the permafrost zone of the WRSA.

There is relatively little waste rock planned to be placed in this WRSA in the future. Open pit development is complete. The final footprint of the Fox WRSA is shown in Figure 2.4-11.

2.4.6.4 Misery Waste Rock Storage Area

Construction of the Misery WRSA commenced from 2000 to 2005 during mining of the starter pit. The total area covered by the Misery WRSA (defined as the constructed perimeter berms and all enclosed land including the uncovered tundra) is 710,000 m^2. The current maximum elevation of the WRSA is 485 masl, 35 m above the local average tundra elevation of 450 masl. In anticipation of the completion of the final open pit, construction of the Misery WRSA recommenced in October 2011.

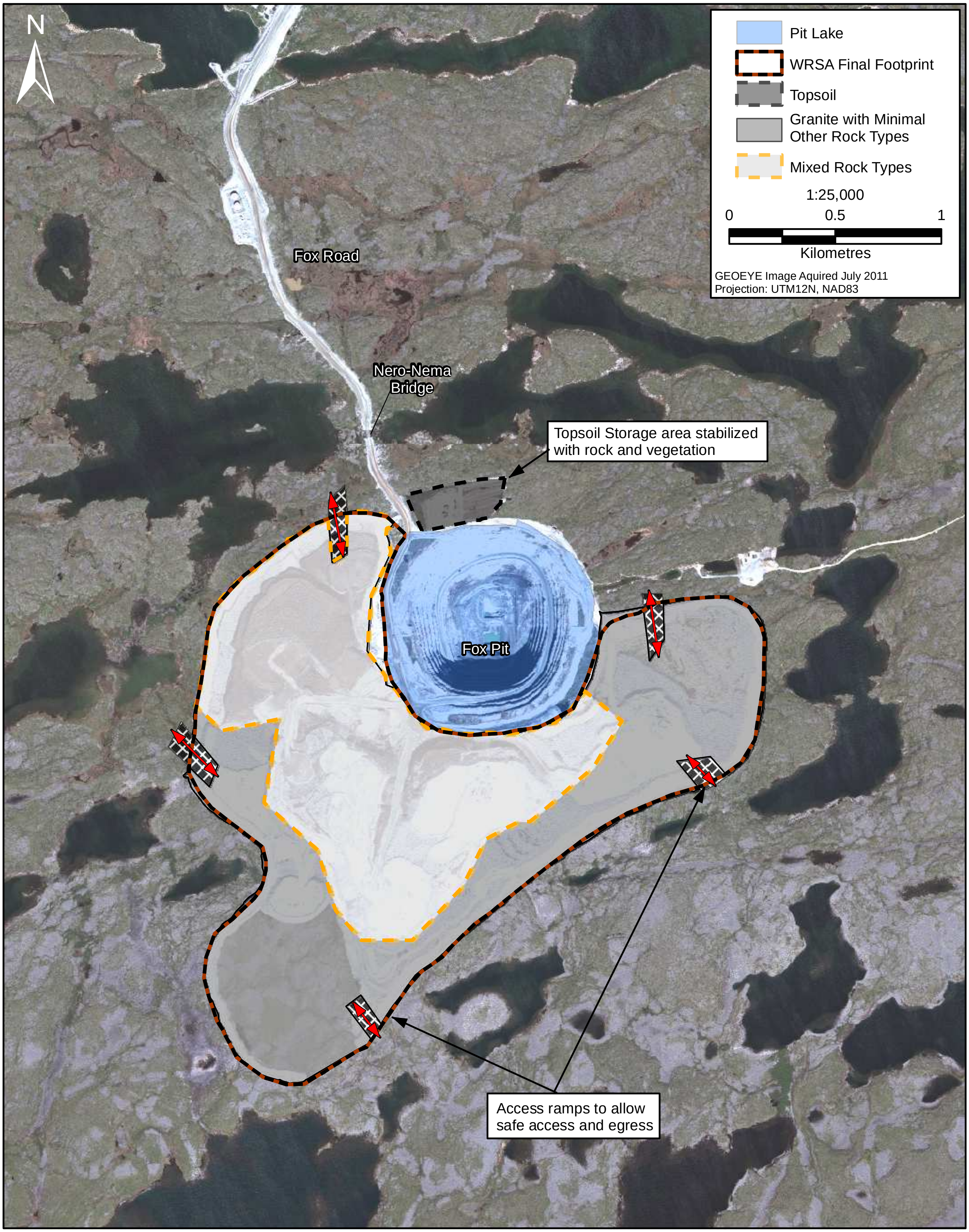
The Misery WRSA is constructed to encapsulate metasediments within the permanently frozen portions of the pile. Methods used included alternating layers of potentially reactive metasediments (10 m-thick) and granite (5 m-thick; Figure 2.4-12). A final 5 m-thick granite cap is placed over the storage area to maintain the active freeze/thaw zone within the upper granite layer to minimize potential oxidation within the metasediments.

The north end of the Misery WRSA contains a till and lake sediment storage area (Figure 2.4-12), where approximately 3 Mt of material stripped from the Misery Pit and salvaged from the construction of the King Pond Dam is stored.

A landfill at the Misery site (Figure 2.4-12) was commissioned in August 2001 and is located north of the Misery Pit within the footprint of the Misery WRSA. When mining was suspended at Misery Pit, the landfill was covered with an interim granite cap. Materials placed within this facility were the same as those disposed of within the Panda/Koala/Beartooth Landfill.

The final footprint of the Misery WRSA is shown in Figure 2.4-13. This footprint represents the planned completion of the rock pile according to the resumption of mining that began in 2011.

A Temporary Kimberlite Ore Storage Area will be used to store kimberlite ore prior to haulage back to the processing plant at the Main Camp (Figure 2.4-13). It may also be used for temporary storage of granite to facilitate the appropriate layering of rock types in the Misery WRSA. The base to the storage area will be a pad constructed out of granite waste rock. Drainage from the pad will flow towards Waste Rock Dam, which is a managed water body. Water impounded behind this dam is pumped to King Pond Settling Facility. The material stored on the pad will eventually be removed from this storage area, as ore to the process plant or as waste to the WRSA. The pad will be reclaimed.



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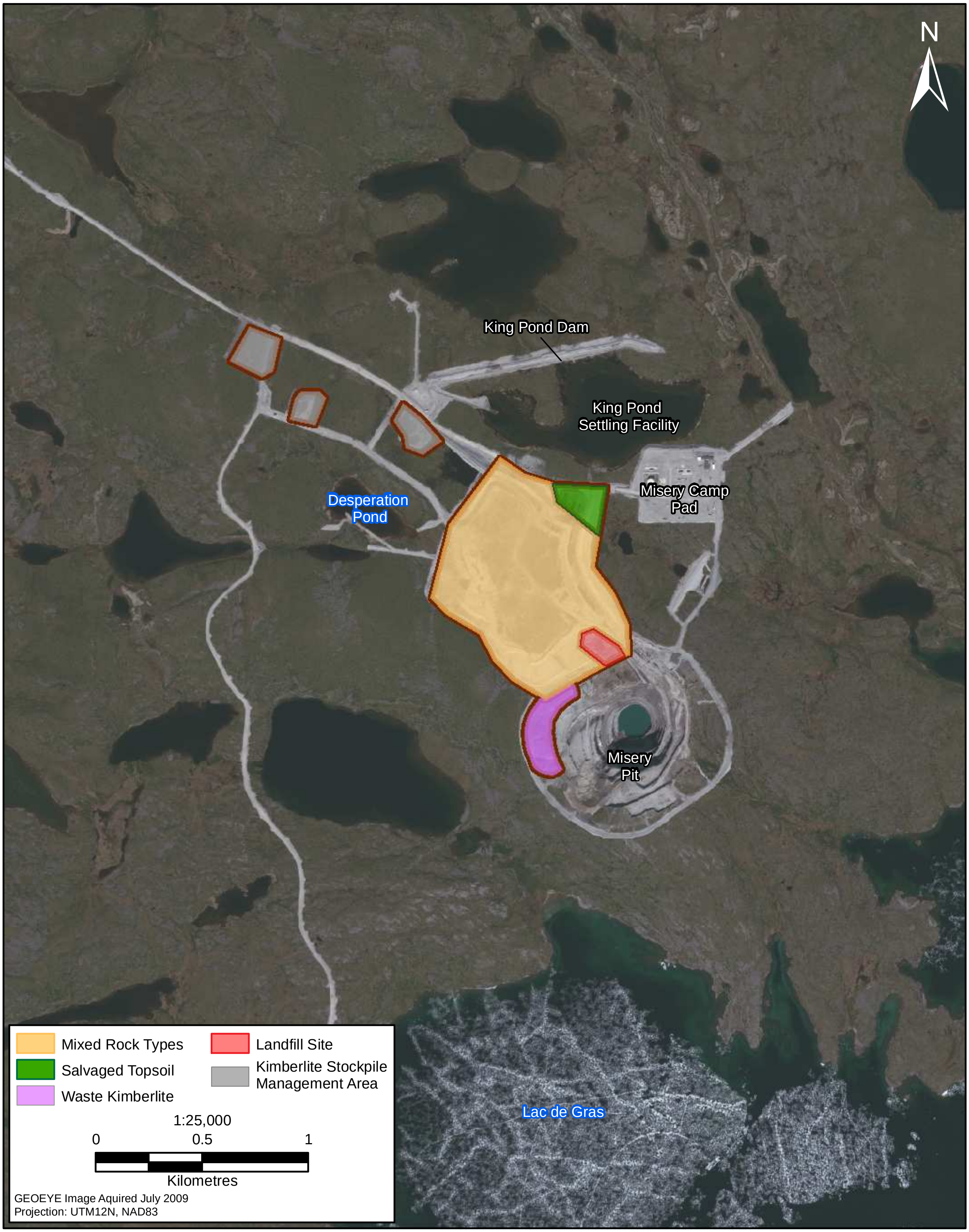
Final Footprint of Fox WRSA

Figure 2.4-11



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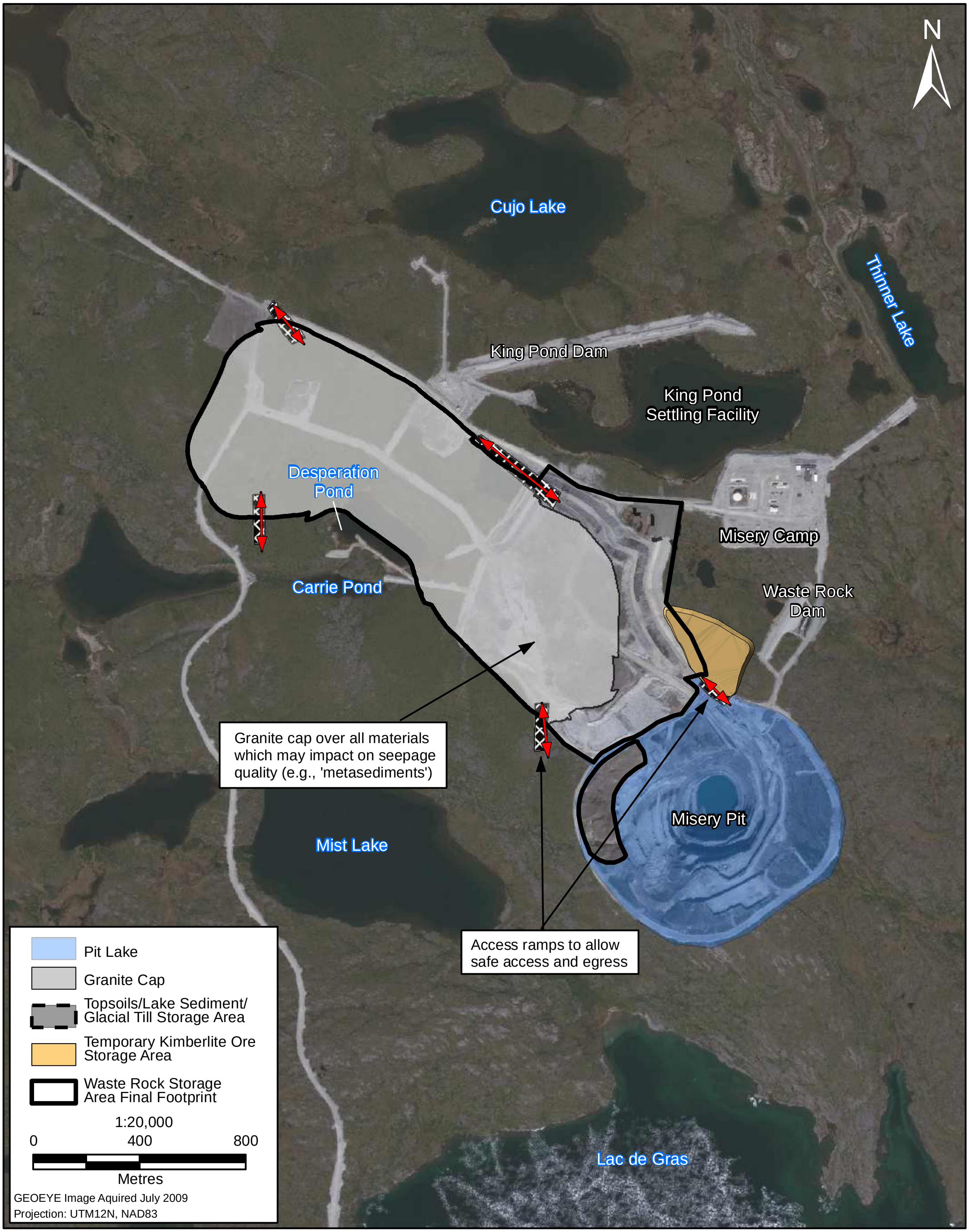
Misery WRSA Material Location

FIGURE 2.4-12



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Final Footprint of Misery WRSA

FIGURE 2.4-13

2.4.7 Waste Rock Storage Area Management

2.4.7.1 Waste Rock Seepage Management

Surface run-off and seepage from the western, northwestern and southern portions of the Panda/Koala WRSA flow naturally into the LLCF. Surface run-off from the eastern portion of the WRSA predominantly drains to the Panda/Koala Pit diversion ditches and sumps. A portion of runoff in the northeastern area of the WRSA flows into Bearclaw Lake. Surface run-off and seepage from the Fox WRSA is managed, in part, by frozen core perimeter berms. The WRSA for the Misery Pit operation is situated within four individual mine water collection areas: Waste Rock Dam, Desperation Pond, Misery Pit, and King Pond.

Runoff from each of the WRSAs is monitored, assessed, and reported to the WLWB under the Annual WRSA Seepage Monitoring Report, which is a requirement of the Water Licence W2009L2-0001 (Section 7.1.2.4). Specifically, seeps from the waste rock piles are monitored for volume and chemical characteristics. Mitigative steps would be taken if it was necessary to contain or collect seeps with unfavourable chemistry (e.g., additional focus studies to address potential effects and additional monitoring).

2.4.7.2 Permafrost Role in Chemical and Physical Stability

Water from precipitation and snowmelt seeps into the waste rock piles and, because EKATI lies within the permafrost zone, the water freezes in place. Permafrost growth through the WRSA is a key component of chemical and physical stability within the piles. The WRSAs are designed to encourage permafrost movement from the underlying tundra into the rock pile. Ground temperature cables have been installed in the WRSAs to monitor the extent and rate of the permafrost growth and these have been monitored regularly (see Section 7.2.2.6 for the 2011 summary of results or Report 46 for details).

Permafrost, if managed carefully, has been recognized as an effective control barrier for the prevention of metal leaching and acid rock drainage at other mine sites across northern Canada because it reduces exposure of some rock types and materials to oxidizing conditions. Acid rock drainage has not been observed or measured at EKATI and it is not expected because of the low reactivity of the local rock. However, to mitigate any potential acid rock drainage production, permafrost growth into the WRSA at EKATI is encouraged. This was done during the early construction phase of the WRSA by placement of a layer of granite on the tundra, across the footprint area. This provides a “pathway” for permafrost growth, and enables the initial layer to freeze prior to placement of additional materials.

In addition, by slowing the movement of water through the WRSA, the potential for seepage is reduced by causing water to freeze in place sooner. This was achieved by the introduction of toe berms in selected areas of the Panda/Koala/Beartooth WRSA in 1999. The toe berms are composed of frozen sand, gravel, and rock and are designed to impound and reduce the flow rate of water and increase its residence time in the WRSA, therefore enhancing freezing within waste rock voids. Toe berms are constructed using material of a low permeability, such as glacial till, that is covered with rock for protection. Toe berms have been constructed at specific locations on the Panda/Koala/Beartooth WRSA and the Fox WRSA. Following construction of the toe berms, a rockfill cover is placed over the toe berm at a typical height of 4 m.

Additional cooling is also expected to occur as a result of the material placement within and around the perimeters of the WRSA (Plate 2.4-2). Highly porous embankment material with a narrow gradation and a relatively low amount of fines can promote enhanced cooling due to cold winter air circulation by convection currents within the open voids of the rock. This behaviour has been noted in field conditions at EKATI. Natural convection cooling of the pore-air will continue to occur until the temperature difference between the embankment’s base and upper surface is no longer large enough to promote convection cooling.

Plate 2.4-2. Typical WRSA embankment (note large fragmentation that encourages cool air flow).

Convection occurs in winter when cold winter air sinks into voids displacing the warm air. In summer, the thermal gradient reverses and the cooler air remains trapped in the voids. This results in a temperature difference that enhances cooling in winter and shuts down in summer. The convective component of heat transfer enhances heat removal by cold winter air and has an overall effect by the lowering of the mean annual air temperature within the rock pile. Figure 2.4-14 shows a schematic of the convective cooling concept.

Ground temperature cables have been installed in the WRSA to monitor the extent and rate of the permafrost growth and these have been monitored regularly and reported in the annual Seepage Monitoring Reports.

Figure 2.4-15 presents a conceptual representation of water movement and ice formation in the WRSA. Generally, ice formation in the WRSA occurs when water from precipitation (rainfall or snowmelt) seeps into the waste rock materials and freezes in place before it escapes from the piles. Ice formation is thought to occur at two locations in the pile: around the pile exterior and along the base of the pile.

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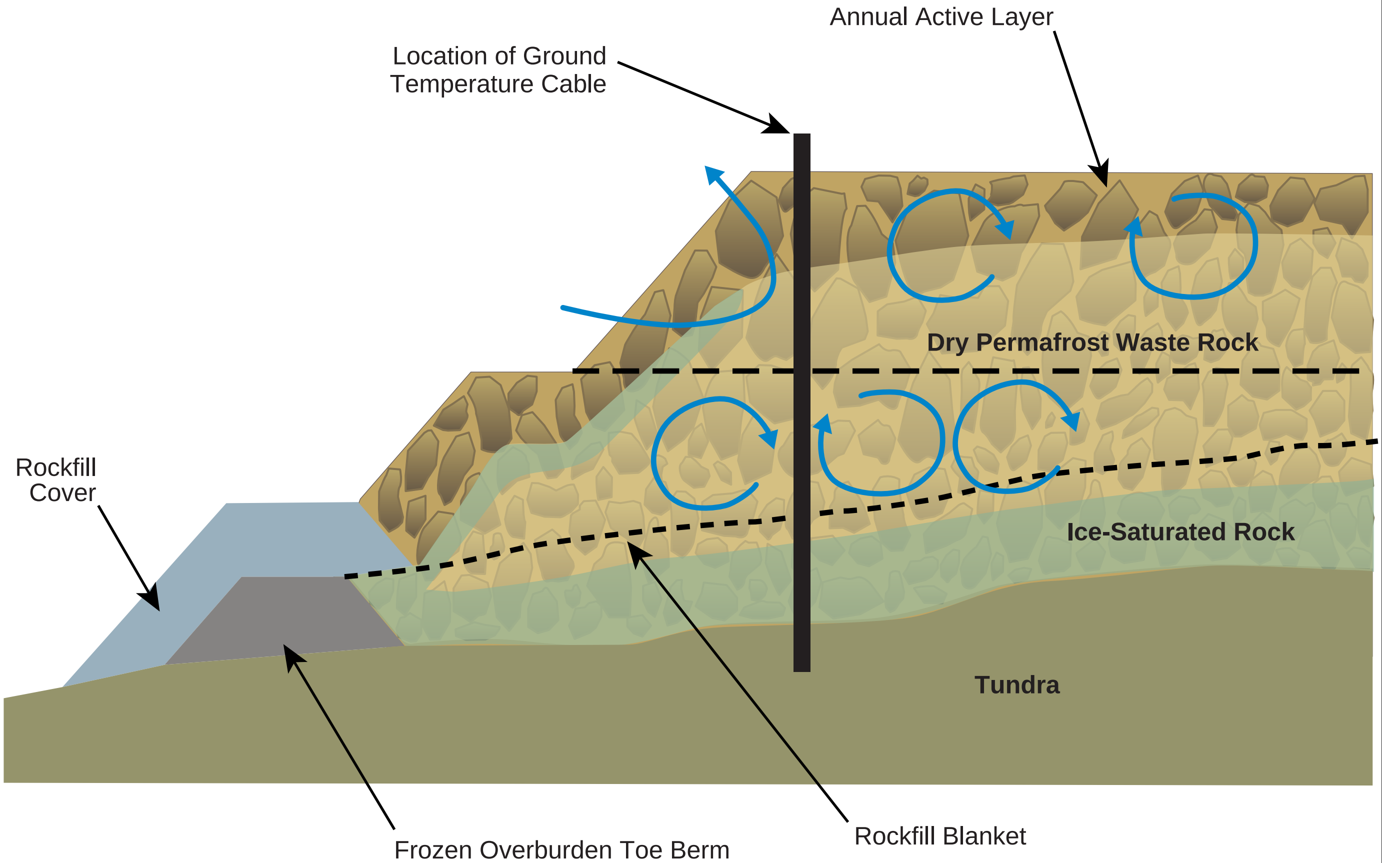

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Figure 2.4-14

Convection Cooling Concept

Table of Contents

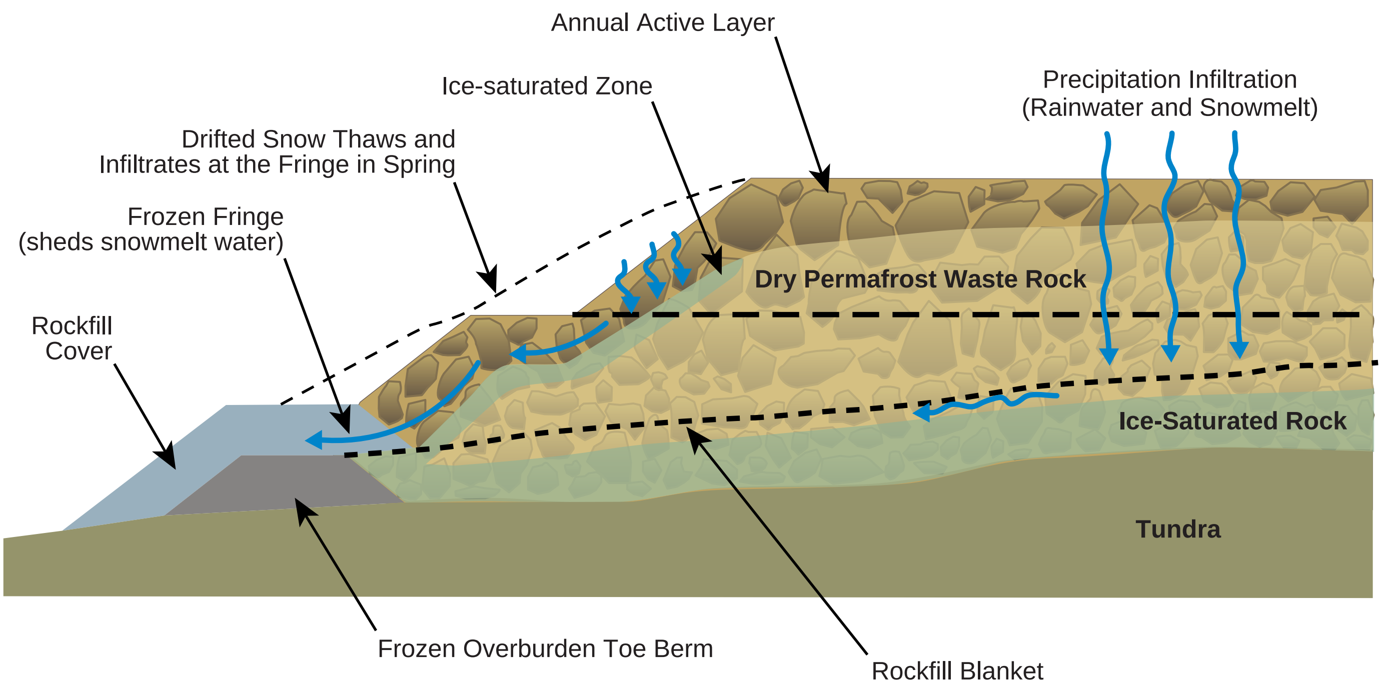

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Figure 2.4-15

Conceptual Ice Formation and Hydrological Model for WRSA at EKATI

3. Summary of Mine Operations

3. Summary of Mine Operations

3.1 MINE OPERATIONS: THE LAST THREE YEARS (2009 TO 2011)

3.1.1 Exploration

The EKATI claim block contains over 150 kimberlite pipes of which seven are known to have economic potential (Koala, Koala North, Panda, Beartooth, Fox, Misery, and Pigeon). There have been no new pipes with sufficient confirmed economic potential that warrant inclusion with the pipes identified in the current mine plan.

3.1.2 Production

Approximately 18 Mt of material was excavated from five operating pits and the underground operations between 2009 and 2011 (Table 3.1-1; BHP Billiton 2010a; BHP Billiton 2011d, 2012). BHP Billiton recently approved the Misery pushback project of the existing Misery pit, which was mined from 2001 to 2005. Pre-stripping operations began in 2011 with 828,305 tonnes (t) of granite excavated from Misery Pit for the extension of two Mistery Pit benches as well as 683,650 t of metasediment and 2,185 t of waste kimberlite (Table 3.1-1).

Table 3.1-1. Production at EKATI Diamond Mine, 2009 to 2011

		Volume (wet metric tonnes)			
Pit or Plant	**Material**	**2009**	**2010**	**2011**	**Total**
Fox Pit	Granite	1,371,000	543,000	86,000	**2,000,000**
Beartooth Pit	Granite	946,000	0	0	**946,000**
Panda Underground	Granite	19,000	0	0	**19,000**
Koala Underground	Granite	161,000	97,000	130,000	**388,000**
Koala North Underground	Granite	1,000	19,000	40,000	**60,000**
Misery Pit	Granite	0	0	828,305	828,305
	Metasediment	0	0	683,650	**683,650**
	Waste Kimberlite	0	0	2,185	**2,185**
Pigeon Test Pit	Topsoil/Overburden	0	864,209[a]	0	**864,209**
Total[b]	**ALL**	**2,498,000**	**1,523,209**	**1,770,140**	**5,791,3494**
Process Plant[c]	**Kimberlite Ore**	**5,097,630**	**4,895,973**	**4,599,849**	**14,593,452**

[a] *The material was placed in the Pigeon Waste Rock Pile (533,209 wet metric tonnes) and the Panda/Koala Waste Rock Pile (331,000 wet metric tonnes)*
[b] *All material in waste rock piles, till storage piles and ore storage piles (wet metric tonnes).*
[c] *Kimberlite ore received, from all producing pits and underground for processing (tonnes).*

In anticipation of Pigeon Pit development, 864,209 t of topsoil and overburden were excavated to the Pigeon waste rock pile and the Panda/Koala WRSA in 2010 (Table 3.1-1). Of the total excavated from operating pits, 19% was granite and 81% was kimberlite ore. The kimberlite ore was processed and the remainder was stored in relevant waste rock piles, till storage piles, and ore storage piles.

Just over 14.5 Mt of kimberlite ore was processed between 2009 and 2011. The annual processing throughput varied by 5% or less between years. No kimberlite was stored for future processing.

A total of 256,859 m^3 of freshwater was extracted from local waterbodies by the mine between 2009 and 2011 (Table 3.1-2). Nearly all of that volume was pumped from Grizzly Lake for use as potable water by the Main Camp and Koala North Underground supporting surface infrastructure. In 2010, 891 m^3 of freshwater was extracted from Little Lake for construction of an ice dam between Pigeon Pond and the Pigeon Test Pit (Table 3.1-2).

Table 3.1-2. Freshwater Use at EKATI, 2009 to 2011

Source	Maximum Limit[1]	Water Volume (m^3)		
		2009	2010	2011
Grizzly Lake	200,000	82,896	83,614	89,458
Little Lake	400,000	0	891	0
Thinner Lake	15,000	0	0	0
Two Rock Lake	143,500	0	0	0
Total	-	**82,896**	**84,505**	**89,458**

[1] *Per year as defined in Water Licence W2009L2-0001.*

Just over 3 million m^3 of PK solids and nearly 17 million m^3 of liquids were pumped into the LLCF between 2009 and 2011 (Table 3.1-3). Eighty-eight percent of the liquids was process water, 10% was mine water pumped from the pits and the underground operations, and the remaining 2% was treated effluent from the sewage treatment plant and other wastes (Table 3.1-3). Between 2009 and 2011 a total of 850,304 m^3 mine water from Misery Pit and Waste Rock Dam was pumped into the KPSF (Table 3.1-4).

Table 3.1-3. Discharges to the Long Lake Containment Facility, 2009 to 2011

Material	Units	2009	2010	2011	Total
Processed Kimberlite Solids	m^3	1,328,140	1,146,649	853,651	3,328,440
Processed Kimberlite Liquids	m^3	5,030,183	4,765,790	4,904,083	14,700,056
Treated Sewage Effluent	m^3	81,272	104,743	88,504	274,519
Mine Water[1]	m^3	582,160	506,941	632,935	1,722,036
Other Wastes[2]	m^3	8,317	34,582	29694	72,593

[1] *From Panda, Koala, Fox, and Beartooth pits and the underground operations.*
[2] *From camp and open pit perimeter sumps and wash bays.*

Table 3.1-4. Discharges to the King Pond Settling Facility, 2009 to 2011

Material	Units	2009	2010	2011	Total
Mine Water[1]	m^3	30,063	289,681	286,790	606,534
Other Wastes[2]	m^3	0	0	243,770	243,770

[1] *From Desperation Settling Pond and Waste Rock Dam in 2009; from Misery Pit and Waste Rock Dam in 2010; from Misery Pit only in 2011.*
[2] *Includes Waste Rock Dam in 2011.*

Beginning in June 2009, mine water was also pumped to Beartooth Pit (following the Water Board approval). The total volumes pumped to the pit on an annual basis were:

- 18,280 m^3 in 2009;
- 421,791 m^3 in 2010; and
- 562,474 m^3 in 2011.

Over 22 million m^3 of water were discharged to the receiving environment over the years 2009 to 2011 (Table 3.1-5). Approximately 96% of the discharges were from the LLCF—no discharges were released from the Phase I Containment Facility between 2009 and 2011. Discharges from the KPSF between 2009 and 2011 was 887,355 m^3 (Table 3.1-5).

Table 3.1-5. Discharges from Containment Facilities to the Receiving Environment, 2009 to 2011

Source	Discharge (m^3)			
	2009	2010	2011	Total
Long Lake Containment Facility (LLCF)[1]	5,582,205	7,840,050	8,505,902	21,928,157
King Pond Settling Facility (KPSF)[2]	282,961	368,931	235,463	887,355

[1] *Water from Cell E of the LLCF is discharged into Leslie Lake.*
[2] *Water from the KPSF is discharged into Cujo Lake.*

Beginning in 2006, the discharge schedule of the LLCF was timed to coincide with spring freshet and the autumn rains to mimic the natural hydrology (Figure 3.1-1). Prior to 2005, discharge occurred over seven to nine months of the year. Between 2009 and 2011, discharge from the LLCF to the receiving environment occurred in July through to November with the greatest proportion discharged in July (Figure 3.1-1). The EKATI Aquatic Effect Analysis Program (AEMP) examines August water quality in downstream receiving lakes, thus capturing the potential effects related to the LLCF discharge (e.g., Rescan 2012b).

In 2009, water was discharged from the KPSF to the receiving environment in June (4%), July (22%), September (28%), October (46%), and December (less than 1%). In 2010 water was discharged in July (16%), August (53%), and September (31%), while in 2011 discharge from the KPSF occurred only in August (12%) and September (88%). Thus, the examination of August water quality for the lakes downstream of the KPSF reflected the previous year's post-discharge water quality in 2009 and 2011 (e.g., Rescan 2012b).

Mining operations have been temporarily suspended at Misery Pit, and Misery Camp was closed between 2009 and 2011. However delineation drilling was completed in 2009 and 2010. All dams and other water structures associated with the Misery site remain operational and are inspected regularly. Desperation Pond water was pumped to Carrie Pond from June 14 to July 10, 2009 and pumped to the KPSF September 18 to September 21, 2009. Desperation Pond water was pumped to Carrie Pond from June 26 to July 14, 2010. Desperation Pond water was pumped to Carrie Pond from June 25 to July 13, 2011. This water also met effluent quality criteria defined in Water Licence W2009L2-0001. All environmental monitoring programs at the Misery site are still ongoing as if the site was still operational.

3.1.3 Construction

Detailed construction activities completed between 2009 and 2011 are provided in Appendix A of this report. A new incinerator building was commissioned in January 2012; after mechanical upgrades in 2010 and various structural and mechanical changes in 2011 to improve the operation and safety of the system, the new incinerator is currently in operation. In 2009, a glycol heat recovery line was commissioned to heat underground mine air from waste heat generated by the powerhouse, thereby reducing the amount of diesel burnt for this purpose.

Construction activities associated with the LLCF included the completion of a Cell A high road and the high road discharge line was made operational in 2009. Dike C of the LLCF was raised to increase the holding capacity (volume) of Cell C during the summer of 2010. A jetty 240 m in length was constructed at the A11 spigot on the Cell B west tailings line in 2011. To better use the available volume in Cell B for tailings storage, a pipeline containing five spigot points was run along the jetty. The construction of the Cell B West Road began in August of 2011 (approximately 450 m of the total was completed). The road will provide access to the west side of Cell C so that a pipeline can be built to further maximize tailings storage space.

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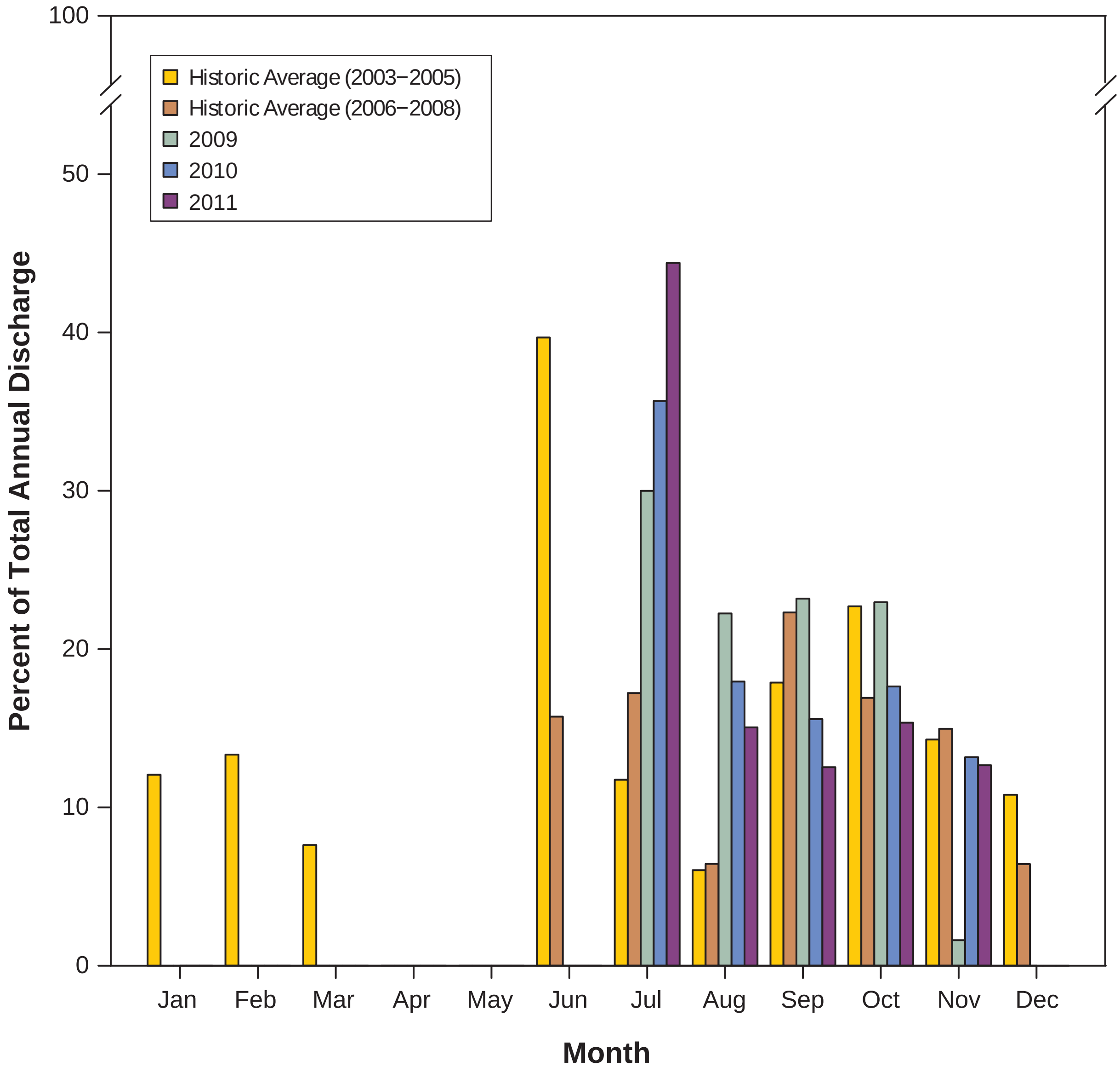

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Monthly Variation in Discharges from the Long Lake Containment Facility - A Comparison of Historical Averages and 2009 to 2011

Figure 3.1-1

The airstrip was resurfaced in July and August 2010 and the electric fence that formerly surrounded the airport and airstrip was replaced with a plastic mesh barrier fence in September of 2010.

Between February and May 2010, a Pigeon Test Pit was constructed in the Pigeon Watershed and the resulting overburden was piled immediately adjacent to the pit, and kimberlite ore was transported to the process plant. The Pigeon Test Pit was fenced with plastic mesh barrier fence.

Phase 1 of the PDC Slope Enhancement Project took place from January to May of 2011 (EBA 2010). During this time a 450 m section of the banks of the PDC were modified to prevent any future spalling/ erosion of material from the banks into the channel. Erosion and sedimentation control measures began prior to construction, were included in the construction design, and continued post construction with the onset of snow melt through the open water season of 2011. This included various aspects such as the installation of silt curtains, the construction of check dams, berms and sumps, and the stabilization of a small pond above the construction area on the east side of the PDC.

3.1.4 Reclamation

BHP Billiton submitted an ICRP for EKATI to the WLWB on August 31, 2011 as a condition of Water Licence MV2001L2-0008 and MV2003L2-0013 renewed in August 2009 as Water Licence W2009L2-0001; Report 44). The plan is version 2.4 (BHP Billiton 2011a) and supersedes previous versions such as the working draft produced in 2008 (BHP Billiton 2008). The recent version resolves all of the WLWB's conditions of approval and BHP Billiton's commitments. As part of the WLWB's approval of the ICRP, it was expected that annual progress of reclamation projects be provided in each Environmental Agreement and Water Licence (e.g., Report 25). In addition, as a condition of the Water Licence, a final closure plan will be prepared and submitted at least two years before mine closure.

Details on the reclamation activities as well as investigation of reclamation techniques between 2009 and 2011 are provided in Section 6.1.2 and 6.4.3 of this report.

3.2 MINE OPERATIONS: THE NEXT THREE YEARS (2012 TO 2014)

Mining operations in fiscal year (FY) 2013 will focus on extraction of ore from the Koala and Koala North underground operations and Fox open pit and on pre-stripping for the Misery Pit "push-back" project. Over the longer term, BHP Billiton will focus on advancing the Pigeon open pit project through the final study phase and into execution.

Construction activities at EKATI will focus on development of the Pigeon Pit as well as the Pigeon Stream Diversion (PSD) Channel. The design of the pit has been developed at a pre-feasibility level and further work is scheduled both from the perspective of kimberlite sampling and engineering design. The PSD is currently undergoing construction with connection to the natural streams planned for 2013.

The second phase of the PDC stabilization was completed in the winter of 2012. The work was completed during the winter because fish are not present in the channel in winter and heavy equipment is more effective when working with frozen soil. Additional instream vegetation mats will be transplanted to the PDC during the summer of 2012.

4. Environment Management Framework

4. Environmental Management Framework

4.1 GUIDANCE

The BHP Billiton Charter provides overall guidance for all activities of BHP Billiton Canada Inc. (Figure 4.1-1). Safety and the Environment (Sustainability) are the first values listed in the BHP Billiton Charter. BHP Billiton also subscribes to the guiding principles of the Towards Sustainable Mining (TSM) initiative of the Mining Association of Canada (Figure 4.1-2). This initiative is designed to enhance the industry's reputation by improving its performance. The principles are backed by specific performance indicators designed to identify the industry's current performance in key areas and point to actions that could be taken to improve it. Areas for which performance indicators have been developed include tailings management, energy and greenhouse gas (GHG) emissions management, external outreach and corporate crisis management training. Further information on the TSM initative can be found on the Mining Association of Canada's website at www.mining.ca.

From 2009 to 2011, BHP Billiton operated under its HSEC policy and Group Level Documents. The Group Level Documents are policies, standards and procedures which give effect to the intentions, directions and mandatory requirements arising from the BHP Billiton Operating Model. HSEC refers to activities related to the health, safety and well-being of BHP Billiton employees. "Environment" refers to the quality of the environment in which EKATI operates, and "Community" refers not only to BHP Billiton employees but to the larger community within which the mine operates. BHP Billiton's HSEC Management Standards align closely with the management standards of the following organizations:

- ISO 14001 is an Environmental Management System designed by the International Organization of Standardization (ISO), a worldwide federation of national standards bodies that applies standards to areas of environmental performance. It provides order and consistency in the way in which organizations allocate resources; assign responsibilities; and evaluate practices, procedures, and processes; and
- SA 8000 is the Standard for Social Accountability developed by Social Accountability International (known until recently as the Council on Economic Priorities Accreditation Agency). The organization is a non-profit affiliate of the Council on Economic Priorities. SA 8000 is a voluntary, universal standard for companies interested in auditing and certifying labour practices in their facilities and those of their suppliers and vendors. It is designed for independent third-party certification. It is based on the principles of international human rights norms as described in International Labour Organisation conventions, the United Nations Convention on the Rights of the Child and the Universal Declaration of Human Rights. It measures the performance of companies in eight key areas: child labour, forced labour, health and safety, free association and collective bargaining, discrimination, disciplinary practices, working hours, and compensation. SA 8000 also provides for a social accountability management system to demonstrate ongoing conformance with the standard.

The minimum standard for achieving ISO 14001 certification is compliance with all applicable laws that regulate mine operations. Compliance with ISO 14001 and corporate management systems is verified primarily through audits. A total of 22 audits were conducted at EKATI over the last three years, including five annual audits for ISO 14001 compliance and certification, two internal audits against Fatal Risk Control protocols, one environmental audit, three health and hygiene audits, two audits against the community management standard, four aviation audits, four audits against the 13 corporate HSEC standards, and one self-assessment under the TSM initiative administered by the Mining Association of Canada.

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Our Charter

We are BHP Billiton, a leading global resources company.

Our purpose is to create long-term shareholder value through the discovery, acquisition, development and marketing of natural resources.

Our strategy is to own and operate large, long-life, low-cost, expandable, upstream assets diversified by commodity, geography and market.

Our Values

Sustainability
Putting health and safety first, being environmentally responsible and supporting our communities.

Integrity
Doing what is right and doing what we say we will do.

Respect
Embracing openness, trust, teamwork, diversity and relationships that are mutually beneficial.

Performance
Achieving superior business results by stretching our capabilities.

Simplicity
Focusing our efforts on the things that matter most.

Accountability
Defining and accepting responsibility and delivering on our commitments.

We are successful when:

Our people start each day with a sense of purpose and end the day with a sense of accomplishment.

Our communities, customers and suppliers value their relationships with us.

Our asset portfolio is world-class and sustainably developed.

Our operational discipline and financial strength enables our future growth.

Our shareholders receive a superior return on their investment.

Marius Kloppers
Chief Executive Officer

September 2011

Towards Sustainable Mining
Guiding Principles
December 2004

As members of the Mining Association of Canada, our role is to responsibly meet society's needs for minerals, metals and energy products. To achieve this we engage in the exploration, discovery, development, production, distribution and recycling of these products. We believe that our opportunities to contribute to and thrive in the economies in which we operate must be earned through a demonstrated commitment to sustainable development.*

Accordingly, our actions must demonstrate a responsible approach to social, economic and environmental performance that is aligned with the evolving priorities of our communities of interest.** Our actions must reflect a broad spectrum of values that we share with our employees and communities of interest, including honesty, transparency and integrity. And they must underscore our ongoing efforts to protect our employees, communities, customers and the natural environment.

We will demonstrate leadership worldwide by:

- Involving communities of interest in the design and implementation of our Towards Sustainable Mining initiative;
- Proactively seeking, engaging and supporting dialogue regarding our operations;
- Fostering leadership throughout our companies to achieve sustainable resource stewardship wherever we operate;
- Conducting all facets of our business with excellence, transparency and accountability;
- Protecting the health and safety of our employees, contractors and communities;
- Contributing to global initiatives to promote the production, use and recycling of metals and minerals in a safe and environmentally responsible manner;
- Seeking to minimize the impact of our operations on the environment and biodiversity, through all stages of development, from exploration to closure;
- Working with our communities of interest to address legacy issues, such as orphaned and abandoned mines;
- Practicing continuous improvement through the application of new technology, innovation and best practices in all facets of our operations.

In all aspects of our business and operations, we will:

- Respect human rights and treat those with whom we deal fairly and with dignity.
- Respect the cultures, customs and values of people with whom our operations interact.
- Recognize and respect the unique role, contribution and concerns of Aboriginal peoples (First Nations, Inuit and Métis) and indigenous peoples worldwide.
- Obtain and maintain business through ethical conduct.
- Comply with all laws and regulations in each country where we operate and apply the standards reflecting our adherence to these Guiding Principles and our adherence to best international practices.
- Support the capability of communities to participate in opportunities provided by new mining projects and existing operations.
- Be responsive to community priorities, needs and interests through all stages of mining exploration, development, operations and closure.
- Provide lasting benefits to local communities through self-sustaining programs to enhance the economic, environmental, social, educational and health care standards they enjoy.

* MAC draws on the 1987 Brundtland Commission definition of Sustainable Development: "Development that meets the needs of the present without compromising the ability of future generations to meet their own needs."

** We use the term Communities of Interest to include all of the individuals and groups who have or believe they have an interest in the management of decisions about our operations that may affect them. This includes: employees, contractors, Aboriginal or indigenous peoples, mining community members, suppliers, customers, environmental organizations, governments, the financial community, and shareholders.

BHP Billiton actively maintains and updates its HSEC system to ensure continuous adherence to this policy. In 2010 and 2011, an annual HSEC Management review was conducted, as well as four Crisis Emergency Management desktop drills and two mock emergency scenarios. In 2009 EKATI underwent two Environmental Health Inspections performed by the Stanton Territorial Health Authority and a fit-for-work/fit-for-life self-assessment. Weekly contractor management was implemented between 2009 and 2011 to ensure that on-site contractors are complying with corporate HSEC activities

4.2 REGULATORY INSTRUMENTS AND CONTRACTUAL AGREEMENTS

The environmental management framework of EKATI has three categories of regulatory instruments and contractual agreements: Environmental Agreement, water licences, and *Fisheries Act* Authorizations (Figure 4.2-1). Within each category monitoring programs have been developed and implemented, each requiring summary reports on a regular basis. The monitoring and research programs also serve to meet the needs of the management plans developed by each of the regulatory instruments and contractual agreements. Many of the plans require regular revision and updating (e.g., Interim Closure and Reclamation Plan) and others are fixed once the final versions were given regulatory approval (e.g., the fish habitat compensation plan for Panda, Koala, Misery, Fox 1, and Alexis and Leslie lakes).

As of April 2012, regulatory instruments and contractual agreements have required the preparation of 26 separate environmental management plans: 13 for the Environmental Agreement, eight for the Type A *Water Licence* for the main EKATI site (W2009L2-0001), and for each of the five *Fisheries Act* Authorizations (four authorizations are currently active and one will be renewed upon development of Pigeon Pit). The management plans have led to or are directly linked to the development and implementation of 12 main monitoring programs as listed in Figure 4.2-1.

Other EKATI regulatory instruments include surface land leases, mining leases, land use permits, Navigable Waters Protection Act authorizations, hazardous waste generator registration number, Aurora Scientific research licence, wildlife research permit, NWT archaeologists permit, explosive magazine permits, and licence to manufacture explosives. The other instruments listed here generally do not have routine monitoring or reporting requirements. AANDC is responsible for inspection of BHP Billiton's activities conducted under the Land Use Permits or Leases. The AANDC inspection reports are a matter of public record.

4.2.1 Environmental Agreement of 1997

The Environmental Agreement is a legally binding document signed on January 6, 1997, between BHP Billiton, the Government of Canada (as represented by 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 site.

The purpose of the Environmental Agreement was to ensure that BHP Billiton follows through with commitments to environmental monitoring, reclamation, and reporting that BHP Billiton made in its 1995 EIS. It was also designed as an integrated and innovative approach to monitoring and adaptive management of the mine's environmental effects. The Environmental Agreement requires the following:

- environmental management plans for construction and operation;
- plans for closure and reclamation;
- research in archaeology and TK;
- 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;

PROJECT # 648-121-01 ILLUSTRATION # a37131f June 5, 2012

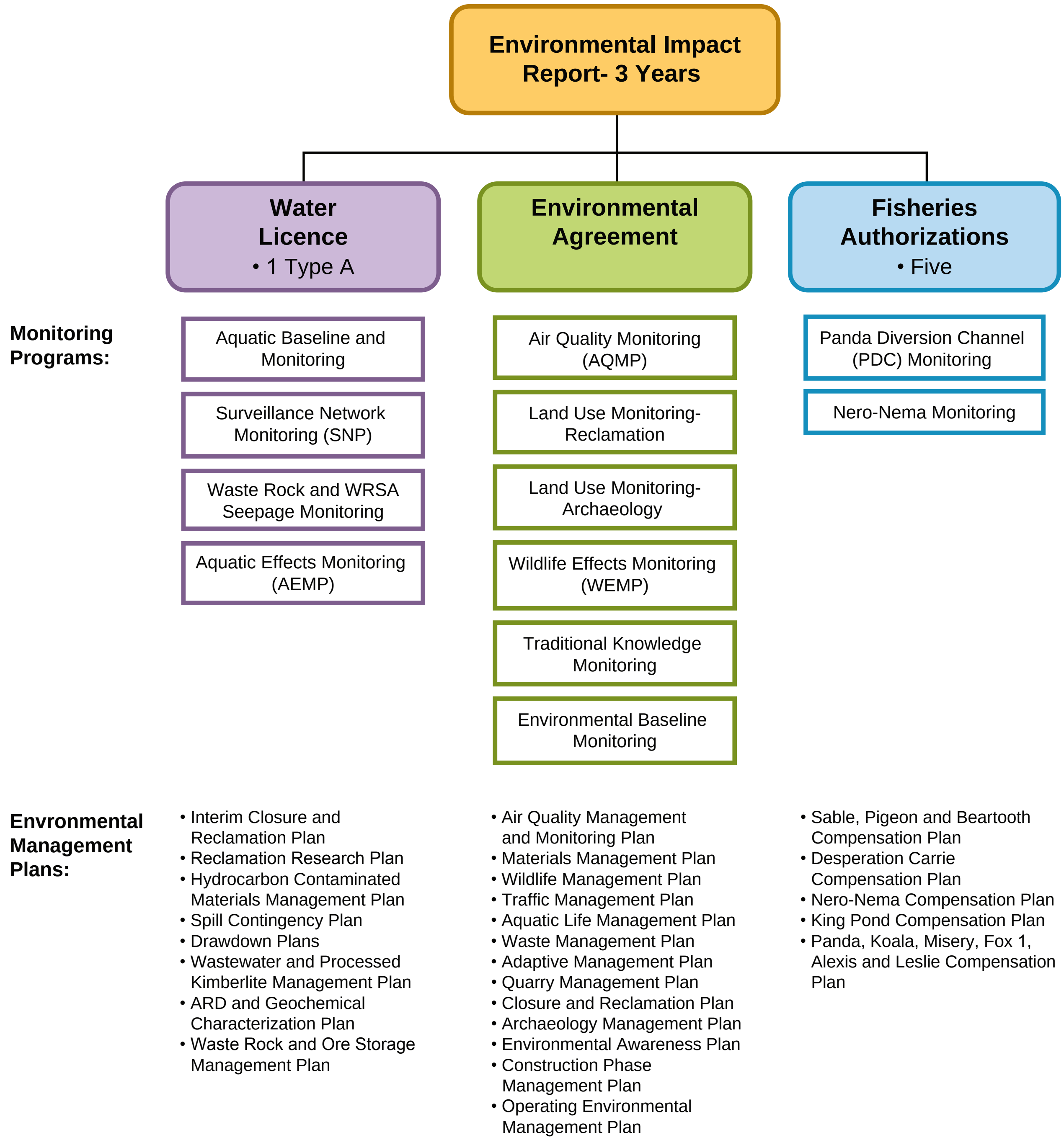

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Figure 4.2-1

The Environmental Management Framework of EKATI

- an EIR every three years beginning in April 2000;
- reclamation security and corporate guarantee to be drawn upon in instances where BHP Billiton does not comply with requirements in the Environmental Agreement; and
- compliance procedures and mechanisms for enforcement and dispute resolution.

The Environmental Agreement also sets out a range of guiding principles for the work to be undertaken under the agreement. These included adaptive management, the full consideration of TK, the precautionary principle, and maximization of environmental protection.

4.2.2 Water Licences

BHP Billiton was issued the first major water licence for the EKATI site in January, 1997 by the Northwest Territories Water Board under the Northwest Territories Waters Act. The licence was Class A Water Licence N7L2-1616 and was amended to include the Fox Pit development in 2001 (Table 4.2-1). In August of 2005, the licence was renewed by the Mackenzie Valley Land and Water Board (now administered by the WLWB) as MV2003L2-0013 for another 8 years.

Table 4.2-1. Water Licences at EKATI

Licence	Class	Purpose	Date Issued	Expiration Date
N7L2-1616	A	Use of water and deposition of wastes in main EKATI area	January 17, 1997	August 18, 2005
MV2003L2-0013	A	Use of water and deposition of wastes in main EKATI area	August 19, 2005	August 18, 2013
MV2001L2-0008	A	Use of water and deposition of wastes in Sable, Pigeon, and Beartooth watersheds	August 15, 2002	August 14, 2009
W2009L2-0001	A	An amalgamation of MV2003L2-0013 and MV2001L2-0008 for use of water and deposition of wastes in EKATI main area and Sable, Pigeon, and Beartooth watersheds	August 15, 2009	August 18, 2013
MV2001L2-0004	B	Watering Sable Haul Road	October 19, 2001	October 18, 2006
MV2002L2-0002	B	Watering Misery Haul Road with water from Lac de Gras	July 19, 2002	July 18, 2013
MV2002L2-0003	B	Operation of Misery Atomization Water Treatment Plant	March 5, 2003	March 4, 2008

Shaded cells indicate the Water Licence was cancelled or not renewed by BHP Billiton.

After a second environmental assessment (as defined by the *Mackenzie Valley Resource Management Act*; BHP and Dia Met 2000), approval was given by the Mackenzie Valley Environmental Impact Review Board for development of the Sable, Pigeon, and Beartooth pipes. A second Class A Water Licence MV2001L2-0008 covering these three pipes was granted in October 2002 (Table 4.2-1). In 2009 the existing two Water Licences (MV2003L2-0013 and MV2001L2-0008) were amalgamated and amended as W2009L2-0001, which will expire August 2013.

Two Class B licences were granted for Sable and Misery road watering at EKATI in 2001 and 2002 (Table 4.2-1). On May 14, 2007 the two road watering licences, MV2001L2-0004 and MV2002L2-0002, were cancelled in favour of Dewatering Plans under the Class A EKATI Water Licence (now W2009L2-0001) that provide for the use of water in a more efficient and “fit-for-purpose” manner. Road watering in addition to obtaining freshwater for domestic purposes, processing, and associated uses is now conducted under the existing Class A Water W2009L2-0001. A third Class B Water Licence MV2002L2-0003 expired on March 4, 2008. Renewal of the licence was not requested because the intended purpose (research on a conceptual water treatment method) was no longer planned.

As part of the requirements of a Class A Water Licence, discharge criteria for water into the environment must be met by BHP Billiton. The discharge criteria for the Class A Water Licence

◎ Table of Contents

W2009L2-0001 is indicated in Table 4.2-2. In addition, any water or waste entering the Receiving Environment shall be non-acutely toxic as determined by the acute toxicity tests described in part B, items 11 (a), 11(b), 11(c), and 11(d) of the Surveillance Network Program (SNP; and to be completed each year after spring break-up and once each year before the fall freeze-up).

Table 4.2-2. Discharge Criteria for Water and Waste Entering the Receiving Environment, Water Licence W2009L2-0001

Surveillance Network Program Station	Variable	Maximum Average Concentration[2]	Maximum Concentration of a Grab Sample[2]
1616-30 (LLCF) and 1616-43 (KPSF)	pH[1]	6.0 to 9.0	6.0 to 9.0
	Total Ammonia-N	2.0	4.0
	Total Aluminum	1.0	2.0
	Total Arsenic	0.50	1.0
	Total Copper	0.10	0.20
	Total Nickel	0.15	0.30
	Total Suspended Solids	15.0	25.0
	Total Petroleum Hydrocarbons	3.0	5.0
	Biochemical Oxygen Demand	40.0	N/A
008-Sa3 (Two Rock Sedimentation Pond, not yet active)	Total Ammonia-N	4.0	8.0
	Total Aluminum	1.0	2.0
	Total Arsenic	0.050	0.10
	Total Copper	0.02	0.04
	Total Cadmium	0.0015	0.003
	Total Chromium	0.02	0.04
	Total Lead	0.01	0.02
	Total Zinc	0.03	0.06
	Total Nickel	0.05	0.1
	Nitrite-N	1.0	2.0
	Nitrate-N	20.0	40.0
	Total Suspended Solids	15.0	25.0
	Total Petroleum Hydrocarbons	3.0	5.0
	Turbidity	10 NTU	15 NTU
	Total Phosphorus	0.2	0.4

LLCF- Long Lake Containment Facility.
KPSF- King Pond Settling Facility.
N/A = Not applicable.
[1] *Any water or waste entering the receiving environment shall have a pH between 6.0 and 9.0 except for surface runoff, which shall have a pH between 5.0 and 9.0.*
[2] *Units are mg/L except for pH (no unit) and turbidity (NTU).*

4.2.3 Fisheries Act Authorizations

EKATI currently operates under five *Fisheries Act Authorizations* from DFO. The purpose of the authorizations is to provide approval for work that result in the harmful alteration, disruption, or destruction of fish habitat. These authorizations require approval by the DFO for fish habitat compensation plans.

The five current authorizations are for the following:

1. The loss of lake and stream fish habitat caused by construction and operation of mine pits, specifically the Koala, Panda, Misery, Fox, and Leslie pits. The loss of this lake habitat was by direct payment to the DFO for use in habitat restoration activities in the NT. The loss of stream habitat was compensated through the construction of the PDC.
2. The loss of fish habitat associated with the construction of a dike across Desperation-Carrie Stream and for the use of Desperation Pond for waste rock storage and water management.
3. The loss of fish habitat caused by the use of King Pond as a settling facility for the Misery Pit operation. The King Pond Fish Habitat and Compensation Plan provides compensation.
4. The loss of fish habitat in Nero-Nema Stream caused by the encroachment on the stream of an abutments of a bridge as part of the road connecting the Fox Pit to the process plant. The Fish Habitat Compensation Plan for the Nero-Nema Stream Crossing provides compensation.
5. The loss of fish habitat that will be caused by the construction of the Sable, Pigeon, and Beartooth pits. Compensation for loss of associated lake habitat was to be accomplished by removing Leslie Lake from the list of lakes to be dewatered for mining purposes. Loss of stream habitat was to be compensated for by the construction of the Pigeon Diversion Channel.

4.3 MANAGEMENT

As part of EKATI's environmental management framework there are management plans associated with the Water Licence, Environmental Agreement, and Fisheries Authorizations (Figure 4.2-1). For the purpose of this document, a selection of management activities and plans relevant to the 2009 to 2011 reporting period are listed in Table 4.3-1 and summaries are provided below.

Table 4.3-1. Selected EKATI Management Plans

Management Plan	Last Update	Review Cycle
Spill Contingency Plan	July 2011	As and when according to terms outlined in the Water Licence.
Waste Management Plan	May 2003 (in process 2012)	Annually and updated to reflect operational needs.
Greenhouse Gas Management Strategy and Reduction	2012	Annual.
Waste Rock and Ore Storage Management Plan (formerly information provided in the Geochemical Characterization and Metal Leaching Management Plan)	October 2011	Annual as defined by the Water Licence part G.8.
Wastewater and Processed Kimberlite Management Plan	October 2011 (in process August 2012)	Annual as defined by the Water Licence part G.8.
Hydrocarbon-Impacted Materials Management Plan	June 2007 (in process 2012)	As and when according to terms outlined in the Water Licence.
Interim Closure and Reclamation Plan	August 2011	Annual progress report.
Wildlife Management Plan	2003	Every five years.

4.3.1 Spill Contingency Plan

The Spill Contingency Plan for EKATI was developed to establish and document practices for responsible management of controlled substance spills. EKATI's Spill Contingency Plan was last updated in July 2011 and now includes a more comprehensive description of the physical characteristics of hydrocarbon tank locations, and is supplemented with a GIS (geographic information system) program containing topography and distances to waterbodies. The plan is reviewed regularly for relevance to operations at EKATI. The plan will be further revised in 2012 and will include operational updates for the Misery Pit “push-back” project.

The most recent version of the Spill Contingency Plan encourages consistent approaches, and promotes improved response capability and management. The plan is underpinned by BHP Billiton’s HSEC policy and minimum standards set by regulatory requirements. Guiding the development and implementation of the plan has been the principle that an effective and high-quality Spill Contingency Plan must provide:

- a clear chain of command for all spill-related emergency activities;
- accountability for the performance of the spill response;
- well-defined expectations regarding spill response and subsequent clean-up programs;
- well-defined task and operational hazards/risk;
- comprehensive hazard prevention and control methods; and
- reporting and record keeping requirements to track program progress.

EKATI’s Spill Contingency Plan focuses on spill prevention and expert spill response. The plan includes elements for training and competence, response in remote areas, and post-emergency clean up and reporting.

All unauthorized discharges are reported to the NT Spill Line per the Spill Contingency Planning and Reporting Regulations of the *Northwest Territories Environmental Protection Act*. Data reported on each spill includes the date, location, quantity, and nature of the product that was released. Over the previous three years, a total of 70 releases were reported (Table 4.3-2). The total number of releases reported between 2006 and 2008 was 100.

Table 4.3-2. Number and Type of Unauthorized Discharges at EKATI, 2009 to 2011

	Number of Unauthorized Discharges			
Product	**2009**	**2010**	**2011**	**Total**
Hydraulic oil	4	10	5	**19**
Diesel fuel	3	3	0	**6**
Glycol	4	3	7	**14**
Transmission oil	1	1	1	**3**
Potable water	3	0	1	**4**
Engine oil	3	0	0	**3**
Coagulant/flocculant	0	2	0	**2**
Processed kimberlite	0	0	2	**2**
Sewage	2	0	0	**2**
Gear oil	0	0	1	**1**
Waste oil	1	1	0	**2**
Mine water	1	1	1	**3**
Hydraulic fluid	0	0	5	**5**
Dust Suppressant	0	1	0	**1**
Unknown	0	1	2	**3**
Total	**22**	**23**	**25**	**70**

The majority of releases over this time frame were hydraulic oil (27%) from equipment on site and glycol (20%). None of the hydraulic oil or glycol releases entered the receiving environment. Two PK spills were recorded in 2011; the first occurred as a result of a tailings line mechanical failure and the material was cleaned up with a Vac Truck and taken to Cell B for disposal. A second PK/reclaimed water spill was as a result of a power outage that caused the pump boxes to overfill and flow outside the process plant. No action was taken because the spill was mixed with snow and frozen at the process plant entrance.

Each year, spill training is included as part of a regular emergency response training practice. Spill response training of BHP Billiton personnel included familiarization tours of areas where hazardous materials may be used or stored at EKATI.

4.3.2 Waste Management Plan

A Waste Management Plan was developed for EKATI in February of 2000 and was revised in May 2003. A revised plan is currently being developed. The principal objective of the Waste Management Plan is to minimize potential adverse effects to the environment, including wildlife and wildlife habitat. The plan is part of a project-wide Operating Environmental Management Plan for the EKATI Environmental Management System. As with any other management document, periodic reviews of the plan are necessary with a two-fold purpose:

- to confirm continuing compliance; and
- to allow the plan to be updated in light of operational or technical changes.

The Waste Management Plan documents BHP Billiton's approach to waste and outlines strategies for dealing with the various waste streams. This plan upholds the four R's of waste management: reduce, reuse, recycle, and recover. It identifies procedures used to sort, handle, and dispose of both inert and hazardous wastes generated at site. EKATI has a landfill which accepts only inert, non-hazardous wastes such as wood and plastic. Other waste that could attract wildlife such as food wastes, paper, and oily rags is incinerated on site. There are incinerators at the Accommodations Complex and the Waste Management Building. A new incinerator was recently commissioned and is functioning in 2012. The Misery site has its own landfill, and all waste requiring incineration is transported to the Main Camp for disposal when Misery Camp is active. Waste streams are divided prior to being taken to the incinerator and landfill (Figure 4.3-1).

In addition to these waste streams, materials such as hydrocarbon-contaminated soils, snow, and ice are disposed in approved locations, per the approved Hydrocarbon-impacted Materials Management Plan. 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. Once the snow and ice have melted, the oil is recovered for off-site disposal, and water is trucked to Cell B of the LLCF per the approved management plan. Waste glycol generated from equipment servicing is collected in dedicated containers and shipped from site for recycling/disposal purposes. Air filters generated at site are deposited in the landfill. The Waste Management Building continues to operate as a waste transfer facility on site, collecting and processing hazardous waste such as oily rags, aerosol cans, waste grease, oil and fuel filters, and other miscellaneous waste.

Hazardous waste transferred off site is sent to NewAlta's waste transfer facility in Leduc, Alberta, where it is combined with waste from other facilities and economies of scale allow for further recycling. Table 4.3-3 shows the waste that was collected, packaged, and sent out for off-site disposal in between 2009 and 2011.

PROJECT # 0648-089-01 ILLUSTRATION # a30844w January 26, 2011

Type of Waste	Description	Instructions	Disposal Location
Food Waste	Fruit peels, paper/plastic wrappers and containers, pop cans, food	Bag the food waste and then place into labelled "Food Waste" or "Incinerator Waste" containers or bear bins.	Main Camp Incinerators
Oily Rags	Used rags and absorbent pads that contain petroleum products	Place in red coloured 45-gallon drum lined with a plastic bag labelled "Oily Rags". Take bags to WMB. Do not overload bags.	Waste Management Building
Office Waste	Paper, newsprint, food waste	Place in garbage containers found in offices.	Main Camp Incinerators
Biohazard Waste	Razors, razor blades, needles, empty medicated glass vials, syringes	Places in yellow plastic bins labelled "Biohazard Waste" found in all common bathrooms and laundry rooms	Main Camp Incinerators
Dry Cell Batteries	Dry cell batteries (I.e. AA, D, C, etc.)	Place in containers labelled "Batteries" or "Dry Cell Batteries".	Waste Management Building
Empty Aerosol Cans	Empty cans containing pressurized gas such as WD40 and spray paint	Place in containers labelled "Aerosol Cans" found at the beginning of each wing and throughout the site.	Waste Management Building
Used Oil and Fuel Filters	Used oil and fuel filter from heavy equipment	Place in drums labelled "oil and Fuel Filters". Waste Mgmt Techs drain, crush and then ship off site for recycling	Waste Management Building
Used Engine and Lube Oil	Used oil from vehicles and heavy equipment	Place in closed lid 45-gallon drum and label as "Waste Oil". Do not mix with any other liquid or product.	Waste Management Building
Used Coolant	Antifreeze and glycol used in equipment and vehicles	Place in closed lid 45-gallon drum and label as "Waste Coolant". Do not mix with any other liquid or product.	Lube Storage Building
Used Flammable Liquids	Waste Flammable liquids such as diesel, gasoline and jet B	Place in closed lid 45-gallon drum and label as "Waste Diesel", "waste gasoline", or "waste Jet-B". Do not mix with and other liquid or product.	Waste Management Building
Vehicle and Equipment Batteries	Light vehicle and heavy equipment batteries	Bring to Truckshop Bay 13 to be drained of Acid. Contact the Team Leaders when dropping the batteries off for further instruction.	Truckshop Bay 13
Used Solvent	Waste solvents generated from maintenance of heavy equipment parts and machinery (i.e.. Degreasers)	Minimize and reuse as much as possible. Place in closed lid 45-gallon drum and label "Waste Solvent - product name". Do not mix the waste solvent with any other liquid or product.	Waste Management Building
5-gallon Product Pails	Empty 5-gallon pails that contained gear oil, grease, etc.	Remove as much residue from the pails DO NOT BRING TO LANDFILL.	Waste Management Building

Type of Waste	Description	Instructions	Disposal Location
Used Floor Dry	Used floor dry that contains petroleum products	Do not mix with other waste. Place in 45-gallon drum and label as "Floor Dry Containing Hydrocarbons".	Waste Management Building
Used Sphagsorb	Used sphagsorb that contains petroleum products	Do not mix with other waste. Place in 45-gallon drum and label as "Sphagsorb Containing Hydrocarbons".	Waste Management Building
Air Filters	Air Filter from heavy equipment	Transport to landfill	Landfill
Waste Grease	Waste Grease generated from operational work	Place in 45-gallon drum and label as "waste Grease" or put in 5-gallon pail and bring to the waste management building.	Waste Management Building
Oil Based Paint Cans	Empty oil based paint cans	Take to the Waste Management Building so it can be drained of residual paint.	Waste Management Building
Water Based Paints	Empty water based paint cans	Take to the Waste Management Building so it can be drained of residual paint and dried out. The empty can gets landfilled.	Waste Management Building
Soot	Soot collected from generator stacks and incinerator stacks	Place in 45-gallon drum and label as "Soot".	Waste Management Building
Incinerator Ash	Ash from the incineration of waste	Allow ash to cool then place in 45-gallon drum and label as "Incineration Ash". Contact Mine Services for disposal.	Landfill
Inert waste	Wood, cardboard, metal, plastic, rubber, glass	Place in containers labelled "Landfill Waste".	Landfill
Hydrocarbon- impacted Soil > 4 cm diameter	Hydrocarbon-impacted soil with diameter size greater than 4.0 cm	Assess the situation. Stop the spill if safe to do so. Contact the Team Leader, Mine Services	Zone S
Hydrocarbon- impacted Soil < 4 cm diameter	Hydrocarbon-impacted soil with diameter size greater than 4.0 cm	Assess the situation. Stop the spill if safe to do so. Contact the Team Leader, Mine Services	Landfarm
Hydrocarbon- impacted snow or ice	Hydrocarbon-impacted snow or ice occurring as a result of operational spills	Assess the situation. Stop the spill if safe to do so. Contact the Team Leader, Mine Services	Contaminated Snow and Ice Containment Facility
Other Wastes	Miscellaneous wastes that are not mentioned in this table	Properly label the waste and get the Material Safety Data Sheets (MSDS) , then contact the waste tech for instruction.	Waste Management Building

Figure 4.3-1

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Waste Management System at EKATI

Figure 4.3-1

Table 4.3-3. Waste Shipped Off Site in 2009 to 2011

Material	Quantity			Units
	2009	2010	2011	
Active Alumina	-	-	4,205	kg
Action 838	8	-	-	drums
Adhesives	-	-	724	kg
Ammonium Nitrate	-	-	41,958	kg
Battery Acid	-	1,988	506	kg
Battery Acid	9	-	-	drums
Calcium Hydroxide	-	-	585	kg
Caustic Waste (Exhaust Soot)	2,108	-	-	kg
Carbon Monoxide Cylinder	-	-	297	kg
Cleaning Solution	-	-	966	L
Computer Monitors	5,324	8,641	-	kg
Contaminated Floor Dry	167	-	-	kg
Dry Cell Batteries	1,592	1,222	-	kg
Engine Soot	-	-	2,224	kg
Flammable Liquid, Corrosive N.O.S.	-	-	18	kg
Fluorescent Light Bulbs	-	-	980	kg
Fuel/Oil Filters (drained and crushed)	7,449	-	20,038	kg
Flo Polymer	-	3,176	-	kg
Gear Oil	-	-	816	kg
Hydrochloric Acid	-	-	10	kg
Kitchen Grease	14,263	12,928	11,560	kg
Lockset Resin	-	-	1,814	kg
Mixed Solvent	4,937	-	-	kg
Old Computers	-	-	1,723	kg
Paint Related Material	-	-	5,163	kg
Potassium Hydroxide Solution	-	-	447	kg
Sodium Nitrate	-	-	1,640	kg
Sofnocat	-	-	433	kg
Used Hydraulic Hose	-	-	680	kg
Vehicle Batteries	14,938	12,628	13,917	kg
Waste Antifreeze	4	-	-	drums
Waste Aviation Gas	4	-	-	drums
Waste Glycol	-	92,000	26,000	L
Waste Grease	15,280	14,388	22,280	kg
Waste Magnafloc 156	3,880	-	-	kg
Waste Magnafloc 333	-	10,322	-	kg
Waste Oil	-	-	680	kg
Waste Oil	92	-	-	drums
Waste Oil and Water	-	50,250	20,000	L
Waste Paint	4	-	-	drums
Waste Paint and Related Materials	-	1,244	-	kg

Note: drums typically contain 205 litres.

Following recommendations from internal audits in 2009, EKATI's waste management and hazardous materials programs are being reorganized to improve processes for purchasing, handling, and disposal of new equipment and chemicals on site. This aims to improve the "cradle to grave" approach and ensures that detailed consideration is given prior to bringing materials to site, in addition to ensuring the procedures are documented and tracked.

Inspections of the EKATI landfill are completed by EKATI Environment Department staff on a weekly basis at a minimum, and often more frequently. This is done to ensure compliance with the Waste Management Plan, and the outcomes are twofold: to measure success of communication of the expectations of waste management at EKATI, and to address any issues of noncompliance quickly.

A second method by which adherence to the Waste Management Plan is monitored is through regular inspections of waste bins prior to their disposal at the landfill. Both types of inspections contribute to keeping chemicals and food waste out of the landfill, both of which are wildlife attractants.

4.3.3 Greenhouse Gas Management Strategy and Reduction

Sustainable development starts with reducing the overall mine footprint. Part of that footprint is air emissions. Every litre is brought to site by truck on the winter road at a substantial cost and at some risk to the environment. When burned, diesel contributes to the volume of GHGs produced in Canada.

BHP Billiton is committed to attaining the highest performance in energy and GHG emissions management by identifying energy consumption patterns and GHG emission sources, monitoring related activities, and setting targets and implementing action plans for improvement.

As stated in the corporate guidance document, BHP Billiton requires that energy use and GHG emissions must be managed where emissions exceed or are anticipated to exceed 50,000 tonnes carbon dioxide equivalent (tCO_2e) per annum for an operation or project through the implementation and maintenance of an energy and GHG Management Plan.

BHP Billiton is currently in the final year of a five year corporate target for GHGs, and corporate GHG reduction targets are being revised. As a result, EKATI's GHG Management Plan is under revision and will be updated to reflect corporate objectives.

The principal objective of the GHG management strategy is to:

- identify, evaluate, and implement energy reduction and GHG reduction projects based on current and forecasted energy use and GHG emissions; and
- implement a monitoring and review program that verifies the effectiveness of the energy reduction and GHG reduction projects.

On a business as usual basis, energy consumption at EKATI is expected to increase on average 1.6% per annum from FY 2012 to FY 2016 by a total of 7%. The increasing trends reflect the mine plan which includes development of Misery and Pigeon open pits. Table 4.3-4 quantifies these trends.

Table 4.3-4. Business as Usual Estimates of Diesel Consumption and Greenhouse Gas Emissions

	FY 2012	FY 2013	FY 2014	FY 2015	FY 2016
Diesel Consumption (L)	60,185,683	63,562,494	61,761,625	63,513,372	64,643,065
GHG Emissions (tCO_2e)	165,989	175,302	170,334	175,166	178,282

BHP Billiton has completed several initiatives and activities to reduce fuel consumption and thereby reducing GHG emissions at EKATI:

- Energy Smart Program (initiated in 2002);
- evolution of mine plan to underground mining (in place of open pit mining);
- "No Idle" Campaign (implemented in 2006);
- waste oil burned on site to heat air for underground workings (thereby reducing the amount of diesel burned to heat underground air and no diesel being burned in transport of oil as waste);
- use of low sulphur diesel fuel;
- preventative maintenance programs on machinery to ensure optimum operation of all combustion and fugitive emission sources;
- construction of a high efficiency incinerator; and
- on-site shuttle service.

In comparison to 2009 diesel fuel consumption, 7.2% less diesel was used in 2011, mainly in the areas of non-motive and heating diesel. The decrease in heating diesel use in 2010 was a result of a much warmer February to April period. Increases in fuel use were only noted in the categories of motive (e.g., vehicles) and aviation fuel. There was a reduction in use of mobile diesel of 3,077,145 L (17%) between the 2008 and 2011 calendar years; however, between 2009 and 2011, mobile diesel use increased slightly. A total of 154,573 t of GHG emissions were calculated to be released as CO_2 equivalencies in 2011 (Table 4.3-5). The 2011 calculated CO_2 equivalency was marginally higher than for 2010; however, both 2010 and 2011 had lower GHG emissions (8 and 7%, respectively) compared to 2009 (Table 4.3-5). The mean annual GHG emissions from 2009 to 2011 were 158,055 tCO_2e. This is 21% less than that estimated during the 2006 to 2008 fiscal years (198,899 tCO_2e; Table 4.3-5).

Table 4.3-5. Summary of Monthly Emission Sources and Resulting Greenhouse Gas Emissions at EKATI, 2009 to 2011

Month	Emission Sources				Total Resulting Emissions			
	Total Fuel[1] (L)	ANFO + Emulsion (kg)	Fugitive Emissions (tCO_2e)	Biomass (tCO_2e)	CO_2 (tonnes)	CH_4 (tCO_2e)	N_2O (tCO_2e)	Total GHG Emissions (tCO_2e)
2009 Annual Total	59,980,179	3,390,844	141	284	164,919	151	1,524	166,594
2010 Annual Total	55,093,441	2,532,076	195	270	151,460	138	1,401	152,999
2011 Annual Total	55,657,930	3,717,615	0	306	153,015	140	1,419	154,573

[1]*Total fuel is comprised of diesel, Jet A-1, waste oil and gasoline.*

BHP Billiton has identified two GHG reduction projects for upcoming years.

1. Automation of Underground Ventilation System - The automation of the underground ventilation system will reduce energy consumption by precisely regulating the time that fans must operate. This system will improve mine safety by relying on a Programmable Logic Controller to automate the ventilation system, instead of the reliance on an individual. This project is scheduled for completion during FY 2013 and is estimated to reduce energy consumption 92,084 GJ and reduce GHG emissions 8,000 tCO_2e from business as usual projections over the next five years (Table 4.3-6).

2. Electronic Fuel Injection Upgrades to Power Generators - Electronic fuel injection upgrades to the diesel power generators will regulate delivery of fuel for combustion to increase fuel efficiency. This project is scheduled for completion at the end of FY 2014 and is estimated to reduce energy consumption 389,639 GJ and reduce GHG emissions 8,000 tCO_2e from the business as usual projections over the next five years (Table 4.3-7).

Table 4.3-6. Automated Underground Ventilation - Estimated Energy and Greenhouse Gas Reductions

	Energy Use Reduction (GJ)	Greenhouse Gas Reduction (tCO_2e)
FY12	0	0
FY13	23,021	2,000
FY14	23,021	2,000
FY15	23,021	2,000
FY16	23,021	2,000

Table 4.3-7. Electronic Fuel Injection Upgrades to Power Generators – Estimated Energy and Greenhouse Gas Reductions

	Energy Use Reduction (GJ)	Greenhouse Gas Reduction (tCO_2e)
FY12	67,179	1,000
FY13	80,615	1,000
FY14	80,615	2,000
FY15	80,615	2,000
FY16	80,615	2,000

Progress on energy efficiency and GHG reductions is reported monthly to the EKATI Environment Department through the monthly HSEC report. Additionally, EKATI's GHG inventory is reported to the following external stakeholders:

- Mining Association of Canada – Towards Sustainable Mining Environmental Progress Report;
- WLWB – Annual Water Licence and Environmental Agreement Report;
- Environment Canada – National Pollutant Release Inventory; and
- Statistics Canada – GHG Emissions Report.

The reporting of emissions to each stakeholder represents considerable effort due to the different reporting requirements and formats (see Appendix 1 in Rescan 2012a).

4.3.4 Waste Rock and Ore Storage Management Plan

The most recent version of the Waste Rock and Ore Storage Management Plan (WROMP) for disposal of mine wastes at EKATI was published in October 2011(Report 46; BHP Billiton 2011b). The latest WROMP combines updated information from previous versions of the WROMP and several amendments. This latest plan also contains the information previously found in the Geochemical Characterization and Metal Leaching Management Plan and therefore fulfills the requirements of Part G.2 and G.3 of the Water Licence W2009L2-0001 (Report 46).

Specifically the WROMP presents 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 CKR including acid/alkaline drainage potential;
- current temperature trends in WRSAs; and
- existing drainage management, seepage monitoring methods, and predictions of drainage quality and metal leaching potential based on the seepage monitoring database.

Building upon this current state of knowledge and 11 years of experience in construction and monitoring of EKATI WRSAs; the report presents the future components of waste rock and ore storage based on the current Life of Mine Plan. This includes estimated production tonnages to the end of mining, the final footprint of the waste storage facilities, plans for managing seepage, and plans for monitoring the physical and environmental performance of the WRSAs.

4.3.5 Wastewater and Processed Kimberlite Management Plan

A Wastewater and Processed Kimberlite Management Plan is a requirement of the Water Licence currently held by BHP Billiton (Report 45; BHP Billiton 2011c). The Wastewater and Processed Kimberlite Management Plan is intended to ensure that wastewater and PK are properly managed, stored, and disposed of at EKATI.

The most recent Wastewater and Processed Kimberlite Management Plan was published in October 2011 and incorporates an updated Life of Mine Plan, the placement of FPK within designated containment facilities, an update of mine operations since the previous submission, and describes site-wide waste water management (Report 45). BHP Billiton is currently updating the plan with more recent FPK deposition management and is expected to be completed in 2012.

4.3.6 Hydrocarbon-impacted Materials Management Plan

The management of hydrocarbon-impacted materials at EKATI, in accordance with BHP Billiton legal requirements as stated in Water Licence W2009L2-0001, is detailed in the Hydrocarbon-impacted Materials Management Plan, approved by the WLWB on June 15, 2007. No additional updates were made to the plan within the reporting period of 2009 and 2011; however, updates are currently being completed for a revised plan to be completed in 2012. Activities carried out under this plan are reported to the WLWB in the Environmental Agreement and Water Licence Annual Report. Materials generated through operation of the mine are identified, and instructions regarding the management of each hydrocarbon-impacted waste stream are provided.

4.3.7 Interim Closure and Reclamation Plan

BHP Billiton is required under the Water Licence, Environmental Agreement, and BHP Billiton Group Level Document (GLD .035) for Directional Planning to have in place an approved ICRP for EKATI during active mining operations. The current version of the ICRP is Version 2.4 dated August 2011 (Report 44; BHP Billiton 2011a).

The ICRP has been developed with input from many groups and agencies. Valuable contributions have come from aboriginal communities (Inuit of Kugluktuk, Lutsel K'e Dene First Nation, Yellowknives Dene First Nation, the Tlicho Government, and the North Slave Métis Alliance), and from representatives of the various government agencies: AANDC, the WLWB, GNWT, Environment Canada, and DFO.

Recommendations and technical information were provided by the IEMA and technical consultants with expertise in environmental and engineering disciplines. The ICRP incorporates reclamation activities and objectives that describe how the reclamation will be completed and the performance standards to be met at final closure.

The reclamation plan for EKATI is to flood the open pits and underground mines to create pit lakes which are once again connected with their surrounding watersheds. Three lakes have been identified as potential water sources for flooding, namely Ursula Lake, Upper Exeter Lake, and Lac de Gras, and flooding will take place over a period of approximately 35 years. Additional research to determine strategies for pump flooding and other potential water sources will continue in order to optimize the pumping schedule and strategy, while ensuring limited impact to fish habitat in the source lakes. In addition to pump flooding, deflection features will be constructed around the perimeter of the pits to deter wildlife during the flooding period.

All WRSA will remain in place. Permafrost has already aggraded into the piles and will continue to grow over time. The aim of closure is to maintain the permafrost. The design of the WRSA takes into account the permanent structure by including a stepped profile and a flat top that prevents snow build-up and encourages growth and maintenance of permafrost in the stockpiles over the long term.

The processed kimberlite beaches in the LLCF will be capped with a combination of rock and vegetation. The facility will be reconnected with the surrounding watershed through a system of external and internal drainage channels and ponds. All dikes and the Outlet Dam will be breached to allow flow-through to occur.

In addition to the constructed drainage channels at the LLCF, the PDC and the PSD will remain in place after mine closure. The Panda Dam will continue to divert watershed flow through the PDC with a spillway to allow high freshet flow to the Panda and Koala pit lakes, with continued flow in the PDC for ongoing use as fish habitat. The PSD will also remain in place, directing stream flow and providing fish habitat from the upper Pigeon stream to Fay Bay.

All buildings and other physical infrastructure will be removed and either buried in a landfill or shipped off site. Areas with the potential for erosion will be stabilized with vegetation cover and/or waste rock. All roads, laydown pads, and the airstrip will remain in place but will be decommissioned so that they are safe for human and wildlife use after the mine site is closed.

Because reclamation of EKATI is in the interim planning stages, research remains a key component of the interim closure plan. Reclamation research at EKATI is based on uncertainties that may exist in the type and extent of environmental effects remaining after mine closure. Key uncertainties such as water quality, wildlife safety, and sustainability of vegetation cover are addressed through research and engineering studies. The Reclamation Research Plan for EKATI is a comprehensive document which assists in answering the question of how to reclaim mine components and define closure criteria so that closure objectives are met. TK, which is given consideration alongside western science, is also included in reclamation research.

A post closure monitoring plan is also in place as a method of observing and tracking the performance of reclamation work against closure criteria. Monitoring programs and schedules are tailored to individual closure criteria, and are used to indicate when reclamation work has been successful, or if further rehabilitation is required.

4.3.8 Wildlife Management Plan

The Wildlife Management Plan at EKATI is closely aligned with the methods used and information acquired through the development and implementation of the WEMP. In the last two to three years there have been significant changes to the WEMP. For example the WEMP now includes the use of focal (in addition to scan) caribou behaviour surveys; the wolverine and grizzly bear DNA program was recently added to better assess population estimates; and motion sensing cameras were used in 2011 to monitor the interaction of wildlife with mine infrastructure (see Section 8 of this report). Thus BHP Billiton has been working on refinements to the 2003 Wildlife Management Plan and the revised plan is expected to be completed in 2012. The revised plan will, among other refinements, incorporate the redesign of the caribou on roads surveys to include the data collected from the motion sensing cameras as well as the refined methods to assess wolverine and grizzly bear populations.

4.4 ADAPTIVE MANAGEMENT

BHP Billiton recognizes the inherent unpredictability of natural ecosystems and practices adaptive management whenever feasible. Adaptive management has been loosely defined as “learning by doing,” and has gained acceptance as a management strategy for natural resources (Holling 1978; Walters 1986; Nyberg and Taylor 1995; Linkov et al. 2006). It combines scientific research and resource management within a framework of experimental management practices. New knowledge is learned from the deliberate manipulation of management systems, which can then be applied to future decision making. This approach deals with the uncertainty inherent in managing ecosystems by treating policies as experiments. It is not a random trial-and-error process, rather it is a process that allows the development and understanding of not only which actions work and which do not, but also why.

Walters and Holling (1990) defined two modes of adaptive management: *active* and *passive*. Active adaptive management explicitly evaluates multiple management alternatives and incorporates the results into future decision making. Passive adaptive management evaluates only one management practice through monitoring the accuracy of earlier predictions. An active approach is akin to a carefully planned experiment and a passive approach is comparable to an uncontrolled non-experimental study (Schwarz 1998). Both approaches can provide a cycle of continuous improvement of operation programs.

Nyberg (1998) noted that although adaptive management experiments may not always include the familiar features of traditional experimental design such as controls, replication, multiple treatments and randomization, this management practice should strive for rigor and practicality. These features are especially lacking in passive adaptive management of large developments where traditional experimental design cannot easily be applied to the “experiment,” in the broad sense that a mine is an experimental unit. In their overview of statistical methods available for adaptive management in the forestry sector, Sit and Taylor (1998) provided some guidance on how to approach adaptive management with scientific rigor. In this overview, statistical methods available for passive adaptive management are outlined, including versions of the Before-After-Control-Impact statistical method for detecting changes to natural systems based on baseline and monitoring data at both impacted and reference sites. The theory of adaptive management is continually being refined through its application, in itself an experiment in adaptive management.

In his introductory guide to adaptive management Nyberg (1999) outlined the simplified steps of adaptive management:

- Problem Assessment - assess the problem and generate testable hypotheses or management practices;
- Design - practices and procedures are designed on the basis of hypothesis;

- Implementation - management practices and procedures are implemented;
- Monitoring - a monitoring program is required to determine the effectiveness of the management actions;
- Evaluation - the results of the monitoring are evaluated to determine whether the predicted outcomes were accurate, and to gain knowledge about how activities could improve the outcome of management actions; and
- Adjustment - from the knowledge gained, adjustments to the management practices are initiated to improve the overall performance of the system.

These steps are repeated as the project progresses, continuing to use the information gained from each iteration to improve operational management.

Similar to the steps identified by Nyberg (1999), IEMA has also provided some guidance on defining adaptive management at EKATI (IEMA 2011). As identified by IEMA (2011), adaptive environmental management involves:

> *1. proactively establishing monitoring programs to determine the (uncertain) consequences of one or more management strategy(ies);*
>
> *2. analysing the results of the monitoring programs to reduce the underlying uncertainty and to determine the effectiveness of the management strategy(ies) and to predict unforeseen effects;*
>
> *3. adaptation of the management strategy(ies) as appropriate. This adaptation may well involve further investigation to increase the probability that any new management strategy adopted will improve the result.*

Recently the WLWB has also addressed the principles of adaptive management with a focus on aquatic effects monitoring with the draft document '*Guidelines for Adaptive Management- a Response Framework for Aquatics Effects Monitoring*' (WLWB 2010). These guidelines were summarised and brought into the context of environmental regulation for mines, in general, in the recent article '*Linking Environmental Assessment to Environmental Regulation through Adaptive Management*' (Racher et al. 2011). It is the Response Framework that provides the approach to responding to specific changes as documented by the results of environmental monitoring. As defined by Racher and coauthors (2011), the Response Framework provides an effect level that requires appropriate action(s) to ensure that significant adverse impacts never occur. This Response Framework can subsequently be linked to monitoring results and allow for management activities to be adaptive, i.e., "learn by doing". In BHP Billiton's recent application for its Water Licence renewal, a Response Framework (as defined by the WLWB) was developed to provide a structured early warning system for water quality in the aquatic receiving environment. This framework will be reviewed during the Water Licence renewal process and to some extent has been applied to the management of chloride and nitrate concentrations in the LLCF as described below.

Adaptive management has been applied to environmental issues at EKATI over the years 1997 to 2008; however, a selection of examples is provided below that are relevant to the 2009 to 2011 reporting period:

- FPK deposition;
- Kodiak Lake;
- elevated nitrate concentrations in the LLCF;

- elevated chloride concentrations in the LLCF;
- PDC slope stabilization; and
- the new caribou fence at airstrip, Beartooth Pit, and Pigeon Pit.

As identified by IEMA and the WLWB, these examples of adaptive management involve monitoring, analysis of results, management and in response to further monitoring subsequent refinement in management.

4.4.1 Fine Processed Kimberlite Deposition

FPK is deposited in the LLCF according to the FPK Deposition Plan to maximize the use of available storage capacity in Cells A, B, and C of the LLCF, and the mined-out Beartooth Pit. The FPK deposition plan has evolved through mine operations in response to monitoring information, observations and refined objectives. The most recent refinement of the deposition plan (use of Beartooth pit and accessing the Cell C West/Cell A South area) was approved by the WLWB in 2011 based on recommendations made by BHP Billiton. This change was a refinement of the established strategy to maximize the use of upstream areas and defer, or eliminate, the use of Cell D of the LLCF. The change was enabled by direct observations and monitoring of FPK deposition, compared against the projected FPK storage capacity needs. The use of Beartooth pit in itself represents an adaptive management approach in that new information will be collected regarding FPK deposition into an open pit that would be used to assess and direct possible future deposition into other mined-out open pits at the EKATI Mine.

Additionally, day-to-day operational changes have been made in 2009-2011, based on observations and 'lessons-learned'. Some of these changes were implemented in response to the unplanned release of FPK to the shore and ice of Fay Bay adjacent to Cell B of the LLCF in May 2008.

Following the initial clean-up of 85% of the PK from the ice and approximately 80% overall, the Fay Bay Monitoring Program was developed to assess potential effects to Fay Bay slope vegetation, water quality, sediment quality, phytoplankton, zooplankton, fish habitat, and fish communities. There were also a number of immediate and long-term responses implemented by BHP Billiton to clean-up the spill and to prevent future spills (see Section 7.4.9 for a complete listing). For example, silt curtains were installed in the near-shore area of Fay Bay and in the narrows between Fay Bay and Upper Exeter Lake (staggered to allow fish movement) as a contingency against FPK migration into the water. Clean-up of the FPK from the tundra preserved the organic soil layer to ensure re-establishment of the natural vegetation cover. As a long-term response, there is no longer deposition of FPK into the northern portion of Cell B and there is review and enhancement of scheduled operator inspections of the LLCF to ensure deposition is according to the FPK Deposition Plan. In addition there was a connection of the Cell B "east" and "west" access roads, creating a ring road around Cell B as well as a plastic liner being installed against the south bank of the Cell B road at its northern extent (i.e., internal to Cell B). To create an internal flowpath that directs runoff water towards the south an internal water channel from the uppermost end of Cell B (excavation of PK and placement of coarse, granular PK) was constructed. At Cell A, a review and enhancement of procedure for PK deposition at the upper end of Cell A to prohibit winter deposition and mark a conservative PK limit in the field was completed. Another management procedure in response to the unauthorized discharge is the strategic management of snow at the north end of Cell B as part of freshet erosion control.

Following the results of the 2010 Fay Bay AEMP it was concluded that there would be no long-term risks to water quality or aquatic life associated with the FPK release into Fay Bay. Thus it was determined that no further action (other than to maintain the current FPK deposition management) to address the unplanned release into Fay Bay was required. Removal of the temporary access road to Fay Bay could not be done without disturbing the natural organic soil layer underlying the road, and it will take longer for vegetation to re-establish here. However, on the basis of the increase in vegetation cover along the roadbase noted in 2011, it would appear that vegetation on the roadbase should provide adequate protection from erosion, as the jute mat breaks down and decays.

4.4.2 Kodiak Lake

Early in the mine life, an inflow of nutrients from the sewage treatment plant at EKATI resulted in an increase in productivity in Kodiak Lake and consequently low winter dissolved oxygen (DO) levels. This effect was observed following the initiation of a Kodiak Lake Sewage Effects Study. Since about 1998, BHP Billiton has directed the treated sewage effluent to the LLCF.

Although low DO in lakes can occur naturally, the effects on organisms can be lethal and/or result in changes in physiology or behaviour. There was no evidence of fish mortalities related to the reduced DO levels in Kodiak Lake. However, each winter since 1997, EKATI environment staff has monitored under ice DO concentrations in Kodiak Lake on a more regular basis (weekly to bi-weekly; see Section 7.4.3). In addition to the regular monitoring, the under-ice waters of Kodiak Lake were aerated to increase DO levels. Aeration was completed only when monitoring deemed it necessary (i.e., volume weighted DO levels were less than the Canadian Council of Ministers of the Environment [CCME] guideline value). For example between 2007 and 2011, aeration was not necessary based on the monitoring results. The 2011 AEMP provides an established data record indicating that Kodiak Lake dissolved oxygen levels have returned to baseline levels (Report 56). Thus additional focused under-ice DO monitoring at Kodiak Lake is no longer necessary (other than that completed during the AEMP under-ice monitoring).

4.4.3 Elevated Nitrate Concentrations in the LLCF

The annual AEMP reports current nitrate concentrations in lakes and streams downstream of the LLCF as well as trends since production began. Elevated nitrate concentrations related to using ANFO for blasting was identified as a key risk that required management by BHP Billiton.

Elevated nitrate concentrations in the LLCF could result in a risk to the aquatic receiving environment downstream of the LLCF. Excessive quantities of nitrate in relation to other macronutrients can have deleterious effects on aquatic systems through eutrophication, increasing the risk of algal blooms and oxygen depletion, decreasing water clarity, changing species composition, and reducing trophic complexity (CCME 2003a). However, phosphorous often acts as the limiting nutrient in freshwater aquatic systems. As such, outside of toxic effects, increases in nitrogen may have reduced impacts on aquatic systems unless concentrations of available phosphorous also increase (CCME 2003b).

Beginning in 2007, five initiatives have been implemented to address elevated nitrate concentrations in the LLCF:

- Adjust timing of effluent discharge to reduce the concentration of nitrate released to the environment (implemented annually since 2008; Reports 5, 12, 36 and 49).
- Conduct an *in situ* experiment in Cell D of the LLCF to stimulate the growth of phytoplankton and the biological uptake of nitrate by fertilizing Cell D with phosphate. As discussed in Section 7.4.1, three additional phases of the *in situ* experiment in Cell D of the LLCF have been completed since the initial phase I in 2008. Monopotassium phosphate fertilizer was added to the surface waters of Cell D in 2009, 2010 and 2011.
- Divert water from underground mine (one source of the nitrate) away from the LLCF to the mined-out Beartooth Pit (implemented since late 2009).

- Numerical modelling of water quality to evaluate potential effects in the receiving environment (culminating in water quality modelling issued in 2012; Report 51).
- Develop a Site Specific Water Quality Objective (SSWQO) for nitrate (issued in 2012; Report 53).

Monitoring was also conducted on a weekly to bi-weekly basis in Cell D and Cell E of the LLCF during the phosphate amendments. The following water quality variables were monitored: nitrate, nitrite, ammonia, pH, dissolved oxygen, euphotic depth, turbidity, TSS, total phosphorus, orthophosphate, total organic carbon, and silicate in addition to metals. Changes in phytoplankton and zooplankton communities in response to the phosphate amendments were also monitored in Cell D and Cell E. Nitrate concentration following the phosphate amendments in 2009, 2010, and 2011 were evaluated and total annual nitrate reduction as a result of the amendments was calculated. For example, the net decrease in the nitrate load in Cell D during the 2009 open water season was 19%. However, nitrate concentrations measured throughout the 2011 open water season were similar to concentrations measured in 2010. This suggested that there was no further reduction in the nitrate load of Cell D as a result of the 2011 Phase IV phosphate amendment program. However, nitrate concentrations also did not increase in Cell D despite continued nitrate loading to upstream containment cells. Added phosphate may have played a role in preventing any further increase to the nitrate load of Cell D.

Management of the phosphate amendments was implemented through weekly evaluation of changes in the physical and chemical composition of Cell D. For example when orthophosphate (bio-available phosphorus) levels began to accumulate indicating an excess, the phosphate amendments were discontinued.

Snow was cleared from a large portion of the surface ice of Cell D during late winter 2012 to facilitate increased photosynthetically active radiation availability under the ice. The increased photosynthetically active radiation, combined with residual phosphate in the water column of Cell D (from the 2011 phosphate additions), should function to stimulate phytoplankton growth earlier in the winter when zooplankton populations are likely at their lowest. This should ultimately increase the potential for nitrate reduction in Cell D, which has been slowed by zooplankton grazing on phytoplankton during the last two open water seasons. LLCF waters will continue to be monitored in 2012; however, phosphate additions were discontinued.

The results of the most recent prediction models (simulating discharge of underground water to Beartooth Pit in 2009 and discharge of FPK slurry to Beartooth Pit starting in 2012) indicate nitrate concentrations downstream of the LLCF will not approach the hardness dependent nitrate SSWQO (see Section 7.3.2). BHP Billiton will continue to ensure nitrate concentrations do not pose a risk to the aquatic receiving environment.

4.4.4 Elevated Chloride Concentrations in the LLCF

Chloride is a major anionic component of total dissolved solids in the aquatic environment. It is an essential element involved in a wide variety of biological process and as a result is a closely regulated by aquatic organisms at the membrane and cellular level. However, as with all micronutrients it can cause toxicity at elevated concentrations.

The annual AEMP reports current chloride concentrations in lakes and streams downstream of the LLCF, as well as trends since production began. Both the AEMP and SNP at EKATI have detected increased chloride concentrations in the receiving environments of the Koala Watershed as a result primarily of deep groundwater infiltration in underground workings. To address EKATI's effects on the aquatic environment related to elevated chloride concentrations, BHP Billiton initiated the following management:

- A Tier I ecological risk assessment was initially commissioned in 2004 to assess the potential risks associated with elevated chloride concentrations. A SSWQO was subsequently developed for chloride (published in peer-reviewed literature in 2012) (Elphick et al. 2011)
- A 2005 detailed water quality assessment of underground water.
- Numerical modelling of water quality to evaluate potential effects in the receiving environment (culminating in water quality modelling issued in 2012; Report 51).
- Underground mine water is pumped to Beartooth Pit (implemented since late 2009).

The results of the most recent prediction models (simulating discharge of underground water to Beartooth pit in 2009 and discharge of FPK slurry to Beartooth pit starting in 2012) indicate chloride concentrations in Leslie and Moose lakes (downstream of the LLCF) will not exceed the chloride SSWQO.

4.4.5 Panda Diversion Channel Slope Stabilization

BHP Billiton has monitored the physical condition of the PDC since its construction and has observed minor soil ravelling and rock falls from the sideslopes. In recent years monitoring information suggested that the risk had increased that these inconsequential events could grow in magnitude to the point of having a negative effect on water quality and fisheries use of the channel.

In 2010 and 2011 BHP Billiton conducted physical work on certain areas of the channel sideslopes to reduce this risk. The work involved excavating an 18 m wide bench at approximately mid-height, such that falling rock or soil would not enter the channel and such that the overall slope angle was reduced to a long-term stable configuration (Report 28). A comprehensive risk assessment for the project was completed and identified the stream bed, release of sediment into Kodiak Lake, and removal of the ice plug as three of the main environmental risks. As identified in Section 7.4.8, several mitigations measures were implemented during the construction activities to address the identified risks. For example refinements to the engineering design resulted in several changes to help protect the environment including a snow/ice pad constructed in the bottom of the PDC to protect the stream bed from blasting and clean-up activities. In addition, the snow/ice pad could be more easily removed than a solid pad of ice. Also, as expected during freshet immediately following the 2010 construction period, monitoring information indicated that TSS were slightly elevated downstream of the construction zone following a few isolated rainfall events. Thus, to prevent surface run-off water from contacting the exposed sediments, several mitigation activities were completed (see Section 7.4.8) to armour the affected area. The construction area has been closely monitored during rainfall events, and the results show that surface water is routed successfully over the armoured area and remains clean where it is observed to enter the PDC from the bench below.

4.4.6 New Caribou Fence at Airstrip, Beartooth Pit, and Pigeon Test Pit

BHP Billiton identified the interaction between wildlife and aircraft at the EKATI airport as a high risk event. In 1997, mitigation measures for the airport included a roped fence design, based on TK, around part of the airstrip to deter caribou from the area. The fence was composed of wooden stakes and a single strand of rope with orange flagging tape. During 1998, an additional strand of rope was added to the fence. Observations made during 1998 and 1999 suggested that the fence was unsuccessful at deterring caribou from the airstrip. While some individuals appeared to be deterred by the fence, several readily passed through it. Therefore, after consultation with stakeholders, BHP Billiton installed a four-stranded electric fence in the spring of 2000. In 2001, caribou reportedly gained access to the airstrip on several occasions. To further reduce the possibility of caribou entering the airstrip area, improvements to the electric fence were made; an additional two strands of electric wire were added in 2001 and another two were added in 2002, for a total of eight strands.

In 2009, there were three caribou mortalities as a result of interactions with the electric fencing. In response to these mortalities, a test section of orange barrier fencing was set up to evaluate drifting snow. Based on the test section and community consultation, BHP Billiton erected a heavy grade orange barrier fence around the airstript as an alternative to deterring wildlife. The fence was erected in August, 2010 and is monitored as part of the WEMP. The new design features a heavy grade orange plastic fencing material that is 1.3 m high with a 5 cm diamond shaped mesh. The plastic fence will not become entangled with antlers, but should this occur, it will break and the animal will be able to escape without harm. This fence design was initially trialled at the Beartooth pit and has subsequently also been applied at the Pigeon site.

Recent observations indicated that the airport fence was not entirely effective at keeping caribou off the airport/airstrip. Therefore during the winter of 2012, BHP Billiton will extend the height of the fence in order to further reduce the likelihood that caribou will jump the fence. Observation made by the wildlife technicians indicated that caribou only jumped the fence in areas where the caribou's head was completely above the height of the fence. These areas have been targeted for priority fixes. EKATI will continue to evaluate the effectiveness of wildlife barriers and modify its approach based on monitoring results, new information from other areas, and from stakeholder input.

4.5 COMMUNITY INVOLVEMENT AND TRADITIONAL KNOWLEDGE

4.5.1 Introduction

BHP Billiton is committed to working with TK to improve environmental monitoring programs at EKATI and to further the preservation and transfer of TK within the Aboriginal community. These commitments are established in the Company Charter and in the Environmental Agreement. The Environmental Agreement (Article X1, Item 11.3) explicitly states that, "BHP shall incorporate all available TK in the Environmental Plans and Programs and shall give all available TK full consideration along with other scientific knowledge as the Environmental Plans and Programs are developed and revised."

BHP Billiton's approach is to work in partnership with the Aboriginal community and with TK holders in a manner that provides benefit and ownership to the community as well as to environmental programs at EKATI.

BHP Billiton has generally adopted a definition of TK adopted by Usher (1992): "All types of knowledge about the environment derived from the experience and the traditions of a particular group of people."

TK can take many forms and be shared in many ways, ranging from general discussions of the local environment to focussed TK sessions.

In 2011, BHP Billiton documented its approach to TK programs at or supported by EKATI in the *EKATI Traditional Knowledge Strategy* (Appendix F). The strategy describes BHP Billiton's strategy for supporting community-based projects and EKATI-based projects. The strategy is implemented by the Environment Advisor for TK, a full-time position that was created and staffed in 2010.

In December 2011, an EKATI TK workshop was jointly organized by BHP Billiton and IEMA. Presentations were made by BHP Billiton, aboriginal communities, and regulators relating to TK projects underway or under discussion with BHP Billiton. The workshop provided an opportunity for communication on TK projects between BHP Billiton, community representatives, federal and territorial government agencies, and the IEMA.

The following discussion provides some examples of community-based TK projects in the 2009 and 2011 reporting period. Many of these projects were the realization of ideas generated through previous TK workshops held between BHP Billiton and the aboriginal community. In addition to this discussion, specific EKATI-based TK projects undertaken in the 2009 and 2011 reporting period are provided in each of the main VEC category sections under Community Involvement and Traditional Knowledge (e.g., Air, Section 5.1.3).

4.5.2 Community-based Projects

4.5.2.1 The Naonayaotit Traditional Knowledge Project

The Naonayaotit Traditional Knowledge Project was initiated with the Kitikmeot Inuit Association (KIA) in 1996 to collect information on regional movements of species over a span of time that covers decades and provides regional understanding of migratory paths. Structured interviews conducted from 1996 to 1998 were used to obtain detailed information from 51 Inuit consultants on wildlife, habitat, and land use. Between 1998 and 2004, that information was translated, organized into a GIS database and edited and the first product of the NTKP, the Placenames Atlas, was released in 2004. In 2006, a series of reports on land use and wildlife was compiled and printed, and a GIS database was transferred to the KIA by BHP Billiton to continue training and building capacity within the community. An Asset and Transfer Agreement was also signed by BHP Billiton and the KIA. This agreement ensures the NTKP is transferred to the KIA with financial assistance, covering GIS staff training on the NTKP database. In 2007, the KIA created a full-time GIS position with the purpose of maintaining and updating the GIS database. In 2010, BHP assisted in updating the GIS software to a more current version. This work represents a successful collaborative effort between BHP Billiton and the Inuit community of Kugluktuk where TK has been compiled and is being used by the KIA, and the resources are in place for the ongoing use of TK within the community. The Inuit of Kugluktuk own the information contained within the NTKP database and add to it as more information becomes available.

In 2011, this work was continued through the initiation of a BHP Billiton-supported project to develop the content for a future publication(s) based on material within the NTKP. Future publications are intended for the general use of Inuit beneficiaries including schools, hunters and trappers organizations, Elders centres, libraries, and visitor centres.

4.5.2.2 Lutsel K'e Dene First Nation Traditional Knowledge Archive Project

In 2011, BHP Billiton supported the Lutsel K'e Dene First Nation in resuming its work on cataloguing, preserving, and digitizing previously collected TK information. The project supported the hiring and training of full time TK staff within the community of Lutsel K'e. The University of Alberta is also a collaborator on the project, providing computer hardware and researchers. This staged project continued through 2012, with BHP Billiton support, and is envisioned to ultimately result in a community-based TK database. The Lutsel K'e Dene First Nation retains ownership of all of its TK information.

4.5.2.3 North Slave Métis Alliance Community Heritage Project

The North Slave Métis Alliance Community Heritage Project supported by BHP Billiton was initiated in 2011. The main goal of this project is to conduct and document genealogical research on the history of North Slave Métis families. The work involves full time staff within the North Slave Métis Alliance, research at southern archive locations, database documentation, and community workshops. This project continued through 2012, with BHP Billiton support, and is envisioned to result in a fully-documented history of North Slave Métis families.

4.5.2.4 Tlicho Traditional Knowledge Archive Project

In 2011, BHP Billiton supported the Tlicho Government in its work on cataloguing, preserving, and digitizing previously collected TK information. The project supported the hiring and training of full-time TK staff within the Tlicho Government TK Department. The Prince of Wales Museum is also a collaborator on the project. This staged project continued through 2012, with BHP Billiton support, and is envisioned to ultimately result in a community-based TK database. The Tlicho Government retains ownership of all of its TK information.

4.5.2.5 Yellowknives Dene First Nation Traditional Language Project

In 2011, BHP Billiton supported the Goyaticko Language Society of the Yellowknives Dene First Nation in initiating a program of cataloguing, preserving and digitizing previously collected TK language information. The project supported the hiring and training of full time TK staff within the Goyatiko Language Society. The Prince of Wales Museum is also a collaborator on the project. This staged project continued through 2012, with BHP Billiton support. The Yellowknives Dene First Nation retains ownership of all of its TK information.

4.5.3 EKATI-Based Projects

BHP Billiton initiated a new program (in 2008) for a representative of the Aboriginal communities to job-shadow members of the EKATI Environment Department for a period of five to seven days. This created an opportunity for two-way dialogue and information sharing as well as providing some capacity-building within the community. In 2009, the on-site environment job-shadow program was again offered to all impact benefit agreement groups and implemented with the Lutsel K'e Dene First Nation.

In 2011, this program was expanded to provide for a five to seven day site visit by an elder or adult and youth from each of the impact benefit agreement communities. The site visits provided exposure to all of the EKATI Mine's environmental monitoring programs with a focus on one specific aspect. In 2011 the focus was on caribou and grizzly bear monitoring through the WEMP (see Section 8). The program was continued in 2012 with a focus on the assessment of fish health through the AEMP. Individual summary reports were prepared and circulated to the attendees and their community leadership.

Site visits on specific topics of interest raised by community representatives have been conducted. In spring 2011, a site visit for community representatives was conducted to review the AQMP (see Section 5.1.3). A summary report on the site visit was prepared. This program continued in spring 2012 with a site visit for community representatives that focussed on a review of water management during spring runoff.

4.5.4 Cultural Events and Community Development Projects

BHP Billiton continues to play an active role in promoting aboriginal culture and sustainable communities through community visits, event sponsorships, and sharing of aboriginal knowledge.

In 2009, BHP Billiton continued its involvement with the communities through donations and support for the Dene National Assembly, National Aboriginal Day, Lutsel K'e Spiritual Gathering, and Tlicho Annual Gathering.

In 2010 BHP Billiton hosted two cultural workshops at EKATI: a Dene Drum Making Workshop that was led by Tlicho community members, and a Seal Skin Mitt Making Workshop that was led by Inuit of the Hamlet of Kugluktuk. The workshops are two in a series of workshops called Trails, and are designed to document and capture aboriginal knowledge across impact benefit agreement communities. Both workshops were recorded and documentaries are available.

In 2010, the EKATI+ Community Development Program supported community development initiatives in all of the impact benefit agreement communities including the territory-wide Breakfast for Learning Program and Jobmatics Career Focusing for Youth. BHP Billiton also supported community-specific requests including a cultural program in N'dilo, education programs in Dettah, the Tlicho Annual Gathering, the Annual Spiritual Gathering in Lutsel K'e, and established an Annual Fishing Derby with the Hamlet of Kugluktuk.

4.6 THE EKATI ENVIRONMENT DEPARTMENT

The EKATI Environment Department is dedicated to maintaining the high standards of environmental protection that are established in the BHP Billiton Charter, the water licences, the environmental agreement and the other various licences, leases, and permits. The environment team is an integral part of the HSEC Group, and reports directly to the Head of HSEC. The EKATI Environment Department consists of:

- Rob Cooper – President of EKATI;
  - Rob MacLean – Head of HSEC;
    - Claudine Lee – Superintendent, Environment Operations;
      - Erin Forster – Environmental Advisor, Fisheries and Aquatics;
      - Jamie Steele – Environmental Advisor, Compliance; and
      - Harry O'Keefe – Environmental Advisor, Wildlife.

Environment Department team members located at EKATI work closely with others within HSEC that are dedicated to TK projects, community relations, regulatory affairs, and long-range planning to gain the most benefit from these overlapping areas. The on-site environment team members also work closely with the teams from the process plant, mine operations, and mine maintenance to carry out mining activities in accordance with the various standards and requirements.

The EKATI Environment Department includes staff dedicated to managing the environmental monitoring and reporting programs (wildlife, air, water, aquatic resources, waste rock) and working with operating departments on implementation of various management plans (such as the wastewater and Processed Kimberlite Management Plan). In addition to full time staff, the team is augmented by a long-standing and successful summer-student program. This program targets northern-Aboriginal students and provides the students with excellent experience in environmental monitoring programs while providing EKATI with valuable manpower during the busy summer season. Specialist consultants are used for programs requiring specific scientific or engineering expertise that is not available in-house.

5. Air

5. Air

5.1 SUMMARY OF MONITORING PROGRAMS

Air quality is the only VEC in the Air category. Air quality is a VEC because of its importance for visibility; effects on worker health and safety; and its importance for wildlife, vegetation and water quality. Air is the vector by which airborne contaminants can be transported great distances. Air quality also has aesthetic value in terms of visibility and odour.

5.1.1 Local Climate

The local climate is monitored annually in support of the current monitoring programs at EKATI. Monitoring of the local climate at EKATI is conducted at two stations: the Koala automated meteorological station located at the south end of the airstrip, and an automated station located at the north end of the airstrip that is primarily used by airstrip personnel. The data collected at both stations includes air temperature, wind speed and direction, relative humidity, and precipitation. To monitor lake evaporation, an automated micro-meteorological station is operated at Polar Lake during the open water season.

Monitoring temperature is an important component of the Air Quality Monitoring Program (AQMP). Day-to-day ambient temperatures control the rate of chemical reactions that generate or transform a number of secondary air pollutants (e.g., O_3, NO_x) as well as thermal advection. Long-term temperature trends reflect emissions of GHGs and particulates. As has been widely reported (e.g., IPCC 2007), Arctic regions are particularly sensitive to global climate change. While global climate change has focussed mainly on GHG emissions, recent research suggests that long-range transport of aerosols (fine particulates, particularly black carbon) may also be driving a significant portion of the observed Arctic warming (Shindell and Faluvegi 2009).

Analysis of the EKATI temperature long-term data indicated that there were clear seasonal trends: daily temperatures generally rise above 0°C in early June, marking the start of the open water season; summer maximums generally reach 18°C; by early October daily temperatures drop below 0°C, marking the end of the open water season and the start of winter; and daily winter minimums commonly reach below -30°C.

In general, the subarctic climate at EKATI is characterized by stable continental polar air masses that produce relatively low annual precipitation. Winter accumulation generally accounts for 40 to 50% of the total precipitation, while August generally records the highest single monthly total rainfall.

Wind speed and direction data are important for assessing how air emissions from the mine will be distributed to the local area and surrounding region. Long-term data indicates that the EKATI area is fairly windy, with the most common wind speeds between 3 to 5 m/s (approximately 11 to 18 km/h). Winds at the site are omni-directional; however, there is a primary component from the east (24% coming from the east-northeast, east, and east-southeast), and a secondary component from the northwest (19% from the west-northwest, northwest, and north-northwest).

5.1.2 Air Quality Monitoring Program

The AQMP was initiated in 1998 and is ongoing. The purpose of the program is to monitor ambient air quality and to assess the effectiveness of air quality management plans in maintaining air quality throughout the life of EKATI mining operations. The results of the AQMP are benchmarked by comparing to:

- applicable ambient air quality guidelines;
- historical and reference air quality data generated at EKATI;
- baseline air quality parameters referenced in the literature; and
- air dispersion modelling predictions.

BHP Billiton continues to meet its commitments through the AQMP reporting (Reports 43 and 60). The results of CALPUFF air dispersion modelling was published in 2006 and were presented and discussed in comparison to observed field data in both the 2008 and 2011 AQMP reports.

Components of the AQMP and discussed in terms of predicted effects include:

1. air emissions and GHG calculations;
2. ambient air quality monitoring:
   - high volume air sampling (HVAS; Plates 5.1-1 and 5.1-2);
   - continuous air monitoring (CAM);
3. dustfall monitoring;
4. snow chemistry monitoring.; and
5. lichen tissue monitoring.

Plate 5.1-1. HVAS station TSP-3, exposed interior view, May 2011.

Plate 5.1-2. HVAS station TSP-3, exposed filter view, May 2011.

Emissions calculations and HVAS measurements have been conducted each year since the commencement of the program in 1998; however, there were no HVAS measurements in 2006 while the AQMP was undergoing review and redesign. Snow and lichen sampling are generally conducted every three years (1998, 2001, 2005, 2008, and 2011). The Dustfall Monitoring Program was initiated in 2006 and has occurred during the summer months of each year since then. The Continuous Air Monitoring (CAM) building was originally installed in April 2007 adjacent to the Grizzly Lake pumping station. However, following consultation with regulatory agencies in 2008, the station was moved to the west side of the mine site, near the Polar Explosives building to improve the ability of CAM in detecting changes to air quality. Monitoring at this new location was initiated in October 2008.

5.1.3 Community Involvement and Traditional Knowledge

In May 2011, an AQMP EKATI Engagement Tour was conducted to educate, demonstrate, and collect any recommendations or ideas on the current AQMP (Plate 5.1-3). Tours were provided of the new incinerator building, as well as of the Cell B air monitoring station where an HVAS and dustfall station is located. EKATI Environment Department staff provided a demonstration of how the high volume air samplers are collected and analyzed in addition to how the dustfall collection is conducted at EKATI. The tour also allowed community members to voice concerns and ask questions regarding air quality monitoring at EKATI. Key concerns of community members included the composition of dust suppressants (DL-10 on roads and EK-35 on the airstrip) used by EKATI, what contributes to EKATI's air quality, what EKATI is doing to reduce GHG emissions, and how the Dustfall Monitoring Program contributes to the overall understanding of air quality at EKATI (Appendix F). In general community participants felt the tour was informative and they gained a better understanding of air quality monitoring at EKATI.

Plate 5.1-3. AQMP EKATI community engagement tour, May 2011.

5.2 PREDICTED AND OBSERVED EFFECTS

The 1995 EIS primary concerns regarding air quality were:

- gaseous emissions;
- particulate emissions; and
- fugitive dust.

Gaseous emissions were predicted mostly from diesel fuel consumption by the power generation station, mobile mining equipment, mining operations (e.g., blasting, ore and waste rock handling) and waste management activities (e.g., incineration of solid waste and used petroleum products).

The biggest sources of fugitive dust were predicted to be traffic along unpaved haul roads, primary crushing of kimberlite ore, and wind erosion of the waste rock storage piles during dry conditions.

In 1995, the initial spatial extent of EKATI air emissions was predicted using an air dispersion model. The air dispersion presented in the 1995 EIS was based on the second version of the Industrial Source Complex model (ISC2). The ISC2 is a Gaussian plume model that can simulate several different types of sources including point, area, line, and volume at multiple locations. Later in 1995, the results of the ISC2 model were updated using the same model and the results were presented in the Additional Information Response of December 1995 (BHP and Dia Met 1995b). Both reports compared predicted values for SO_2, NO_x, and Total Suspended Particulates (TSP) to the Canadian Ambient Air Quality Objectives (CAAQO). The updated ISC2 model predicted negligible overall, long-term effects on ambient air quality in areas at or beyond the boundaries of the claim block. Under the worst case conditions, the models predicted that the long-term combined process emissions were all less than the CAAQO at or beyond the boundaries of the EKATI claim block. Model predictions in 1995 suggested there would be no residual environmental effects from wet deposition of SO_2 and NO_x (i.e., no acid rain) because of the comparatively low level of SO_2 and NO_x emissions from EKATI.

Fugitive dust was defined as any uncontrolled particulate emissions from project activities in the 1995 EIS and a Fugitive Dust Model was used to predict annual TSP concentrations. The residual effects from fugitive dust were predicted to be negligible, in part because precipitation would remove any deposited dust from the surrounding vegetation. In addition, haul roads were to be constructed using on-site materials; therefore, it was anticipated that dust from those roads will contain the same materials as the present surface soils. Heavy metal concentrations in the onsite materials used to construct the roadways are low (see below). Thus, the fugitive dust was predicted in the 1995 EIS to have negligible effects on plants and animals. For the same reason, fugitive dust would not significantly affect wildlife near the open pits or waste dumps.

Blasting was also predicted to contribute to air emissions; however, it was anticipated that the effects would be minimized through blasting practices, and were predicted to be negligible. It was also anticipated that the gaseous air emissions will be diluted by ambient air, and deposition of particulate around open pits following a blast will be wind dispersed or removed from vegetation following precipitation events. Thermal inversions may occur in the pit, which could lead to poor air quality within the pit. If thermal inversions resulting in poor air quality occur, mitigation measures would be implemented (e.g., management of where haul trucks are active within the pit). This is mainly a potential impact to worker health and safety and environmental effects are considered negligible.

In summary, the 1995 EIS predicted that the effects on air quality during exploration, construction, operation, closure, and post-closure would be either negligible, not applicable, or unknown (e.g., effects of waste rock dumping and the presence of waste rock dumps on climate).

5.2.1.1 Air Emissions from Process Plant Operation and Blasting in Open Pits

The 1995 EIS predicted that there would be negligible residual effects as a result of air emissions from the operation of the process plant. The 2000 and 2003 editions of the EIR concluded that mining activities had not significantly adversely affected air quality at EKATI (BHP Billiton 2000, 2003). At the time of the 2006 and 2009 EIRs, the results of the annual AQMPs were not completed and therefore any effects were indicated with uncertainty. Generally the previous EIRs indicated that there were low emissions of particulate matter and air quality measures were within applicable guideline values (i.e., 24-hour TSP).

Air emissions at EKATI are monitored using the High Volume Air Sampler and the Continuous Air Monitoring station.

High Volume Air Sampler

Ambient concentrations of TSP at EKATI have been collected seasonally (during the summer) since 1997 using the HVAS method. The NT Ambient Air Quality Standard for 24-hour TSP concentration is 120 μg/m^3. The GNWT standard is developed in line with the Canada-wide National Ambient Air Quality Objectives and Guidelines for 24-hour TSP. This standard sets the bar for the long-term air quality protection of unpolluted areas in the country. Between 2009 and 2011, results of the HVAS indicated that only two measured values (in 2010), out of 169, exceeded the 24-hour standard of 120 μg/m^3; however, these exceedances were most likely due to measurement error. All other values were generally well below the set standard (Figure 5.2-1).

As recommended by government regulators, the winter of 2010/2011 was the first year that HVAS was conducted. Because of the extreme winter conditions on site, the winter HVAS program was hard on the equipment and caused frequent failures due to freezing motors and dials. Severe winter weather also prevented samples from being taken on some scheduled days, as EKATI Environment Department staff did not visit the HVAS sites due to safety concerns. These equipment failures and weather advisories limited the total number of samples that were originally planned for the winter monitoring period (Figure 5.2-1).

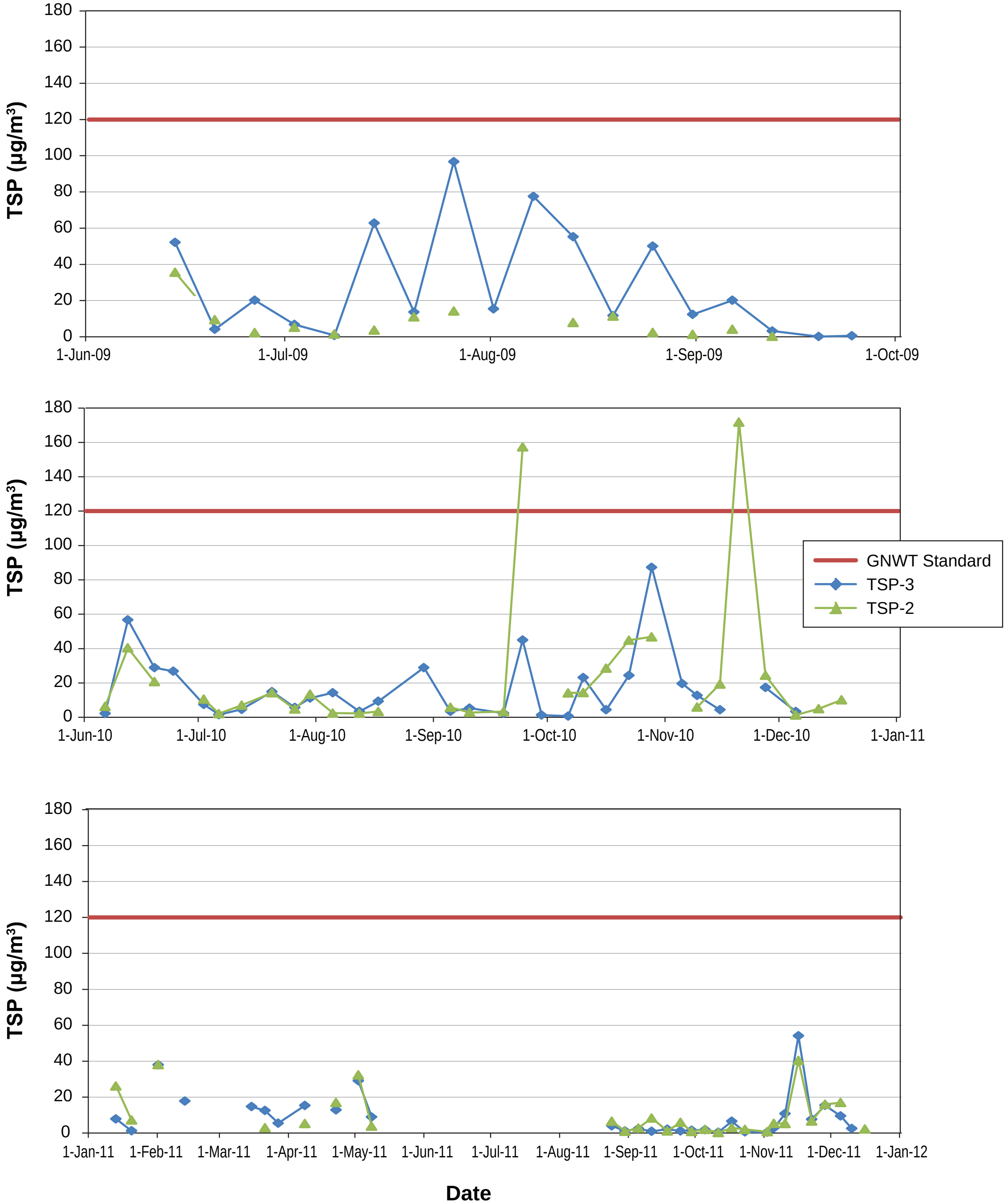
Between 2009 and 2011, 13% of the HVAS filters returned negative values following analysis. During this time, monitoring technicians were having problems with portions of the filter paper sticking to the rubber edge of the filter cassette, leading to negative TSP values being returned from the laboratory. Other possibilities that were noted include incorrect measurements of the filter's initial or final weight.

The current HVAS data suggest EKATI mine operations produce suspended particulates; however, concentrations are generally within the guidelines. These findings support the CALPUFF air dispersion modelling prediction that deposition of TSP resulting from mine fugitive dust emissions would be indistinguishable from background rates at a distance of 14 to 20 km from active mining areas (Rescan 2006a).

Continuous Air Monitoring

A CAM station is located at the Polar Explosives site. The equipment is housed in a building approximately 3 × 3 m and analyzers continuously measure concentrations of SO_2, NO_x, TSP, and $PM_{2.5}$, as well as ambient outdoor temperature. Teledyne 100E and 200E analyzers measure SO_2 and NO_X, respectively, and two Met One BAM-1020 particulate analyzers measure TSP and $PM_{2.5}$.

The EKATI mine site has adopted NT Ambient Air Quality standards and CAAQO ambient air quality standards as operational targets (Tables 5.2-1 and 5.2-2). These standards are typically applied to residential/public areas (as opposed to industrial sites) providing the EKATI site with a greater level of protection than what is expected for an industrial site. NO_2 and SO_2 never exceeded the NT standards during the 2009 to 2011 monitoring period (Figures 5.2-2 and 5.2-3). During the 2009 to 2011 reporting period, over 75% of $PM_{2.5}$ data were invalid, possibly due to tape tension or calibration errors (Figure 5.2-3; Table 5.2-3). The available data (representing the first, second, and third quarters in 2009 and the third quarter in 2011) showed one exceedance of NT $PM_{2.5}$ standards (3% over), recorded in March 2009 (Figure 5.2-3). TSP data from August to December 2011 were invalid, possibly due to calibration errors. There were a total of five exceedances of NT TSP standards (ranging from 4 to 107% over): one in May 2010, three in May 2011 and one in June 2011.



Note: Two, four, and ten results were removed from TSP-2 in 2009, 2010 and 2011, respectively, due to negative values. Three and four results were removed from TSP-3 in 2010 and 2011, respectively, due to negative values. No measurements were taken between May 9th and August 23rd, 2011.

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Figure 5.2-1

2009 to 2011 Total Suspended Particulate

PROJECT # 648-121 ILLUSTRATION # a37395w July 27, 2012

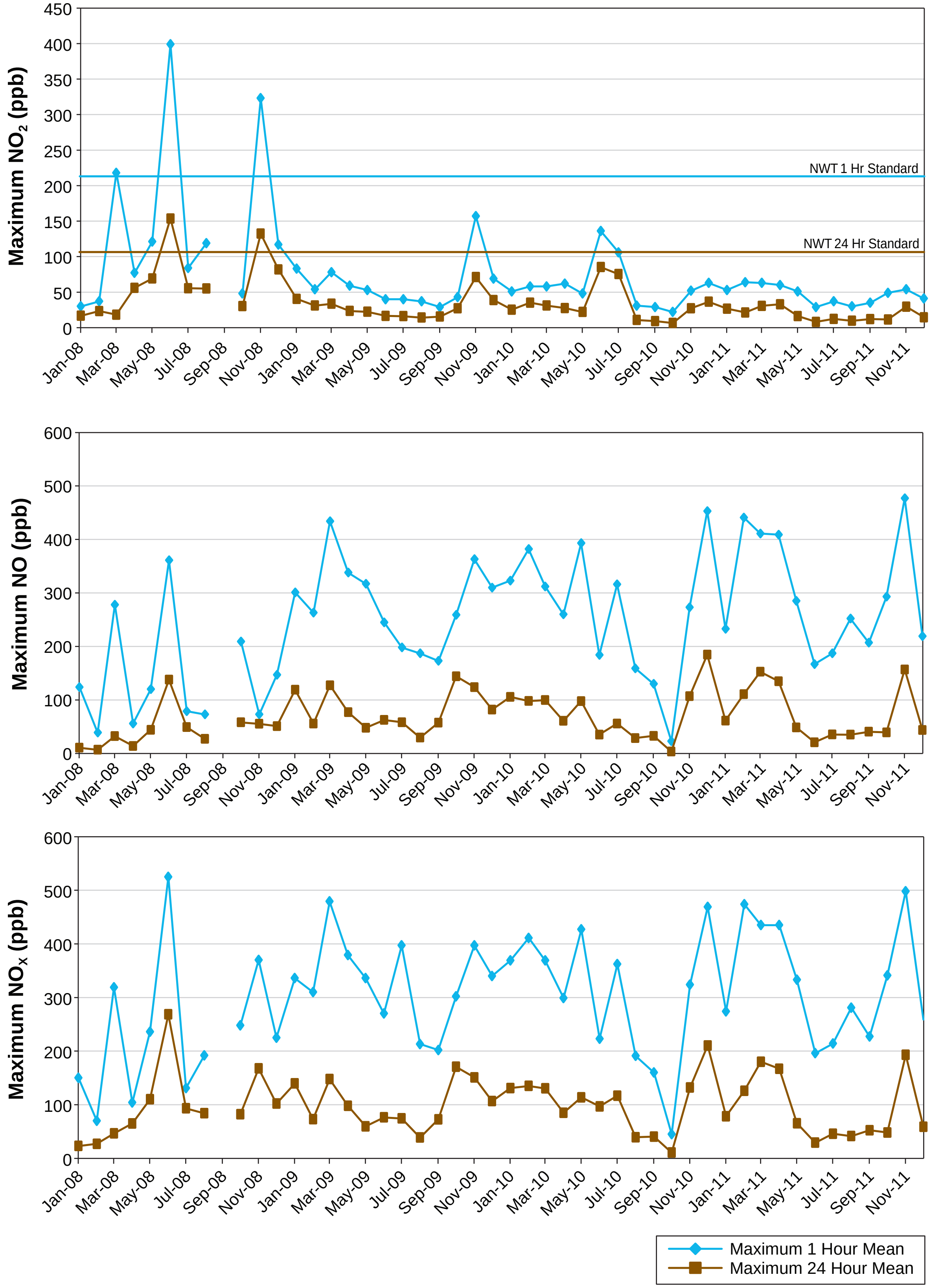

Figure 5.2-2

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2008 to 2011 CAM Monthly Results: NO_2, NO and NO_X

◎ Table of Contents

PROJECT # 648-121 ILLUSTRATION # a37396w July 27, 2012

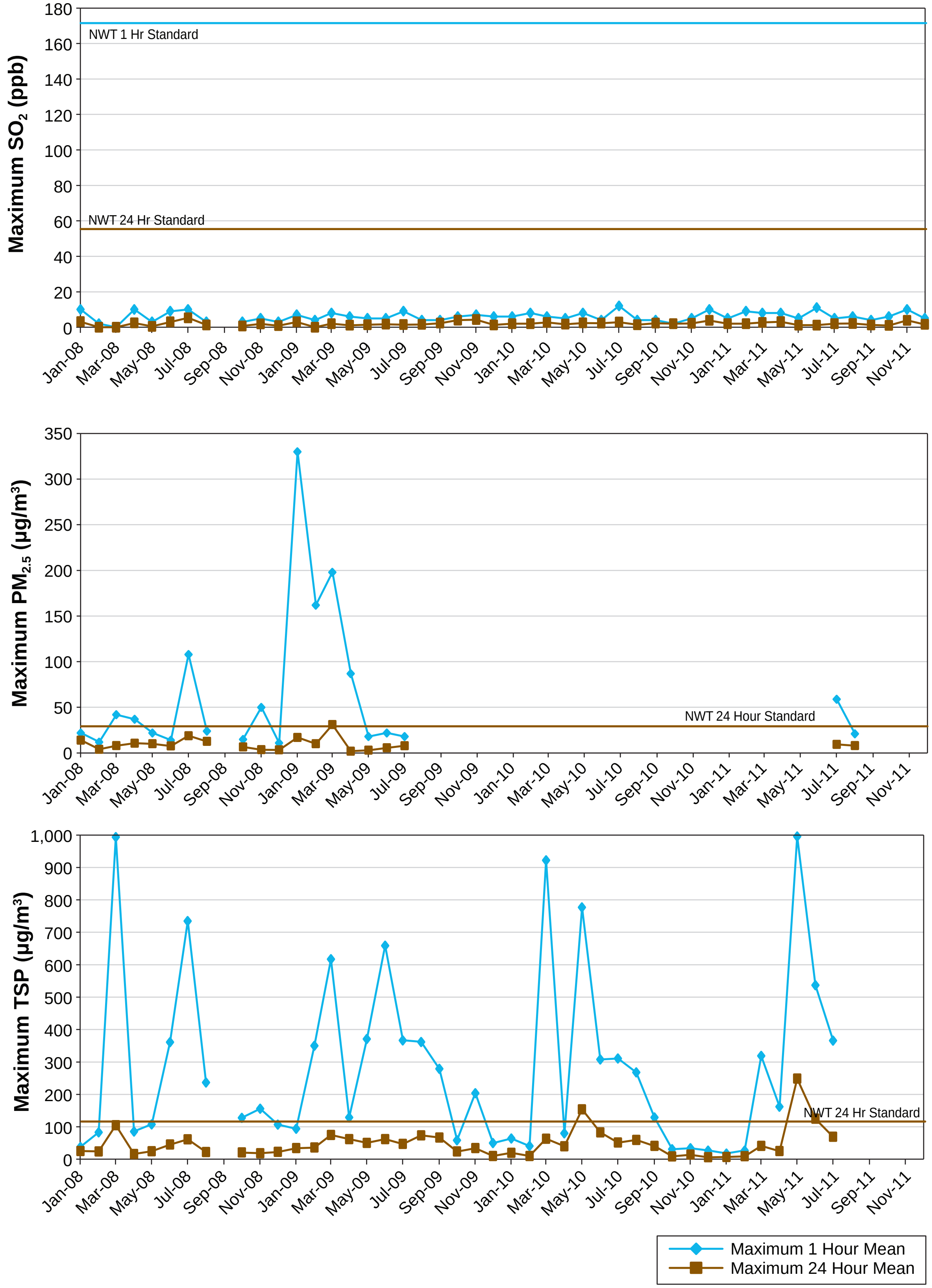

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Figure 5.2-3

2008 to 2011 CAM Monthly Results: SO_2, $PM_{2.5}$ and TSP

Table 5.2-1. Summary of Northwest Territories Ambient Air Quality Standards

Parameter	Unit	1 Hour	24 Hour	Annual
Sulphur Dioxide (SO_2)	µg/m^3 (ppb)	450 (172)	150 (57)	30 (11)
Nitrogen dioxide (NO_2)	µg/m^3 (ppb)	400 (213)	200 (106)	60 (32)
Total Suspended Particulate (TSP)	µg/m^3	-	120	60
Fine Particulate ($PM_{2.5}$)	µg/m^3	-	30	-

Note: Values in brackets are concentrations in units of ppb.
Source: (GNWT 2011)

Table 5.2-2. Summary of Canadian Ambient Air Quality Objectives

		Maximum Desirable			Maximum Acceptable		
Parameter	Unit	1 Hour	24 Hour	Annual	1 Hour	24 Hour	Annual
Sulphur Dioxide (SO_2)	µg/m^3 (ppb)	450 (172)	150 (57)	30 (11)	900 (344)	300 (115)	60 (23)
Nitrogen dioxide (NO_2)	µg/m^3 (ppb)	-	-	60 (32)	400 (213)	200 (106)	100 (53)
Total Suspended Particulate (TSP)	µg/m^3	-	-	60	-	120	70
Fine Particulate ($PM_{2.5}$)	µg/m^3	-	-	-	-	30	-

Note: Values in brackets are concentrations in units of ppb.
Source: (Environment Canada 2010)

Table 5.2-3. CAM Building Data Capture on a Quarterly Basis, 2009 to 2011

	Operational Time (%)					
Quarter	SO_2	NO_2	NO	NO_x	$PM_{2.5}$	TSP
Q1 2009	97.9	97.6	97.6	97.6	72.0	95.8
Q2 2009	100.0	100.0	100.0	100.0	68.5	74.7
Q3 2009	100.0	100.0	100.0	100.0	27.1	92.2
Q4 2009	94.3	100.0	100.0	100.0	0.0	65.8
Q1 2010	100.0	100.0	100.0	100.0	0.0	100.0
Q2 2010	100.0	100.0	100.0	100.0	0.0	100.0
Q3 2010	99.9	99.9	99.9	99.9	0.0	99.8
Q4 2010	37.2	37.2	37.2	37.2	0.0	37.2
Q1 2011	73.0	73.0	73.0	73.0	0.0	71.7
Q2 2011	100.0	99.9	99.9	99.9	0.0	99.9
Q3 2011	87.5	87.5	87.5	87.5	43.5	25.3
Q4 2011	89.8	89.8	89.8	89.8	0.0	0.0

An important aspect of the results produced from the CAM building is the data capture during each of the reporting quarters, measured as the percentage of operational time for each instrument (Table 5.2-3). The 2011 AQMP also provides the percentage of data capture on a monthly basis and provides detailed notes on reasons for lack of data (e.g., faulty instrument; Report 60). The Canada-wide standard for data capture indicates that an annual data set should be considered complete if at least 75% of the scheduled sampling days in each quarter have valid data. In general, complete annual datasets were not attained in any of the reporting years and particularly the $PM_{2.5}$ data capture were poor throughout the 2009 to 2011 reporting period. With continued maintenance and regular checks to ensure instruments are operational (and calibrated properly) it is anticipated that these percentages will improve during the next reporting period. BHP Billiton has contracted qualified personnel to address the data capture issues with the CAM building to ensure that changes in air quality related to the mine operations is detected (see Section 5.4.3).

5.2.1.2 Air Emissions from Diesel Power Generation (Including Diesel Consumption for the Mining Fleet)

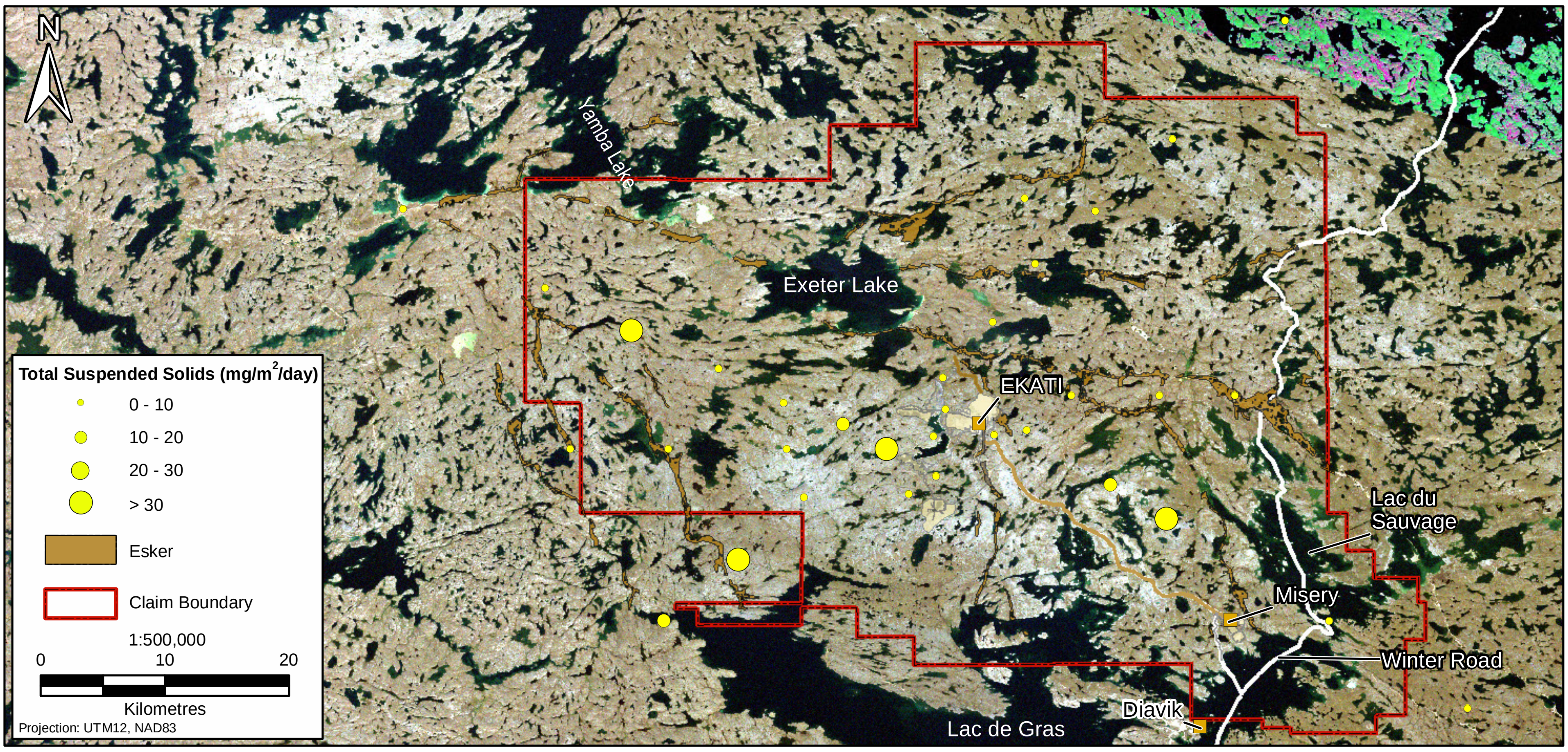
Diesel fuel is consumed every year at EKATI for the transportation of ore and waste rock, heat and production of electricity, blasting, and other mine activities. The 1995 EIS predicted that air emissions from diesel power generation would have negligible residual effects on the EKATI environment. Historical effects related to air emissions from diesel power generation indicated in previous EIRs noted that there were greater concentrations of metals (aluminum, titanium, and iron) in lichen tissue within the study area. Snow surveys prior to 2006 indicated higher concentrations of particle-associated analytes (e.g., aluminum, chromium, cobalt, barium, iron, magnesium, manganese, nickel, vanadium, and TSS) within 5 km of the mine. However, between 2006 and 2008, snow samples indicated that TSS and a number of metals (e.g., aluminum, chromium, cobalt, iron, magnesium, nickel, and vanadium) associated with fine particulates were elevated above background levels in a zone approximately 9 km in diameter around the mine footprint. In addition, the 2009 edition of the EIR indicated that GHG emissions have levelled off prior to a steady increasing trend.

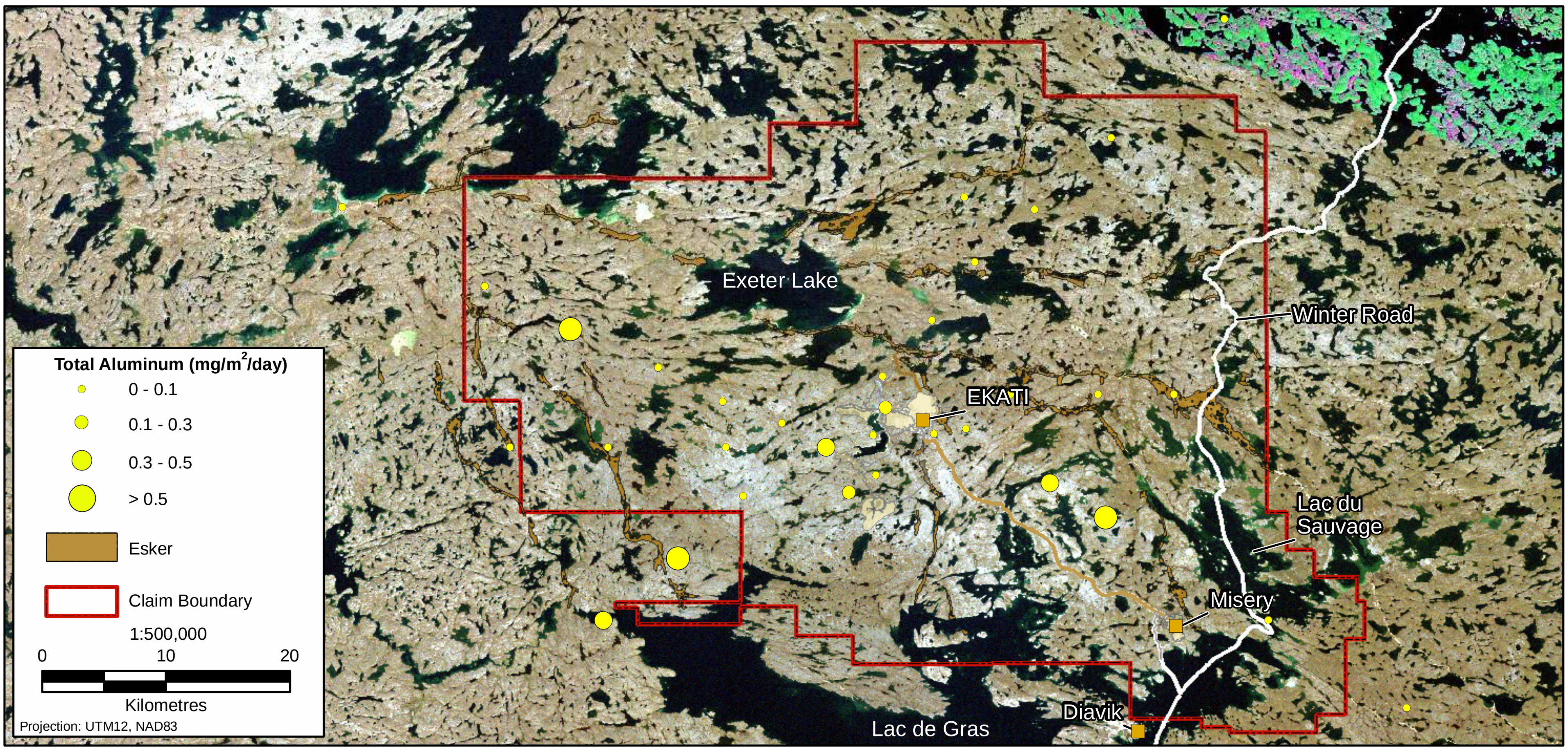
Section 4.3.3 of this report provides summaries of the calculated air emissions for the 2009 to 2011 reporting period that has resulted from the diesel fuel consumption. These values are reported annually to National Pollutant Release Inventory and the GHG Emissions Reporting Program. Among other contaminants, National Pollutant Release Inventory tracks criteria air contaminants (carbon monoxide, oxides of nitrogen, sulphur dioxide, volatile organic compounds and particulate matter (total, PM_{10} and $PM_{2.5}$), while the Greenhouse Gas Emissions Reporting Program tracks total GHG emissions as carbon dioxide equivalent (CO_2e). The average annual GHG emissions between the reporting years 2009 to 2011 was 158,055 tCO_2e. This is 21% less than that estimated during the 2006 to 2008 AQMP reporting years (198,899 tCO_2e).

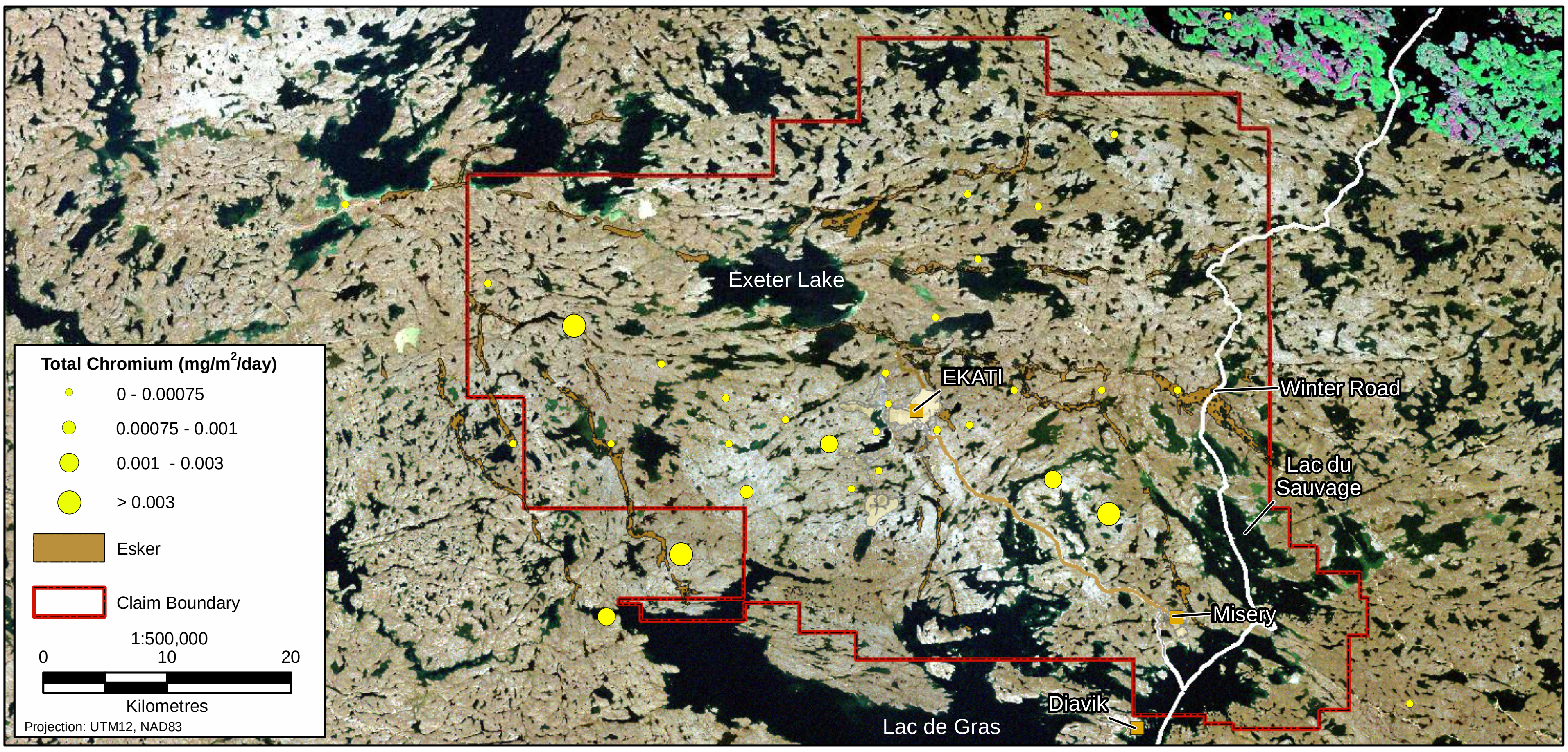
Spatial analysis of 2011 snow chemistry data suggests that winter loading of TSS and a number of metals likely associated with fugitive dust and fine particulates are not elevated in a zone directly surrounding the mine footprint and concentrations remain low with distance from mining activity (Figures 5.2-4 and 5.2-5). The exceptions were three sampling locations that had elevated concentrations between 15 km and 30 km from mining activity (Figure 5.2-5). Variables associated with gaseous emissions, blasting, and long range transport (e.g., NO_3^-, NH_3, SO_4^{2-}) do not show strong trends with distance from mining activity (Figure 5.2-6). The 2011 results were generally within the range or lower than those reported for 2008 and 2005. Duplicate samples in 2011 were collected for quality assurance and quality control purposes at four of the 33 sites. Results suggest similar values when duplicate samples were compared.

Selected snow chemistry data were also compared to background conditions based on 20 years of monitoring data (1988 to 2008) from Snare Rapids. Snare Rapids is a Canadian Air and Precipitation Monitoring (CAPMoN) station located approximately 150 km northwest of Yellowknife and 150 km southwest of EKATI. CAPMoN stations are situated in locations considered remote and pristine.

Most elemental concentrations in the snow cores measured in 2011 were below established background concentrations observed at the Snare Rapids CAPMoN station (e.g., Figure 5.2-6). The exceptions are for the sampling locations directly near mining activity; however, concentrations are less than those typically associated with industrial developments.







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Surface Loading Rates for Total Suspended Solids, Aluminum and Chromium from 2011 Snow Chemistry Data

FIGURE 5.2-4

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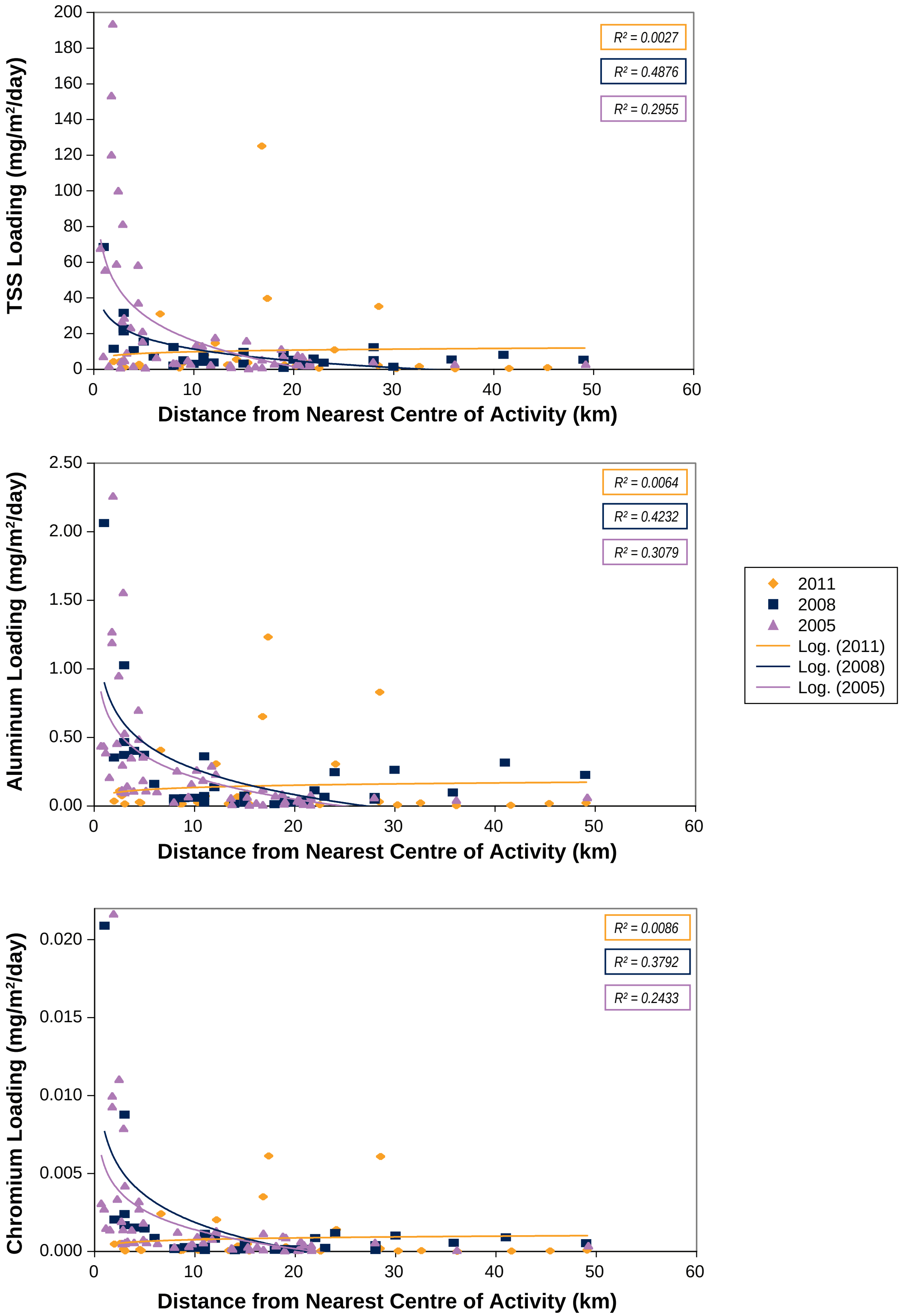

Note: Historical background data are not available for these parameters

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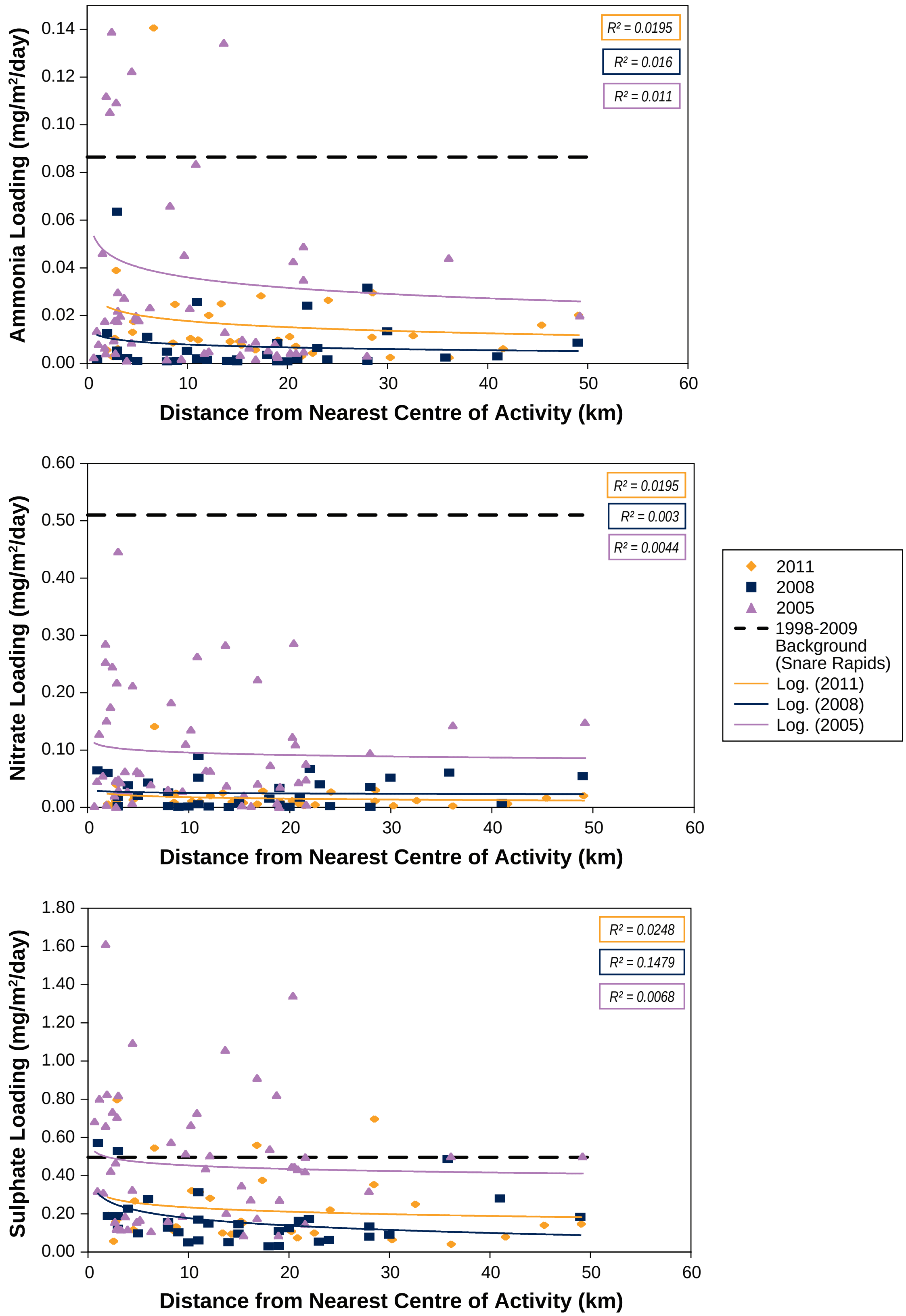
Winter Surface Loading Rates for Total Suspended Solids, Aluminum, and Chromium as a Function of Distance from Mining

Figure 5.2-5



Note: Background is based on average winter (October to May) loading rates observed at the Snare Rapids CAPMoN station, NWT.

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Winter Surface Loading Rates for Nitrate, Ammonia and Sulphate as a Function of Distance from Mining

Figure 5.2-6

Lichens are useful indicators of the distribution of dust, particulate, and air emissions from a variety of sources, including but not limited to road dust, mine sites, and vehicle exhausts. The chemical analysis of lichen tissue provides a precise measurement of ambient air pollution level changes over time. Lichens were collected from 38 sites in 2011 near EKATI and results were compared to similar collections made in 2005 and 2008 (Plates 5.2-1). Thirty-three chemical parameters were analyzed from the lichen tissue lab results.

Plate 5.2-1. Collecting lichen samples at sample location AQ-106, August 2011.

Concentrations of the elements in lichen tissue collected from the sampling stations around EKATI in 2011 were similar to published background levels from the literature (Table 5.2-4).

Table 5.2-4. Comparison of Four Crustal Element Concentrations in Similar Lichens from the Literature versus Those Found at the EKATI Diamond Mine

Element	Background Concentrations (mg/kg) from the Literature[1]	EKATI Mine Concentrations (mg/kg) in 2008	EKATI Mine Concentrations (mg/kg) in 2011
Copper	6 to 20 in *Parmelia sulcata* < 1 to 50 in Canadian Arctic Background Areas	4.8 to 18.5 in *P. rufescens* 0.88 to 11.20 in *F. cucullata*	0.88 to 23.9 in *P. rufescens* 0.79 to 124 in *F. cucullata*
Chromium	0.5 to 10 in *P. sulcata* 0 to 10 in Canadian Arctic Background Areas	0.6 to 22 in *P. rufescens* 0.5 to 12 in *F. cucullata*	0.2 to 15.9 in *P. rufescens* 0.3 to 17.8 in *F. cucullata*
Zinc	50 to 80 in *P. sulcata* 200 to 500 in Canadian Arctic Background Areas	32 to 70 in *P. rufescens* 11 to 56 in *F. cucullata*	20.8 to 76 in *P. rufescens* 19.1 to 53.8 in *F. cucullata*
Manganese	5 to 120 in *P. sulcata* 10 to 130 in Canadian Arctic Background Areas	68.9 to 357 in *P. rufescens* 25.3 to 228 in *F. cucullata*	47.6 to 225 in *P. rufescens* 51.1 to 294 in *F. cucullata*

[1]Nieboer, Richardson, and Tomassini (1978); Nash and Gries (1995); Rhoades (1999); Bargagli and Mikhailova (2002).
Source: Enns (2012).

Elemental concentrations in the two indicator lichens collected in the study area show that mine influence of dust is confined to a relatively small area, and tends to decline with distance from the mine site. Specifically, dust-born elements such as magnesium, aluminum, and nickel are more concentrated near the mine site and roads (e.g., Figure 5.2-7).

Nitrogen and sulphur concentrations at EKATI occur over a much wider geographic distribution which is similar to the pattern observed in 2008 (e.g., Figure 5.2-8). However, concentrations of nitrogen and sulphur have increased in some locations, possibly due to emissions and not from dust. The lichen tissue concentrations of most dust-borne metals and crustal elements have decreased in 2011 in comparison to concentrations observed in 2005 and 2008, with the exception of nickel and copper; however, all concentrations are very low in comparison to other studies conducted in the Arctic.

5.2.1.3 Roads and Road Traffic Create Fugitive Dust

The 1995 EIS predicted that roads and road traffic would create a negligible residual effect of fugitive dust. Historical analyses indicated that daily average TSP concentrations were below guideline values; although there was some slight enrichment in some substances in lichen, no effects were evident from vegetation surveys. Snow survey data indicated higher concentrations of TSS within 5 km of the mine in 2001. A subsequent snow survey indicated higher than background levels for winter deposition of TSS and a number of metals in a zone around 9 km around the mine footprint due to fugitive dust and fine particulates. Earlier editions of the EIR also indicated that fugitive dust loadings are small; hence, there is a high gradient in TSP deposition close to sources. Generally, dustfall monitoring results between 2006 and 2008 suggest that fugitive dust levels are elevated immediately adjacent to the road but fall off quickly with distance—in most cases by 1 km from the road the deposition rate is similar to background levels.

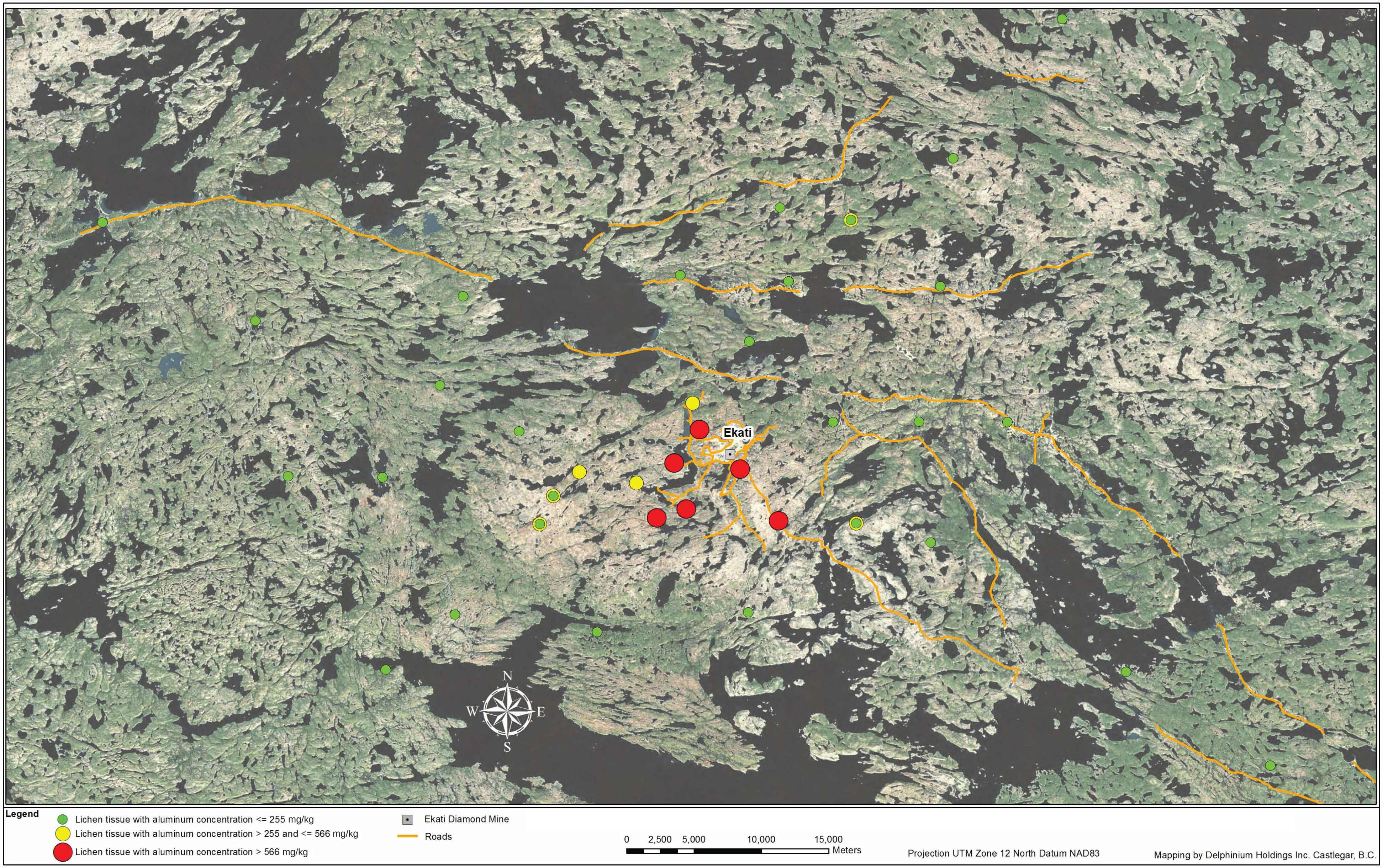
The Dustfall Monitoring Program, first initiated in 2006, was developed to determine the deposition patterns for fugitive dust from the haul road (Plates 5.2-2 and 5.2-3). Relocations of the background stations AQ-49 (Plate 5.2-2) and AQ-54 were based on the results of the EKATI CALPUFF modelling published in 2006. As of 2008, the program expanded to sample at additional locations. The 2009 to 2011 monitoring period for this report uses the same sample locations as used in 2008. Two of the dustfall stations serve as background sites and are approximately 21 km and 36 km west of the mine (these sites coincide with the snow and lichen collection sites for comparison purposes). Ten stations were established in groups near the Fox and Misery haul roads. For each group, one station was established approximately 30 m from the road centreline on the predominant upwind (northeast) side of the road; the other four stations were established on the predominant downwind side (southwest) at 30 m, 90 m, 300 m, and 1,000 m from the road centreline. The remaining stations are located at the LLCF (two stations) and the airstrip (three stations).

Fugitive Dust

There are no specific guidelines for fugitive dust deposition in the NT. The 1979 British Columbia Pollution Objective for the Mining, Smelting and Related Industries for total particulate (sum of soluble and insoluble particulate) is 1.7 $mg/dm^2/d$ to 2.9 $mg/dm^2/d$ as a 30-day average. This British Columbia dustfall objective is similar or slightly more stringent than other Canadian jurisdictions.

Between 2009 and 2011, dustfall concentrations were found to be much higher at the Fox Haul Road monitoring stations than at the Misery road (Figure 5.2-9). These results reflect the amount of vehicular activity occurring in these areas over the course of the monitoring period. Similar to previous monitoring years, dustfall monitoring results indicate that fugitive dust levels are elevated immediately adjacent to the road but fall off quickly with distance. At distances greater than 1 km from the roads, deposition rates were similar to reference levels. No significant visual trends were found in dustfall measurement data collected near the airstrip or the LLCF (Figure 5.2-10).

PROJECT # 0648-121-01 ILLUSTRATION # a34705w-EIR June 12, 2012



Note: Double/triple colour symbols may be displayed because each site had three separate Lichen samples analysed.

Source: Enns (2012).

Figure 5.2-7

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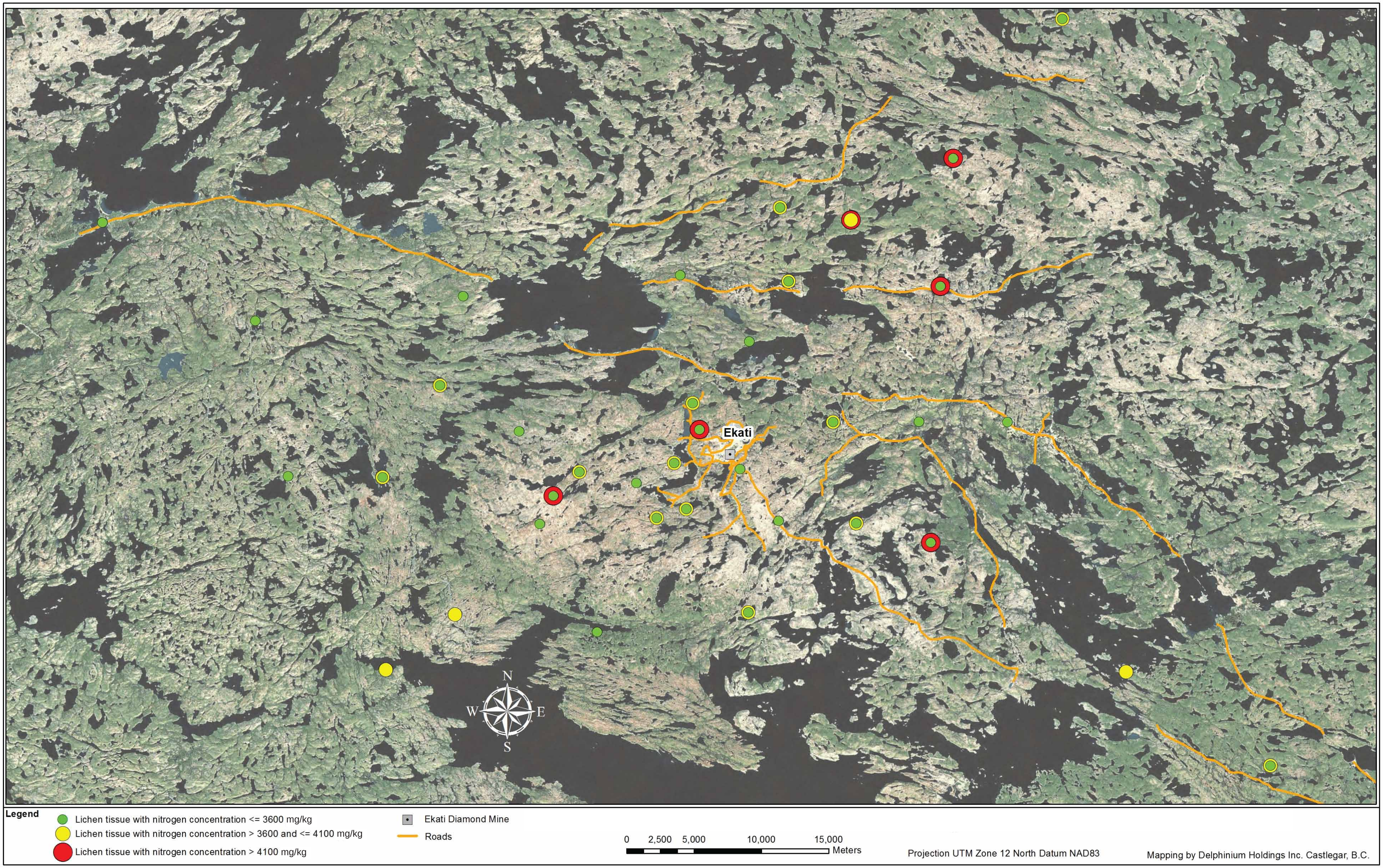
EKATI Diamond Mine Lichen Biomonitoring Stations: Aluminum in *Flavocetraria cucullata* Tissue, 2011

Figure 5.2-7

◎ Table of Contents

PROJECT # 0648-121-01 ILLUSTRATION # a34701w-EIR June 12, 2012



Note: Double/triple colour symbols may be displayed because each site had three separate Lichen samples analysed.

Source: Enns (2012).

Figure 5.2-8

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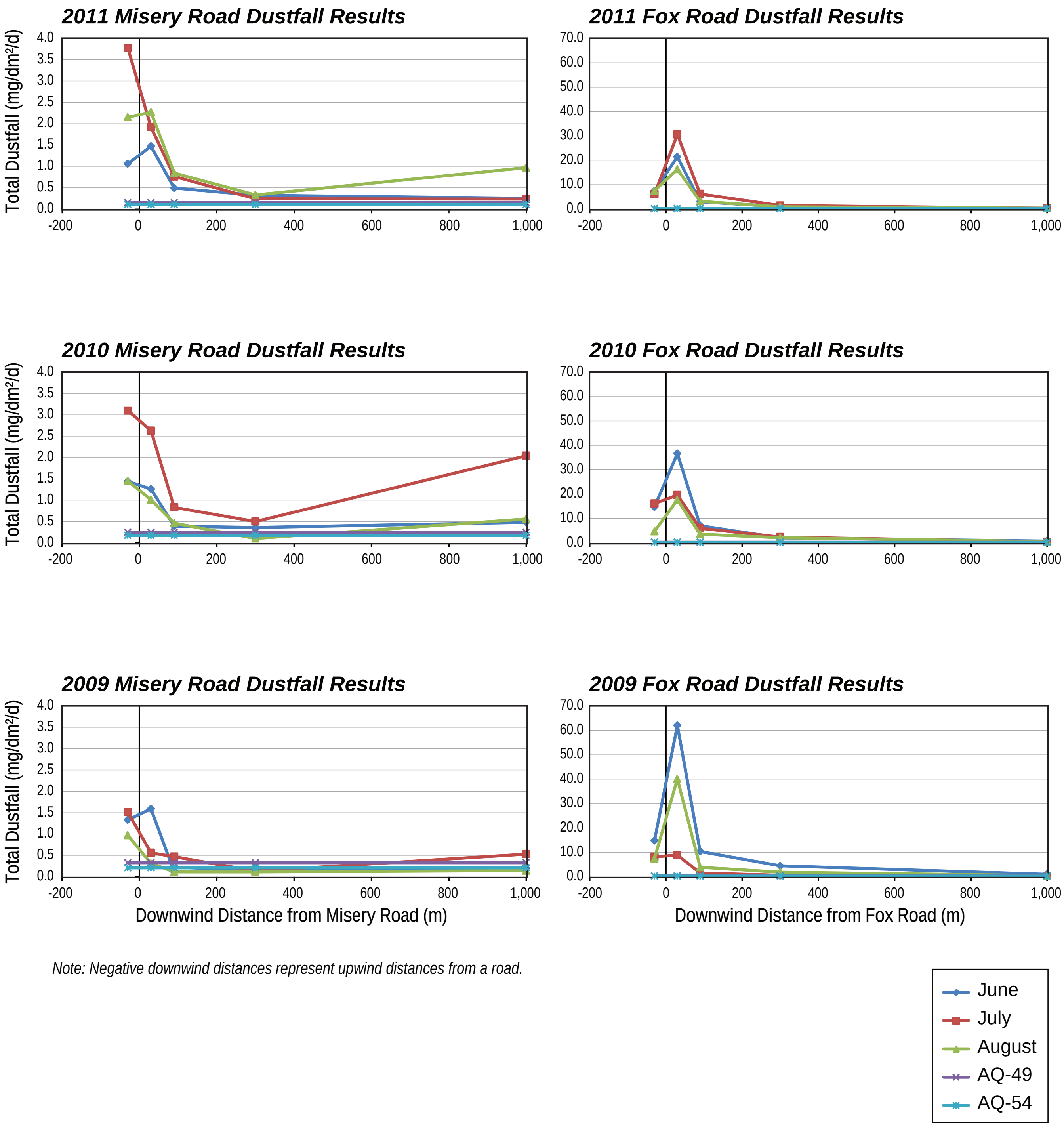
EKATI Diamond Mine Lichen Biomonitoring Stations: Nitrogen in *Flavocetraria cucullata* Tissue, 2011

Figure 5.2-8

PROJECT # 0648-121-01 ILLUSTRATION # a33469n-EIR June 12, 2012



Note: Negative downwind distances represent upwind distances from a road.

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Figure 5.2-9

2009 to 2011 Total Dustfall Measured at Misery and Fox Road Monitoring Stations

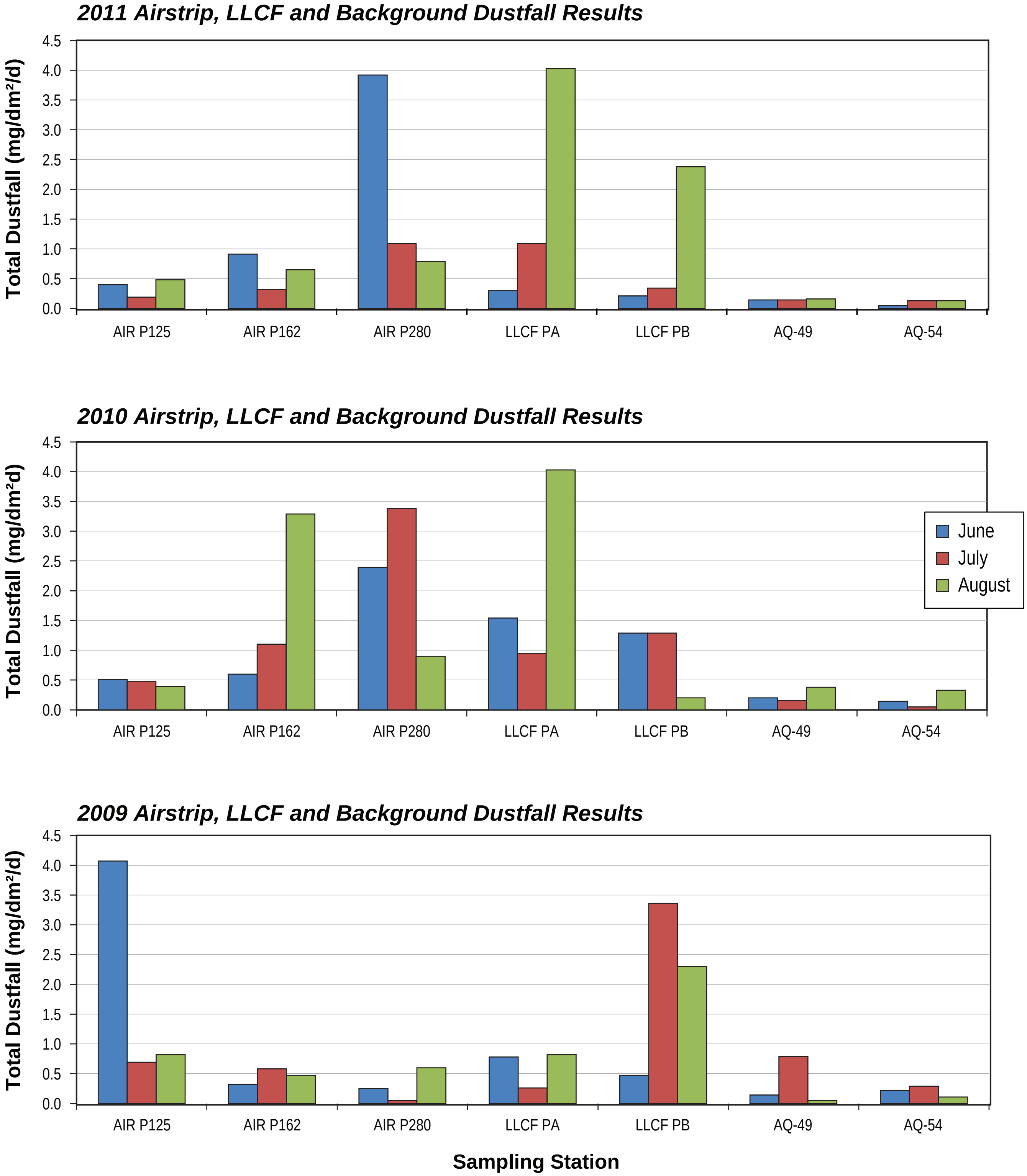

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Figure 5.2-10

2009 to 2011 Total Dustfall Measured at Airstrip, LLCF and Background Monitoring Stations

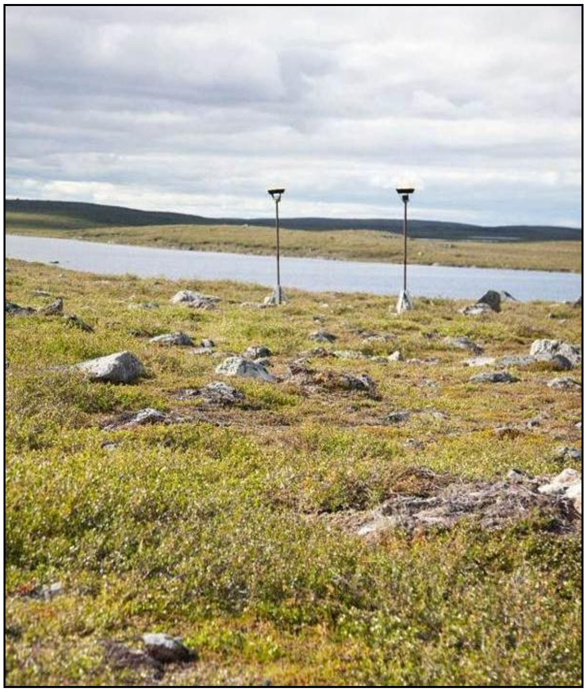

Plate 5.2-2. Dustfall collectors at background site AQ-49, August 2011.

Plate 5.2-3. Close-up view of a dustfall collector during a non-sampling month, May 2011.

Acid and Metal Deposition

Acid deposition is primarily a result of SO_2 and NO_X emissions from industrial facilities. Nitrate and sulphate are of special concern as they are associated with acid deposition, which is known to have harmful effects on terrestrial and aquatic ecosystems. Acid deposition was calculated from averaging the sum of nitrate and sulphate loads collected from the dustfall samples, once converted to units of eq/ha/yr, for three consecutive months (excluding July and August 2009), for each sampling location within the project area. Environment Canada measures deposition in terms of “critical load,” which is defined as the amount of acid deposition a particular region can receive without being adversely affected. Estimates of critical load ranges for acid deposition have been established for both aquatic and terrestrial ecosystems for many areas of Canada. Terrestrial critical loads have yet to be established for the NT or other regions characterized by tundra. However, the range of established critical loads for soil in other Canadian jurisdictions that can be compared to loadings at EKATI provide some context as to the likely effect of the mine on acid deposition (Environment Canada 2004a; Table 5.2-5).

Table 5.2-5. Established Critical Loads for Soil in Canadian Jurisdictions

Province	Median (eq/ha/yr)	Fifth Percentile (eq/ha/yr)
Newfoundland	572	247
Nova Scotia	817	277
Prince Edward Island	2,063	715
New Brunswick	1169	559
Quebec	519	358
Ontario	548	388
Total	559	358

Source: Table 8.4 in Environment Canada (2004a)).

The maximum acid deposition value at EKATI was calculated to be 617 eq/ha/yr, and the median value from all non-background sites was 90.6 eq/ha/yr (based on three months of data). These values are below the established critical soil load for all Canadian provinces. The actual annual loading would likely be well below this prediction, due to neutralizing processes that were not accounted for.

Metal deposition analytical results indicated that many metals have very low sample concentrations or were below analytical detection limits. All metal deposition values were below 0.8 $mg/dm^2/d$. There are no guidelines to compare metal deposition values; however, all metal deposition values at the two background monitoring stations were below 0.03 $mg/dm^2/d$.

Loading rates for nitrate, ammonia, and sulphate from the snow core chemistry in 2011 were also compared with 2008 and 2005 data as a function of distance from the nearest centres of activity (Figure 5.2-6). Limited spatial trends were observed in these elements with distance (up to 50 km) from mining activity (Figure 5.2-6). In general, concentrations of nitrate, ammonia, and sulphate are well below the range of expected background concentrations at all sampling locations (Figure 5.2-6). However, there are exceptions within the results for ammonia and sulphate. The average ammonia loading observed for one sample and duplicate sample was 1.406 $mg/m^2/d$, which was above the expected background loading. For sulphate, expected background levels were exceeded at four sites.

5.3 LONG-TERM PREDICTIONS

5.3.1 Long-term Datasets

Although results of EKATI's air quality long-term monitoring (i.e., HVAS and CAM) have been compared to national standards for the current reporting period the long-term trends are uncertain. As indicated in Section 5.2.1.1 air quality monitoring datasets have some missing data related to equipment malfunction (generally as a result of weather extremes). BHP Billiton has acknowledged these limitations and has made some improvements and will continue to address these issues (see Section 5.4.3).

5.3.2 CALPUFF Air Dispersion Model

A CALPUFF air dispersion modelling study was completed in 2006 and published by Rescan (2006a). Model predictions of ambient SO_2 and NO_2 concentrations showed that NT Ambient Air Quality Standards (Table 5.2-1) and CAAQO (Table 5.2-2) were predicted to be met outside of the active mining area when using the Ozone Limiting Method for estimating the NO to NO_2 conversion rate. The active mining area was defined as any footprint area that is subject to or associated with various mining activities (e.g., active open pits, haul roads, plant site, and PK contaminant areas). Ambient concentrations of SO_2 and NO_2 were predicted to be well below applicable standards outside the EKATI claim block.

Model predictions of 24-hour $PM_{2.5}$ concentrations exceeded NT guidelines of 30 $\mu g/m^3$ within a corridor along the Misery Haul Road and the active mining areas. The corridor was defined in the dispersion model to represent the haul roads between the Main Camp and the Misery site. In addition, model concentrations of 24-hour TSP and annual average TSP exceeded NT guidelines within this corridor. The model predicted that standards for ambient $PM_{2.5}$ and TSP concentrations were met everywhere outside the EKATI claim block.

The model results showed that the potential acid input loads were less than 0.25 keq/ha/yr at a distance of 2.5 km to 3 km from the centre of EKATI mine or effectively within the active mine area. Potential acid input quantifies the theoretical maximum possible acid deposition input rather than the most likely acid deposition input. The GNWT does not currently have critical load standards; however, other Canadian jurisdictions have established critical load limits. A potential acid input load of 0.25 keq/ha/yr is the current standard for highly sensitive soils adopted by the Government of Alberta.

Model predictions for nitrate deposition were not conclusive due to uncertainties associated with chemical reaction rates of NO_X conversion to nitrate. However, model predictions of potential (maximum) nitrate deposition rates show that contributions of mining operations to nitrate deposition are negligible beyond 5 km to 10 km from the mine areas. In addition, snow core chemistry and lichen data do not show a defined decreasing trend of nitrate deposition with increasing distance from mining activities. If the mining activities at EKATI resulted in significant local nitrate deposition, a trend of decreasing nitrate loadings with distance from the mine should have been evident in these analysis results.

The model results showed a steep gradient of TSP deposition close to sources, and the deposition of TSP resulting from mine fugitive dust emissions was indistinguishable from background deposition rates at a distance of 14 km to 20 km from the active mining areas.

The CALPUFF air dispersion model results compared favourably with observed 2011 field data (i.e., snow core chemistry, HVAS, lichen and dustfall). The modelled sulphate deposition contributions from EKATI, Misery, and Diavik Diamond Mines Inc. (Diavik) are of the same magnitude as background levels beyond 3 to 5 km from the active mining areas. However, the 2011 snow core chemistry and lichen data did not show a trend of decreasing sulphate deposition with distance from the active mining areas. This result indicates that sulphate deposition is likely less than the model predictions and is dominated by background deposition where contributions to sulphate deposition from EKATI, the Misery site, and Diavik are negligible.

5.3.3 Development of Pigeon Pit

Deposition of fugitive dust from Pigeon Pit operations, vehicular traffic, and waste rock dumping could result in slight increases in TSS, total aluminum, total nickel and nitrogen in nearby waterbodies. Blasting activities may result in the introduction of nitrogen to nearby waterbodies (e.g., Pigeon Stream) and to pit water. The waterbodies most likely to be affected are Pigeon Stream and Little Reynolds Pond, although other waterbodies within a 1 km to 3 km radius of the dust-generating activities may also be influenced (e.g., Fay Bay; BHP Billiton 2000). Resulting concentrations of these parameters are not expected to exceed federal criteria for the protection of aquatic life, and are not expected to cause a change in the biology of aquatic ecosystems (based on Grizzly Lake monitoring; 1985). The expected effect on water quality from blasting and dust generating activities is negligible.

Construction of surface facilities (field office, truck line up area and fuel storage facility) could result in fugitive dust emissions and intermittent sediment loading to nearby waterbodies; however, the proposed construction area drains towards the LLCF and is therefore not a concern for natural water-bodies in the area.

5.4 ENVIRONMENTAL RISKS AND MANAGEMENT

5.4.1 Particulate Emissions

High ambient concentrations of particulate matter (especially fine particles less than 30 µm) from emissions and fugitive dust could, if not mitigated, have effects on wildlife and vegetation populations (Bell and Treshow 2002). Air quality may be affected by particulate and gaseous emissions from stationary and mobile diesel-powered heavy equipment and fugitive dust, which are all by-products of mining activities. Combustion of fossil fuels releases carbon dioxide (CO_2), methane (CH_4) and nitrous oxide (N_2O), which are GHGs that are associated with global climate change (IPCC 1995). Nitrate and sulphate, related to fugitive dust and snow core sampling, are of special concern as they are associated with acid deposition, which is known to have harmful effects on terrestrial and aquatic ecosystems. These compounds are associated with combustion and blasting at the mine.

The goal of the EKATI AQMP is to provide the monitoring data that the mine needs to track ambient concentrations in order to determine if it is necessary to initiate adaptive management actions that would prevent adverse effects to the environment. BHP Billiton monitors GHG emissions and is continuously seeking ways to make its operations more energy efficient and to reduce emissions. The primary sources of particulate, gaseous emissions and fugitive dust at EKATI are:

- emissions from diesel-fired power generation;
- emissions from diesel fired boilers;
- vehicle traffic, including trucks, aircraft, and other mobile equipment on unpaved roads; and
- mining activities, including blasting, and waste rock and ore handling.

The EKATI AQMP also reports on sulphur dioxide SO_2 and nitrogen oxides NO_x as a result of blasting and combustion. Acid deposition is the end product of reactions between SO_2 and NO_x and water in the atmosphere. The acidity (or pH) of acid deposition is influenced by atmospheric concentrations of sulphur- and nitrogen-derived acids and bases. Atmospheric levels of acids and bases are primarily determined by anthropogenic emissions of SO_2, NO_x, ammonia and base cations (Environment Canada 2004a). EKATI has developed an air quality management plan to minimize air emissions and is currently updating the plan with respect to the current operations. Monitoring results (CAM results, dustfall, snow chemistry) suggest that SO_2 and NO_x are elevated but generally do not exceed relevant guidelines. BHP Billiton continues to minimize the contribution to acid deposition through:

- use of low sulphur diesel fuel; and
- preventative maintenance programs on machinery to ensure optimum operation of all combustion and fugitive emission sources;

Dioxins and furans can enter the aquatic environment as a result of air emissions from waste incinerators (Su and Christensen 1997). Recent work by Environment Canada at EKATI indicated that elevated concentrations of dioxins and furans (polychlorinated dibenzo-p-dioxins and polychlorinated dibenzofuran) were evident in Kodiak Lake sediments when compared to a reference lake (Counts Lake) and pre-operation conditions (A. Wilson et al. 2011). The new incinerator (originally commissioned in 2010 and operational in January 2012) was installed to address air emissions.

Work on the new incinerator was restarted in September 2011 to bring the new incinerator building to working status. Activities included:

- Upgrades to the ventilation system;
- Repairs to the fire suppression system;
- Repairs to ram feeder;
- Installation of backup power supply;
- Installation of fuel supply for generator and burners;
- Modifications to the Induced Draft Fan to ensure negative pressure in the primary chamber; and
- Upgrade to fire alarm system.

The new incinerator began burning waste consistently on January 19, 2012. The Incinerator Management Plan and finalized operational work instructions are to be completed in 2012.

The first several months of operation will be required to fine tune processes and adjust work instructions. At the time of the current report, EKATI was undergoing a waste audit in order to understand its incinerator waste streams. Understanding of the waste streams will allow for consistent feeding and operation of the incinerator producing repeatable results.

Waste generation is being proactively managed to divert plastic waste from the incinerator and to eliminate plastics from coming to site through procurement strategies. During the commissioning of the incinerator it was found that metal cans were interfering with complete combustion of waste, these cans have been diverted from the waste stream and are being cleaned before going to the landfill.

Annual stack testing will be implemented in 2012 to monitor stack emissions and compliance to Canada Wide Standards for dioxins and furans.

5.4.2 Fugitive Dust

Pro-active measures to reduce fugitive dust at EKATI include:

- control of fugitive dust emissions through road watering and the use of approved dust suppressants; and
- speed limits are posted and enforced;

Dust suppression at EKATI is initiated upon visual assessments of the road or airstrip. Monitoring the long-term effectiveness of dust suppression is presented in the AQMP reports (e.g., lichen tissue results). Specific activities related to dust suppression included:

- Water was used as a dust suppressant on the Misery Haul Road throughout the AQMP reporting period and is approved by AANDC for water usage and as a dust suppression method. A water truck was deployed periodically in areas that are prone to generate fugitive dust where DL-10 is not approved, such as some areas around the Main Camp.
- The use of DL-10 is approved for some areas around the Main Camp and the Fox Haul Road. DL-10 is not used in the front of the Main Camp as it has been determined that light vehicles travelling at the speed limit (20 km/hour) do not generate dust. DL-10 is applied in the approved areas around camp and on the Fox Haul Road in June of each year, including June 30, 2009, June 11, 2010, and June 15, 2011. Envirokleen is used as a dust suppressant when required to mitigate the effects of fugitive dust underground and is applied as necessary.
- EK-35 is used on the EKATI air strip in accordance with Boeing regulations to assist in the control of fugitive dust from incoming and outgoing aircraft and associated vehicle traffic. The application of EK-35 on the air strip was completed in June during 2009 and 2010. In 2011, the application of EK-35 was completed in August after resurfacing and maintenance of the airstrip was completed.

Air quality, particularly fugitive dust, also has the potential to affect aquatic environments by increasing the level of contaminants in waterbodies. As part of the 2009 three year AEMP re-evaluation a method was derived to produce an order of magnitude estimate of the contribution of dustfall to the aquatic environment. Using dustfall data from 2006 to 2008, the following analysis were completed (Report 10):

1. Dustfall results were used to develop decay functions with distance from mine infrastructure. Background dustfall results from far-field stations (AQ49 and AQ54) were subtracted so that deposition is only project related. Functions were derived for a number of variables that are included in both the AEMP and dustfall analyses.

2. The area under the curve of the decay functions was mathematically integrated to calculate the total mass of deposition per day per unit length of infrastructure.
3. A spatial layer was developed in GIS outlining the EKATI footprint, including: the LLCF, waste rock dumps, pits, the Main Camp, airstrip, and roads. This layer was clipped with a layer of watershed boundaries to determine the total perimeter of footprint within five watersheds of interest (Vulture, Lower PDC, Moose-Nero, Martine, and Koala). These watershed boundaries were selected to match with existing AEMP sampling locations.
4. The total perimeter length was multiplied by the mass of deposition calculated from integrating the decay function to determine the total dustfall deposition within the watershed of interest.
5. An average concentration was calculated by dividing the total watershed deposition by the annual runoff volume for the watershed (using an average annual runoff depth of 166 mm).

The results indicated that, in general, the equivalent concentration calculated from dustfall is at least three orders of magnitude smaller than the average observed stream concentration. Given the conservative assumptions used in these calculations, the results suggested that any link between dust generation and aquatic effects would be negligible. This analysis will be completed again in 2012 as part of the 2012 AEMP re-evaluation.

The current Dustfall Monitoring Program does not include monitoring dust levels emanating from the Fox and Misery WRSAs. In response to regulator comments, BHP Billiton will implement a program in 2012 to address this potential risk to wildlife, vegetation, and water quality. Three dustfall monitoring stations will be placed at distances of 100 m, 300 m, and 1000 m west of the Fox WRSA. This spread in distance will assist in the determination of the depositional pattern of the fugitive dust, and it is expected to show decreasing dust levels with increasing distance. The placement of the dustfall monitoring stations to the west of the pile was decided upon because the predominant wind direction onsite blows from the east and east-southeast, causing maximum deposition to occur to the west of the piles. The Fox WRSA was chosen because it is currently active and the stations can be placed in locations that are not also influenced by roads and the Main Camp. The results of the dustfall monitoring will be analyzed on an annual basis and presented as part of the 2014 AQMP report.

5.4.3 Ability to Detect Changes in Air Quality

BHP Billiton acknowledged following submission of the 2008 AQMP report that the air sampling program required some review and collaborative work to improve the monitoring program. The improved ability to detect changes in air quality and effects on the environment will allow BHP to better manage air emissions. BHP Billiton continues to seek improvements to dust and air quality controls.

The CAM building was originally installed in April 2007 adjacent to the Grizzly Lake pumping station. However, following consultation with regulatory agencies in 2008, the station was moved to the west side of the mine site, near the Polar Explosives building, to improve the ability of CAM in detecting changes to air quality. Monitoring at this new location was initiated in October 2008. As indicated in Table 5.2-3 there has been a significant portion of time throughout the reporting period in which the CAM instruments were not functioning. Thus BHP Billiton has contracted qualified personnel to address the data capture issues with the CAM building. The data collected at the CAM building are reviewed on a quarterly basis and weekly inspections of the building are completed to ensure that malfunctioning sensors are replaced in a timely manner. BHP Billiton is currently looking into internet connections for the building for more frequent downloads and to complete monthly reviews of the data.

A peer review commissioned by IEMA was conducted on the 2008 AQMP report and resulted in several revisions. There were 32 comments regarding the 2008 AQMP report that were identified by IEMA, of which the majority were addressed and incorporated into a revised 2008 AQMP report finalized in July

2011 (Rescan 2011a). Early reviews of the AQMP also resulted in the implementation of the dustfall monitoring in 2006 as well as improvements to the lichen monitoring.

Additional reviews and technical meetings to address the key concerns of the monitoring program included:

- a technical meeting between BHP Billiton, IEMA, Environment Canada, and GNWT;
- a technical meeting between BHP Billiton's technical consultant, Rescan Environmental Services Ltd., and IEMA's technical consultant, SENES Consultants; and
- GNWT has provided additional technical information regarding snow core sampling.

The snow core sampling program was revised in 2008 based on a review in 2005 in consultation with Environment Canada, GNWT, and IEMA. The revised program defined 33 snow core sampling sites in a generally radial pattern away from the mine site, to measure change with distance from the mine site. Further to this, BHP Billiton conducted a review of snow core sampling methodology, and investigated the possible effects of melting snow samples prior to laboratory analysis in 2010 (Plates 5.4-1 and 5.4-2). This investigation was continued in 2011 and a parallel study was conducted to compare results of snow samples sent to the laboratory in solid (snow) and liquid states. The result of this study was inconclusive, showing no obvious difference in analytical results between samples analyzed from a solid or liquid state. Maintaining a solid state was difficult and samples sent to the laboratory as snow often melted and leaked thereby contaminating the sample. The snow core sampling procedures used at EKATI for the snow core sampling program are the same used by Environment Canada, CAPMoN stations, and the US Environmental Protection Agency.

Plate 5.4-1. Snow core sample being collected with a Mt. Rose snow core sampler.

Plate 5.4-2. Snow core sample about to be weighed.

◎ Table of Contents

BHP Billiton conducted HVAS sampling for TSP throughout the winter for the first time in 2010. Alternative technologies are being investigated to increase the reliability and accuracy of TSP measurements.

An AQMP EKATI Engagement Tour was conducted in May 2011 to educate, demonstrate, and collect any recommendations, ideas or thoughts, and address any concerns from community participants on methods and results of EKATI's air quality program.

5.5 SUMMARY AND CONCLUSIONS

5.5.1 Key Environmental Risks

BHP Billiton has addressed the risk of particulate emissions at EKATI with initiatives to reduce fuel consumption; however, particulates and gaseous emissions produced as a result of mine activities still poses a risk to vegetation performance and wildlife indirectly (Table 5.5-1). Fugitive dust and its potential effects on vegetation, wildlife and water quality also continues to be a concern at EKATI (Table 5.5-1). With the implementation of a revised air monitoring program following regulator review of the 2008 AQMP, previous concerns regarding detecting changes in air quality at EKATI have been addressed and will be continued to be addressed (Table 5.5-1).

Table 5.5-1. Key Environmental Risks for Air

Particulate Emissions
Management • Initiatives and activities to reduce fuel consumption including the use of low sulphur diesel fuel and preventative maintenance programs on machinery to ensure optimum operation of all combustion and fugitive emission sources. • Improvements to the AQMP including moving the CAM building to a more suitable location. • Community engagement tour to address future improvements of the AQMP.
Residual Risk • Particulates and gaseous emissions produced as a result of mine activities (e.g., emissions from diesel-fired power generation) pose a risk to vegetation performance and wildlife indirectly.
Future Actions • Will continue to manage emissions and make further practical reductions to air emissions (e.g., new incinerator). • Commissioning of new incinerator in 2012.
Fugitive Dust
Management • Control of fugitive dust through road watering and the use of approved dust suppressants. • Speed limits are posted and enforced.
Residual Risk • Fugitive dust produced as a result of mine activities poses a risk to vegetation performance and wildlife indirectly. • Fugitive dust has the potential to affect aquatic environments by increasing the level of contaminants in waterbodies. The elevated level of contaminants may impact aquatic assemblages (i.e., concentration is greater than an applicable benchmark value). Following evaluation of the magnitude of the contribution of dustfall to the aquatic environment using results of a decay function, results indicated that the equivalent concentration calculated from dustfall is at least three orders of magnitude smaller than the average concentration observed in EKATI streams.
Future Actions • Following IEMA's suggestions, the contribution of dustfall to the aquatic environment will again be evaluated in the 2012 AEMP re-evaluation. • Dustfall monitoring stations will be placed in the vicinity of the Fox WRSA to assess fugitive dust levels.

(continued)

Table 5.5-1. Key Environmental Risks for Air (completed)

Ability to Detect Changes in Ambient Air Quality
Management • The CAM building was moved to a more suitable location in 2008. • The monitoring program has been peer reviewed and improvements were made including implementation of dustfall monitoring in 2006 and improvements to the lichen monitoring.
Residual Risk • There is a risk that BHP Billiton will be unable to identify changes to ambient air quality because of limitations in the monitoring program.
Future Actions • Improvements to the 2012 and 2013 AQMP program will be made based on recommendations as a result of review of the 2011 AQMP. • Alternative technologies are being investigated to increase the reliability and accuracy of TSP measurements.

5.5.2 Looking Forwards

BHP Billiton is continually striving to ensure that the air quality programs are operating smoothly and to ensure that the environmental impacts on air are not worse than what was originally anticipated for the EKATI mine.

Over the next three years, BHP Billiton will continue to seek improvements to dust and air quality controls. BHP Billiton does not anticipate any changes in the mine plan or camp facilities that would negatively affect air quality. The resumption of mining at the Misery pit would require heavy equipment, blasting, and diesel fuel but this is already included in the mine plan. A new incinerator building is now in operation and it is anticipated that it will reduce emissions (particularly dioxins and furans) from incineration compared to the older models. Annual stack testing will be implemented in 2012 to monitor stack emissions and compliance to Canada Wide Standards for dioxins and furans. Additional dustfall monitors are being placed in the vicinity of the Fox WRSA to determine if WRSAs contribute to a significant source of dustfall in the area. With the results of this additional monitoring, new management strategies may be implemented.

6. Land

6. Land

6.1 SUMMARY OF MONITORING PROGRAMS

There are four VECs within the land category: Permafrost, Physical/Terrestrial Environment, Groundwater, and Archaeology (Heritage Studies). Permafrost was chosen because of the possibility that infrastructure development may cause local disturbances to the permafrost layer resulting in changes in hydrological patterns and soil stability. The Physical/Terrestrial Environment VEC addresses the physical loss of land due to mine development and the reclamation of that land. Groundwater was chosen as a VEC because local thawing of the permafrost layer due to mine activities can result in movement of water and because the Koala and Panda Underground operations are deep enough to interact with the sub-permafrost groundwater aquifer. Archaeology was made a VEC because of its cultural and scientific importance.

6.1.1 Geotechnical Inspections

Dams and dikes have been constructed throughout the life of the mine to control the flow of water into operating pits and underground operations. They are also used to contain sedimentation facilities at the Misery site and at the future Sable Pit site. As part of the annual geotechnical inspection at EKATI, structures (including all dams) are examined and ground temperatures are recorded (Reports 17, 31, and 48). The majority of dams at EKATI are constructed with a frozen core, on permafrost foundations that would be thaw-unstable and/or permeable if they were allowed to thaw. The frozen core is maintained by thermosyphons installed during construction.

6.1.2 Reclamation Projects, Research, and Monitoring Program

The Environmental Agreement requires that closure and reclamation must be undertaken in such a manner to enhance the natural recovery of the areas affected by the EKATI mine operations. In addition the Water Licence requires a set of closure criteria (developed by BHP Billiton) to identify when reclamation at EKATI is complete.

The reclamation goal, closure objectives and closure criteria in the ICRP will be used to define specific performance requirements to be met during progressive reclamation and implementation of the Final Closure Plan (Report 44). Figure 6.1-1 shows the framework of the reclamation goal, closure objectives, and criteria for EKATI.

Progressive reclamation projects are directed towards reclaiming sites no longer required for mine operations. Reclamation projects to date have included exploration camps, exploration drill and adit sites, locations of unplanned releases, slope stabilization at the PDC, and the Airport Esker quarry site. Reclamation research , such as vegetation trials, have been underway since early in the mine life and are continuing to identify the best means of reclaiming disturbed areas in the future. Findings from reclamation projects and research assist in identifying the best methods for future progressive reclamation projects.

Post Closure Monitoring programs and schedules have been tailored to individual projects. Monitoring results indicate if there is a need for future management of the site being reclaimed. If monitoring results indicate a negative change from the expected progression in the reclamation process adaptive management is used to problem solve how performance is improved through corrective action.

PROJECT # 648-121-01 ILLUSTRATION # a37229w June 25, 2012

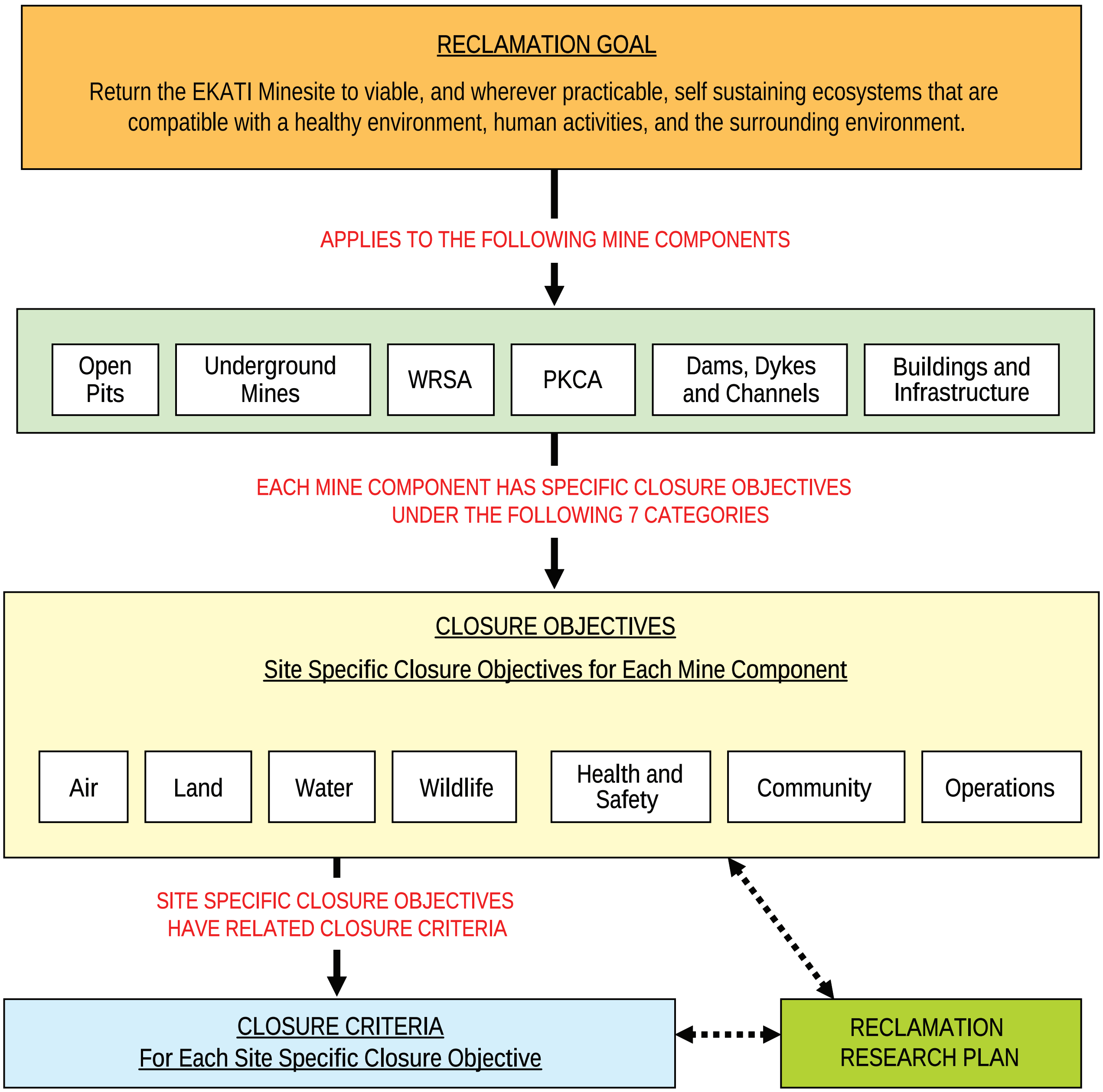

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Figure 6.1-1

ICRP Reclamation Framework

6.1.3 Archaeological Monitoring Program

The Archaeological Monitoring Program was initiated as part of EKATI's commitment to protect archaeological and heritage sites.

At EKATI, an archaeological site is defined as a location that contains physical evidence of past human activity or use. Under this definition, traditional Aboriginal use sites are provided the same level of protection as archaeological sites.

Archaeological assessments or investigations were conducted in the summer 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 or greater 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 during the low and slow helicopter reconnaissance. No new areas requiring survey were disturbed post-2007.

A summary of investigations and results as well as any information regarding site tours are presented in annual reports that were distributed to the Prince of Wales Heritage Museum and the five Aboriginal groups local to EKATI. There is no public distribution of the annual reports to ensure the protection of heritage sites and to comply with the terms and conditions of archaeology permits. However, in 2007 a general non-technical document was produced to summarize the archaeological investigations since the first environmental baseline work in 1994, historical land use of the area, and heritage management practices at EKATI (Rescan 2007).

6.1.4 Community Involvement and Traditional Knowledge

When archaeological investigations are completed, an elders tour of the proposed area of development is conducted. However, between 2009 and 2011, there were no proposed exploration drill sites or land developments outside of a previously investigated area and, therefore, no new surveys or elders tours were undertaken.

Work was initiated on identifying approaches to community participation in planning for reclamation of EKATI. This project will continue through 2012 and beyond.

6.2 PREDICTED AND OBERVED EFFECTS

6.2.1 Permafrost

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 would be local in nature and restricted to the mine footprint. The low relief of the claim block and the implementation of good engineering design and construction practices specific to Arctic areas would mitigate most of the mine effects on permafrost. Hence, the residual effects on permafrost were considered negligible.

Previous editions of the EIR indicated that the construction of the PDC in 1997 resulted in the thawing of ground ice near Grizzly Creek that contributed to erosion of silt into the PDC. However, the silt soon washed down to Kodiak Lake, leaving fish habitat in the PDC largely intact. Mitigation measures were implemented immediately, and the effects were considered negligible. Spring freshet and heavy autumn rains in 2000 caused thawing and erosion of ground along Fred's Channel adjacent to Culvert Camp. Remedial work in 2001 and reclamation activities from 2003 to 2005 stabilized that area.

Although not monitored specifically, additional permafrost disturbance during the 2009 to 2011 monitoring period would be specific to the construction of Pigeon Test Pit and the PSD. Mitigation activities, including the design of PSD and construction activities occurring in the winter, were implemented to address any residual effects to permafrost.

Special design considerations and annual monitoring of the WRSAs to enhance permafrost development within the rock piles is considered a management practice to improve the long term chemical stability of WRSAs that incorporate low-risk but environmentally reactive materials such as the metasediment rock type encountered at the Misery site. Permafrost development in the WRSA is further discussed as a management action for the effects on water quality in WRSA seeps (see Section 7.4.4).

Table 6.2-1 provides a result summary of the 2011 geotechnical inspection (SRK Consulting 2012). Some cooling of the ground temperatures was noted in each of the inspected structures during the 2011 inspection. This is considered due to the cooler winter of 2010/2011. In general, permafrost conditions have been maintained under structures developed for the purpose of mine activities. The constructed dams continue to function because of the stability of the underlying permafrost conditions and the maintenance of a frozen core.

Table 6.2-1. Summary of Results of the 2011 Annual Geotechnical Inspection

Structure	Condition	Action Required
Phase I Pond	Fair	No remedial work is required
Panda Diversion Dam	Good	Core remains cold due to the thermosyphons; no remedial work is required
Long Lake Outlet Dam	Good	Core remains cold due to the thermosyphons installed through the dam in the original creek area; no remedial work is required
Intermediate Dike B	Good	No remedial work is required
King Pond Dam	Good	No remedial work is required
Waste Rock Dam	Good	No remedial work is required
Desperation Pond Cofferdams	Good	No remedial work is required
Bearclaw Diversion Dam	Good	The intake jetty, the diversion pipeline, and the outfall blanket are all functioning as intended. The dam core remains cold due to the thermosyphons, and no settlement or distress has been noted; no remedial work is required
Intermediate Dike C	Good	No remedial work is required

Note: n/a indicates ground temperatures were not measured.
Desperation Pond Cofferdams are not true frozen core dams.

6.2.2 Physical/Terrestrial Environment

6.2.2.1 Land Disturbance and Loss of Vegetation Cover

Several habitat types occur at low proportions relative to the EKATI study area as a whole, but nevertheless may be potentially important to local wildlife (McLoughlin et al. 1999; McLoughlin et al. 2000). These cover types include spruce forest, esker complex, riparian tall shrub, lichen veneer, and sedge wetlands. Lichen veneer and spruce forest are seasonally important to caribou for forage. Riparian tall shrub is important feeding habitat for grizzly bears (McLoughlin et al. 2002), caribou (Griffith et al. 2002), and species of songbirds that require vertical structure in their nesting habitat. Esker complexes provide important denning habitat for grizzly bears, wolves, and foxes. Continuing to monitor changes to these habitat types provides an index of potential impacts to wildlife that may seasonally use these areas to meet some of their life requisites.

The 1995 EIS acknowledged that mining has unavoidable long-term effects on the landscape. However, by keeping the mine footprint as small as practical and by progressively reclaiming the footprint, the effects were assessed as negligible-to-minor during construction, negligible during operations and positive during closure. The total area of terrestrial habitat loss for the EKATI mine was estimated to be 3,170 ha, as described in the *2000 Environmental Assessment Report* for the Sable, Pigeon, and Beartooth Expansion Project.

Early editions of the EIR reported large annual increases in the footprint area as a result of the construction activities and development of new mining areas. However, recent editions (e.g., 2009 EIR) have indicated that there is very little new land disturbance.

In 2009, 41 additional hectares (ha) of habitat were altered by the EKATI development. The construction of the Cell A high road resulted in a loss of 0.96 ha of habitat. In addition, the area between the Cell A high road and the Cell A low road (approximately 40.47 ha) is now considered lost. In 2009 an additional 2.5 ha was disturbed through the construction of the Pigeon Haul Road and the Pigeon Test Pit. As a result of some work around the Pigeon Pad and some work around Misery Pit, 5 ha of habitat were altered by the EKATI development in 2010. In 2011, about 3.5 ha of additional habitat were lost due to mine development.

At the end of 2011, the actual direct habitat loss is estimated to be 3,002 ha. Some of the habitat loss will be mitigated as reclamation activities will be undertaken following mine closure.

6.2.2.2 Land Area Disturbed by Temporary Roadbed

Following the unplanned FPK release in the fall of 2008, land monitoring indicated that the retrieval of FPK from the tundra was completed in a controlled manner by hand and vacuum, thereby reducing the disturbance of the thin, natural organic soil layer. The protection of the organic soil layer has enhanced re-establishment of the natural vegetation cover. To complete some of the initial monitoring and clean-up a temporary road was built for access to Fay Bay. However, removal of the temporary access road to Fay Bay resulted in disturbance within the roadbed exposing granular soil susceptible to erosion. Measures to reduce runoff and sediment transport (including the use of sandbags and jute matting) were completed. In addition, a vegetation performance monitoring program was initiated in 2008 to ensure that the disturbed area was successfully re-vegetated. Monitoring was to be conducted annually for the first five years following the unplanned release and then every other year for the next five years. Follow-up monitoring will then be completed once every five years.

Monitoring of the vegetation performance was completed in 2009, 2010, and 2011. The 2011 monitoring results indicated that the Fay Bay overflow was stable with no evidence of surface erosion. Vegetation continued to recover in all disturbed areas. Reedgrass (*Calamagrostis canadensis*), hairgrass (*Deschampsia ceaspitosa*) and seeded grasses provided the majority of the plant cover along the roadbed, and shrubs continued to recover adjacent to the roadbed.

6.2.3 Groundwater

6.2.3.1 Alteration of Groundwater Flow

The 1995 EIS predicted that with mitigation produced by good engineering practices the residual effects of the groundwater flow regime on the overall hydrological system in general and on mining activities in particular would be negligible.

Prior to 2006 there were some observed effects on shallow groundwater as a result of the Panda Pit development; however, there is no evidence to date suggesting continued impacts to shallow groundwater. Water levels measured at North Panda and Grizzly lakes, both close to Panda Pit, have not shown any changes in water elevation attributable to the Panda Pit development. These lakes are expected to have taliks connecting them to groundwater and particularly to any shallow groundwater.

To date, detailed information on the deep groundwater regime has not been collected as a result of the technical difficulties in obtaining the water. However, EKATI's hydrologic system is measured as part of the EKATI AEMP (see Section 7), and to date there have been no detectable effects on the overall hydrologic system.

6.2.3.2 Alteration of Water Table

The 1995 EIS predicted that, similar to the other predicted effect for groundwater, there would be negligible effects to the water table with mitigation produced by good engineering practices.

As indicated above, there were no observed change to groundwater levels in North Panda and Grizzly lakes (nearest lakes to Panda and Koala pits) during the development of the Panda Pit.

6.2.3.3 Mixing of Groundwater Extracted from Underground Mines with LLCF Water

The effect "Groundwater Mixes with LLCF Water" was not predicted in the 1995 EIS and was introduced in the 2006 EIR. The pumping of naturally occurring groundwater from the underground mine to the LLCF causes a change in the surface water as a result of the naturally elevated chloride (salt), which represents a potential risk to the surface water. A number of adaptive management programs have been implemented by BHP Billiton to prevent this risk from becoming a negative impact. These programs are described in Sections 4.4.4 and 7.4.1 as adaptive management in response to predicted and observed effects associated with water quality in the EKATI receiving environment.

6.2.4 Archaeology (Heritage Studies)

The 1995 EIS predicted that with care taken to avoid archaeological site disturbance, there would be minor effects associated with the disturbance of archaeological sites. The effect was considered minor because there would be a relatively small area of the mine footprint compared to the area of the disturbed claim block. In addition, mitigation efforts through annual archaeological surveys and the salvage of threatened sites would reduce the effects. Early in the planning of EKATI, BHP Billiton shifted significant infrastructure such as the Misery Road away from areas with known concentrations of archaeological sites.

Previous editions of the EIR indicated that for effects predicted under the archaeology VEC (disturbing archaeological sites), a rating of negligible to minor residual archaeological significance was assessed. The only reason for the inclusion of the descriptor "minor" was the fact that some archaeological sites were disturbed during early exploration activities before the mine was built. This is a permanent disturbance that was known during writing of the 1995 EIS.

As of 2008, 200 archaeological sites had been recorded and a number of traditional sites had been documented. Within the EKATI claim block, most archaeological sites are lithic scatters including stone tools or flakes from stone tools that were discarded during manufacture. Other sites include isolated finds (usually a tool or a flake) and habitation sites with features such as hearths or tent rings (a circular arrangement of rocks used to hold down tents).

Between 2009 and 2011 there were no proposed exploration drill sites or land developments outside of a previously investigated area and, therefore, no new surveys were undertaken. This effect was therefore not assessed for this edition of the EIR.

6.3 LONG-TERM PREDICTIONS

6.3.1 Proposed Development

EKATI is now in the late stages of development; however, there are proposed activities that have the potential for effects on land VECs.

There is some potential for permafrost to be affected during all phases of the proposed development as a result of activities such as construction of the PSD, as well as development of Pigeon Pit and its waste rock deposition.

Vegetation will be affected during all stages of the proposed development of Pigeon Pit, PSD, Cell C west road and during the Misery Pit “push-back” project, either as loss of existing vegetation due to excavation and burial, or degradation of vegetation due to different levels and kinds of disturbance.

As discussed in Section 6.4 and outlined in the Sable, Pigeon, and Beartooth environmental assessment (BHP and Dia Met 2000), mitigation to reduce potential impacts will be implemented where appropriate. For example, land-use planning objectives at EKATI are to minimize disturbance and maintain pristine tundra to the edge of the development. Any encroachment outside of existing development areas is strictly controlled, and vehicles must remain on roadways.

6.3.2 Reclamation Projects, Research, and Monitoring Program

The 2011 approved ICRP includes reclamation research and engineering studies to address uncertainties in the closure planning (Report 44). The reclamation research investigates, interprets, and develops how reclamation will be completed. Research needs evolve through the operations, and reclamation phases, with a significant portion of research effort put forward in the operations phase prior to submittal of EKATI’s Final Closure and Reclamation Plan. Research plans also change with the direction of the life of mine planning, and when there are changes in how mine components will be closed. The Reclamation Research Plan for EKATI is a comprehensive document which assists in answering the question of how to reclaim mine components and define closure criteria. TK, which is given consideration alongside western science, is also included in reclamation research. Specific focus at this stage of research is given to working with communities to identify the process of how TK can be incorporated into the research plans and research activities.

A schedule of reclamation research and proposed reclamation activities is provided in the 2011 ICRP (Report 44). Some research was initiated or was ongoing in 2011, such as the investigation of pit lake water quality, management of EFPK, closure objectives, and criteria for wildlife as well as incorporation of TK in reclamation research.

Results from the previous year’s research and planned reclamation projects for the upcoming year are reported in the Environmental Agreement and Water Licence Annual Report (e.g., Report 25). An annual dedicated report on re-vegetation research and projects is also provided to stakeholders. Commencing in 2012, BHP Billiton is required by the WLWB to deliver an Annual Interim Closure Plan Progress Report at the end of each calendar year. The report will include the following:

- Community Engagement
- Reclamation Research Update
- Proposed Changes to Reclamation Design Concepts
- Progressive Reclamation Work Completed

- Schedule of Closure Activities
- Record of Revisions to Be Made in Version 3.0 of the ICRP.

6.4 ENVIRONMENTAL RISKS AND MANAGEMENT

6.4.1 Permafrost Exposure

Permafrost is continuous throughout the EKATI area except under larger lakes and rivers. Exposure of permafrost has several environmental risks related to changes in hydrological patterns and soil stability. Several mitigation activities have been used at EKATI to address effects to the environment, where permafrost will be exposed as a result of mining activities:

- annual geotechnical inspections of mine structures of dams and dikes;
- engineering design and construction supervision of engineered structures in permafrost (e.g., PSD);
- winter construction and soil excavation in permafrost areas where lakes and streams are potentially affected by sedimentation (dams, dikes, culverts, and bridges);
- preferentially dewatering lakes during winter;
- exploratory drilling on land and in lakes and temporary road construction for exploration, preferentially during winter months;
- capping of exposed permafrost to reduce thermal degradation and erosion (e.g., Fred's Channel); and
- assessment of ground temperatures (e.g., thermistors) prior to placement of mine water in Beartooth Pit and commencement of the Misery Pit "push-back" project.

The results of these activities often relates to a significant reduction of sedimentation in lakes and streams during and after construction as well as reduced erosion potential of stream beds and lake shores from dewatering projects. In addition, mobilization during the winter has led to reductions in the likelihood of contaminants entering groundwater of waterbodies. The development of Pigeon Pit and construction activities associated with the PSD will use practices to minimize disturbance to permafrost (e.g., over-excavation and backfilling of thaw stable material for the PSD).

6.4.2 Groundwater Quality and Quantity

Mitigation activities to address the effects on groundwater at EKATI have focused on controlling chloride loads to the LLCF and the potential risk of chloride to aquatic biology in the downstream receiving environment. Modelling assessment of predicted LLCF water quality was based on data from field sampling programs that included assessments of water volumes and contaminant loadings originating from the underground developments. As described in Section 7.4.1 of this document, the use of Beartooth Pit for mine water storage until is the primary management option for chloride concentrations in LLCF water. In addition, a site-specific water quality objective for chloride was developed using original research and was recently published (Elphick et al. 2011).

After closure, naturally elevated chloride concentrations in sub-permafrost groundwater could interact with and affect surface water quality in those pit lakes that extend below permafrost. This risk is addressed through predictive water quality modelling that is being undertaken as part of the ICRP.

6.4.3 The Physical or Terrestrial Environment

Changes in the physical and terrestrial environment as a result of mine development may lead to loss of habitat and displacement of wildlife. As part of the WEMP, BHP Billiton has monitored the amount of direct habitat loss accrued due to the development and production phases of EKATI annually since 1998.

With peak of surface mining activity occurring during the previous edition of the EIR, the rate of future land disturbance is expected to be minimal. In addition, some of the habitat loss at EKATI will be mitigated prior to mine closure as progressive reclamation activities are ongoing and the remaining areas will be reclaimed following mine closure.

To manage land disturbance, BHP Billiton has the following processes in place:

- Land disturbance procedures, which require approval of the EKATI Environment Department prior to any new land disturbance;
- Design and location of mine infrastructure to minimize footprint expansion;
- Stabilizing disturbed sites no longer part of the operations, through progressive reclamation; and
- Focused reclamation research planning to ensure that reclamation activities identified for mine closure will serve their purpose.

Re-vegetation work projects focus toward enhancing natural recover by using native plants, and creating sites where colonization will occur. Plant species and communities research have been completed for establishment of upland and riparian communities similar to the local tundra that will be self-sustainable in the long term. Other re-vegetation research has focused on determining the most appropriate closure objectives and criteria to be used at final closure to prove that re-vegetation activities have been successful. Specific areas of research associated with terrestrial reclamation during the 2009 to 2011 reporting period included the following:

- Assessment of on-going reclamation projects;
- Fay Bay vegetation stabilization;
- Research at the Rock Pad Reclamation Study;
- Developing seed collection, storage and propagation methods; and
- Identification of reference sites to compare reclamation efforts.

Progressive reclamation projects aimed toward reducing disturbance caused by mining operations between the 2009 and 2011 reporting period focused on the following areas:

- Fay Bay vegetation stabilization;
- Assessment of re-vegetation sites including the Tercon Laydown, Paul Lake Bridge Laydown, Culvert Camp (Airport Esker), and Fred’s Channel (Airport Esker);
- Panda open pit and underground mine reclamation; and
- Stabilization of stockpiled topsoils.

One of the key findings arising from the reclamation research and progressive reclamation projects are that potential plant growth materials, such as topsoil, glacial till and lake sediment are available for reclamation at EKATI, the supply, however, is limited. These materials could be applied as topdressing to encourage colonization and surface stabilization of potential erosion sites on camp and laydown pads. Locations of topsoil and lake sediments stockpiles are shown in Figures 5.4-6, 5.4-11 and 5.4-13 in the 2011 ICRP (Rescan 2011c). Other key findings from the research and progressive reclamation projects are summarized below.

Soil analysis has indicated that lake sediments and esker material have low organic content, low moisture holding capacity and low cation exchange capacity, and would be the main factors responsible for poor plant growth if this material was used for reclamation. The high fines content of lake sediment is also a physical limitation for plant establishment. The surface of lake sediment (and glacial till) deposits tends to be hard and dry, impairing moisture penetration and providing few microsites for seed to gain a foothold. The addition of fertilizer would assist plant establishment. Chemical characterization of lake sediment and glacial till has not identified any concern with respect to plant toxicity. Organic soil, the top approximate 1 m of soil horizon, made up of organics and decomposing materials is not as developed as soils further south in latitudes. However, this is the most favourable (physical and chemical properties) growth local to the EKATI mine site.

Research at EKATI has also indicated that plant development and sustainability is enhanced by recontouring disturbed sites to create microsites. This is achieved by deep ripping the soil surface, introduction of large rocks and boulders, and/or planting a nurse crop of grasses. Sites that recontouring is completed include areas where seeds will collect, seedlings are protected from wind scouring, and where moisture (snow) will accumulate. Where salvage topsoil has been stockpiled the best plant covers have been created where piles are free-dumped, and not spread out on a flat surface.

Native plant seeds collected from the EKATI area have successfully been grown as seedlings in a nursery and planted at EKATI in reclamation sites. Species establishing from rootstocks include *Betula glandulosa* (dwarf birch), *Calamagrostis canadensis* (bluejoint), *Cerastium arvense* (chickweed), *Epilobi*um spp. (fireweed), *Ledum decumbens* (Labrador tea) and *Vaccinium uliginosum* (bilberry).

Early efforts to identify potential upland species candidates and collection sites in the EKATI claim block found few species in sufficient quantity for seed availability for revegetation. Native plant species potentially useful for revegetation of various upland site types with coarser substrate (other than lake sediments), included *Epilobium angustifolium* (fireweed), *E. latifolium* (river beauty), and the legumes *Astragalus alpinus* (alpine milkvetch), *Hedysarum mackenzii*, (liquorice root), *Oxytropis deflexa* (deflexed oxytrope) and *O. Maydelliana* (Maydell's oxytrope). Two plant groups: legumes and *Epilobium* (fireweed and river beauty) are the most favourable for early establishment at disturbed sites. Legumes have a symbiotic relationship with nitrogen-fixing bacteria allowing them to live in nutrient poor soils, and *Epilobium* are prolific seed producers, adapted to disturbed soils. In addition, they do not suffer from grazing pressure, and their high biomass helps increase soil organic matter.

Other tundra colonizers *Betula glandulosa* (dwarf birch) and *Salix planifolia* (Diamond willow) and mosses (e.g., *Ceratodon* and *Polytrichum* spp.) have also been identified as species that are among the first to colonize many of the disturbed upland sites at EKATI, and thereby enhance site conditions for colonization by other native species. Of note, is that dwarf birch is also regarded as a climax species in a number of the ecological plant communities identified at EKATI in 1995 (Heath Mat Tundra, Heath-Lichen Tundra, Birch Hummock, and Birch Seep).

Grazing by caribou and Arctic hare significantly affects establishment and early growth of plants, especially native forbs, and fencing is usually required to protect vegetation research sites. However, type of stock (live versus dormant) and season of planting (fall dormant versus spring dormant) apparently have no effect on seedling survival after the second growing season.

Seed scarification of legume species, including *Oxytropis deflexa, O. Maydelliana and O. hudsonica* and *Hedysarum Mackenzii* (native legumes at EKATI) is the key to successful establishment of these species by direct seeding.

Transplanted tundra sod, harvested from areas in the EKATI claim block have shown some success in providing islands of native species that area able to colonize local disturbance sites. Plants species usually included in tundra sods include: *Silene acaulis* (moss campion), *Empetrum nigrum* (crowberry) and upland tundra shrubs, the sod of latter consisting primarily of *Ledum decumbens* (Labrador tea), *Vaccinium uliginosum* (bilberry), *Vaccinium vitis idea* (mountain cranberry) and *Arctostaphylos alpina/rubra* (bearberry).

Vegetation can be successfully established and plant cover maintained when planted directly into processed kimberlite. The presence of a diverse soil microflora and nodulation of legume roots growing in processed kimberlite are positive indicators of soil development, and important factors in the development of a self-sustaining plant cover. The concentration of soil salts remain at moderate levels (Electrical Conductivity (EC) = 4.5 dS/m 6.3 dS/m), without an apparent affect on growth of native grass cultivars or the natural colonization of dwarf birch. Salts in PK are drawn upwards through evaporation and accumulate in the near surface layers. Since seedlings in general are more sensitive to elevated salt concentrations, vegetation of the LLCF surface should not be delayed longer than necessary to achieve acceptable consolidation, to minimize the accumulation of salts in the near surface layer. Native-grass cultivars have rooted to a maximum depth of 90 cm in the PK, where soil moisture was readily available. Root density was greatest in the upper 25 cm.

6.4.4 Disturbance of Archaeology Sites

Archaeological sites are assessed in the summer prior to any new exploration or development. When archaeological sites are identified, the likelihood of impacts is assessed and suitable mitigation measures are recommended if site avoidance is not possible. Data recovery is the most common form of mitigation at EKATI. This may involve subsurface excavation and/or systematic surface collection depending on the nature of the archaeological deposits. Data recovery provides important archaeological information and ensures that representative samples of cultural material are conserved.

Practices for protecting archaeological resources include monitoring, mitigation, emergency response, and employee orientation. Archaeological investigations are conducted early in the planning stages of all proposed land-based exploration drilling and development to ensure that established archaeological sites are avoided when possible. For example, there have been occasions where drill sites have been moved to avoid disturbing archaeological or heritage resources.

No new proposed drill sites or land development is currently planned in areas that have not already been assessed.

6.5 SUMMARY AND CONCLUSIONS

6.5.1 Key Environmental Risks

The risks to land during the 2009 to 2011 reporting period were manageable under the current management plans (Table 6.5-1). No substantive new land disturbance was completed and reclamation research studies indicated positive performance.

Table 6.5-1. Key Environmental Risks for Land

Permafrost Exposure
Management • Annual geotechnical inspections of mine structures of dams and dikes. • Engineering design and construction supervision of engineered structures in permafrost (e.g., PSD). • Winter construction and soil excavation in permafrost areas where lakes and streams are potentially affected by sedimentation (dams, dikes, culverts, and bridges). • Preferentially dewatering lakes during winter. • Exploratory drilling on land and in lakes and temporary road construction for exploration, preferentially during winter months. • Capping of exposed permafrost to reduce thermal degradation and erosion (e.g., Fred's Channel). • Assessment of ground temperatures (e.g., thermistors) prior to placement of mine water in Beartooth Pit and commencement of the Misery Pit "push-back" project.
Residual Risk • Exposure of permafrost can result from mine activities such as development of pits. If permafrost degrades or does not develop it could lead to several environmental risks including changes in hydrological patterns and soil stability. At EKATI the risk of permafrost exposure is managed; however, there remains a risk of localized permafrost degradation that can affect mine infrastructure.
Future Actions • Maintain current management practices. • The development of Pigeon Pit and construction activities associated with the PSD will use practices to minimize disturbance to permafrost (e.g., over excavation and backfilling of thaw stable material for the PSD).
Groundwater Quality and Quantity
Management • Utilization of Beartooth pit for mine water storage until mine water can be managed through the LLCF. • A site-specific water quality objective for chloride was developed for EKATI. • Modelling assessment on predicted LLCF water quality.
Residual Risk • Increased concentrations of chloride related to underground water can have negative impacts on aquatic biology in downstream receiving environments. There is a risk that underground water quality and quantity (with associated chloride loads) will require additional management to what is currently being completed for the LLCF and of the pit lake water quality at mine closure. • Mine development affects the regional groundwater flow pattern.
Future Actions • BHP Billiton will continue to use Beartooth Pit for mine water storage through the mine life. • Predictive water quality modelling is being undertaken as part of the ICRP to address regional groundwater behaviour during pit flooding during the closure phase. This research will assist BHP Billiton's management plans for pit lake water at mine closure and improve the current understanding of groundwater.
The Physical or Terrestrial Environment
Management • Land disturbance procedures in place that require approval of the EKATI Environment Department prior to any new land disturbance. • Design and locate mine infrastructure to minimize footprint expansion. • Stabilizing disturbed sites no longer part of the operations, through progressive reclamation. • Focused reclamation research planning to ensure that reclamation activities identified for mine closure will serve their purpose.

(continued)

Table 6.5-1. Key Environmental Risks for Land (completed)

The Physical or Terrestrial Environment *(cont'd)*
Residual Risk • Mining related changes in the physical/terrestrial environment results in a loss of habitat and displacement of wildlife. • Disturbed areas are not adequately reclaimed.
Future Actions • Undertake focus reclamation research to reduce risks at mine closure. • Best practices, lessons learned and mitigation measures will be implemented to minimize land disturbance and vegetation loss during the Misery Pit "push-back" project and development of Pigeon Pit and the associated WRSA.
Disturbance of Archaeology Sites
Management • Exploration drill sites or land development are preceded by summer investigations for archaeological sites or heritage sites to ensure disturbance is avoided or mitigated. • When archaeological sites are identified, the likelihood of impacts as a result of mine activities is assessed and suitable mitigation measures are recommended if site avoidance is not possible. • A chance find procedure is initiated when archaeological sites are found. • Land disturbance procedures are in place that requires approval of the EKATI Environment Department prior to any new land disturbance.
Residual Risk • Despite archaeological investigations prior to land disturbance, there remains a risk of impacting archaeological sites when ground is disturbed.
Future Actions • No new proposed drill sites or land development is currently planned in areas that have not already been assessed.

6.5.2 Looking Forward

Open pit mining at Misery Pit is expected to resume over the next three years in which case the continued development of the Misery WRSA will be assessed. In addition, the development of Pigeon Pit and the associated WRSA will add to the land disturbance and vegetation loss. However, best practices, lessons learned, and mitigation measures will be implemented to address risks to the physical or terrestrial environment. Reclamation projects will continue over the next three years and reclamation research activities will continue or be initiated as outlined in the EKATI 2011 ICRP.

7. Water

7. Water

7.1 SUMMARY OF MONITORING PROGRAMS

Three water VECs are considered: Surface Hydrology, Water Quality and Aquatic Life Other than Fish, and Fish. Surface Hydrology is a VEC because almost half the surface area of the EKATI claim block is covered by water. This means that changes to surface hydrology may affect water quality, aquatic habitat, and fish populations. Water Quality is a VEC because aquatic life, defined as any plants or animals which live at least part of their life cycle in water, rely on standards of water quality. In addition, downstream human communities depend on a high standard of water quality. Aquatic Life Other than Fish is a component of this VEC because the distribution, abundance, and productivity of the invertebrates that make up a large proportion of the prey of fish are driven to a large degree by variation in water quality. Fish are a VEC because they are a subsistence food, a source of recreation for local communities, and because they have historical cultural value. In addition fish are 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 mammals. The "No Net Loss" policy of the Canadian government plays a large role in regulation of EKATI activities in relation to fish resources.

7.1.1 Surface Hydrology

7.1.1.1 Stream Flow in EKATI Streams

As part of the AEMP, continuous stream flow is measured over the ice-free season with a pressure transducer linked to a datalogger (Reports 13, 32, and 56). From 2009 to 2011, stream flow monitoring was undertaken annually at three streams within the Koala Watershed (Vulture-Polar Stream, Lower PDC, and Slipper-Lac de Gras Stream), one stream within the King-Cujo Watershed (Cujo Outflow), and one reference watershed (Counts Outflow; Table 7.1-1; Figure 7.1-1). The transducers are calibrated by manual stream flow measurements completed four to five times each year.

7.1.1.2 Stream Flow in the Panda Diversion Channel

As part of the PDC Monitoring Program at EKATI, stream flow monitoring was conducted at three locations: Lower PDC, Polar-Vulture, and Pigeon streams (Figure 7.1-2). Methods are the same as those completed for the AEMP stream flow monitoring.

7.1.2 Water Quality and Aquatic Life Other than Fish

7.1.2.1 Aquatic Effects Monitoring Program

EKATI's AEMP is a requirement specified in BHP Billiton's Class A Water Licence (W2009L2-0001; Reports 13, 32, and 56). The AEMP is designed to detect changes in the aquatic ecosystem that may be caused by mine activities. There are three other components to the aquatic monitoring at EKATI, including the SNP, special effects studies and monitoring programs, and environmental baseline studies. Data from two SNP sampling stations located at the two effluent discharge locations are also incorporated into the AEMP for comparative purposes: 1616-30 in the LLCF and 1616-43 in the KPSF.

Special effects studies are carried out on as-needed basis to answer questions raised by the results of AEMP monitoring that require further investigation or to focus on specific issues by providing additional information not collected in the AEMP (e.g., Fay Bay Monitoring Program).

Table 7.1-1. AEMP Hydrometric Stations, 1994 to 2011

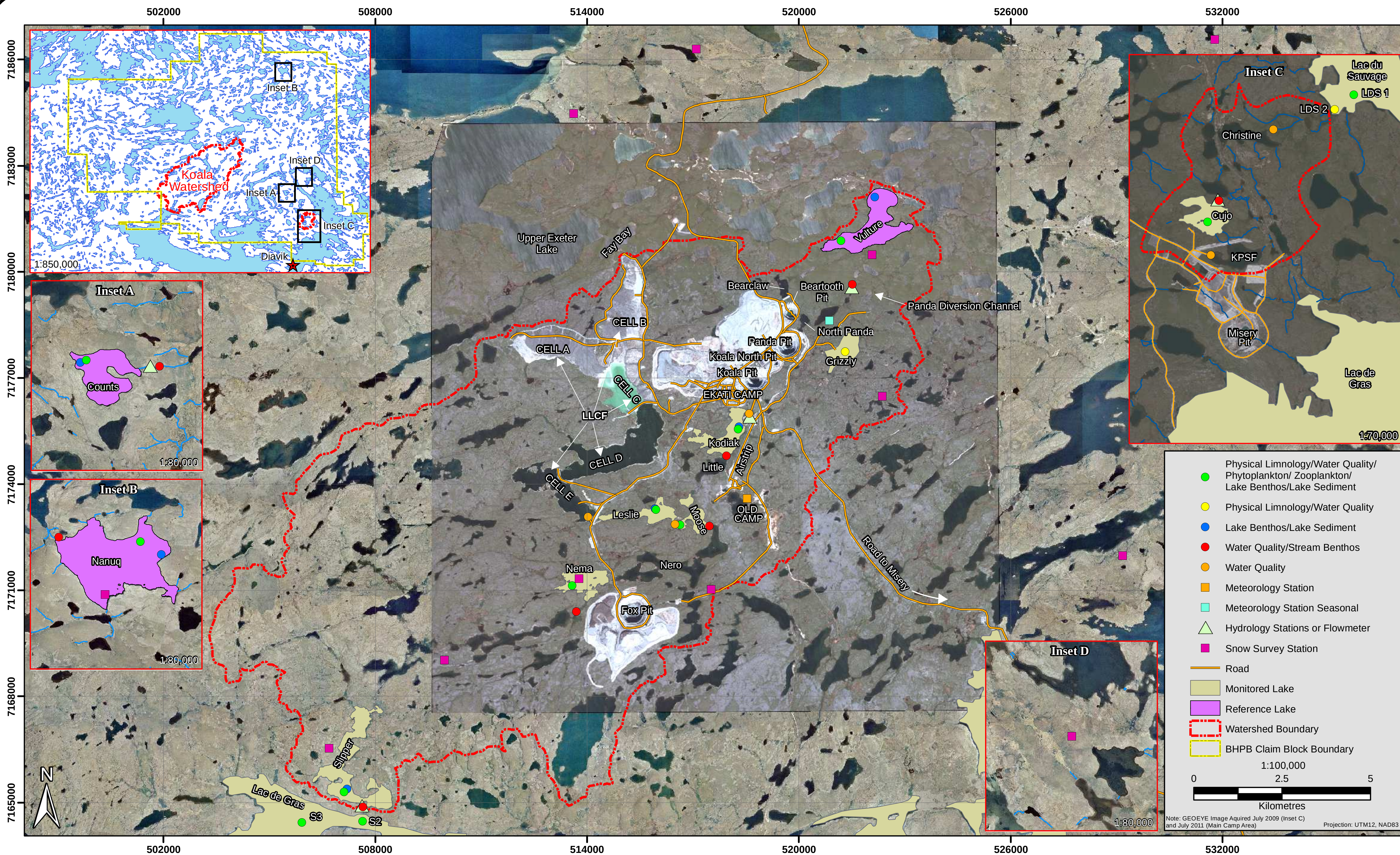
Station Number	WGS-14	WGS-39	WGS-24	WGL-46	WGS-35
Location	Vulture-Polar	Lower PDC	Slipper-Lac de Gras	Cujo Outflow	Counts Outflow
Northing (m)	7179565	7175900	7164913	7162100	7169713
Easting (m)	521484	518600	507616	539000	535280
Drainage Area (km^2)	7.17	21.3	185	2.9	4.25
1994			X		
1995			X		
1996			X		
1997	X		X		X
1998	X		X		X
1999	X	X	X	X	X
2000	X	X	X	X	X
2001	X	X	X	X	X
2002	X	X	X	X	X
2003	X	X	X	X	X
2004	X	X	X	X	X
2005	X	X	X	X	X
2006	X	X	X	X	X
2007	X	X	X	X	X
2008	X	X	X	X	X
2009	X	X	X	X	X
2010	X	X	X	X	X
2011	X	X	X	X	X

<u>Monitoring Components and Locations</u>

In the Koala Watershed, the AEMP monitors waters downstream of the LLCF, including Leslie Lake, Leslie-Moose Stream, Moose Lake, Moose-Nero Stream, Nema Lake, Nema Martine Stream, Slipper Lake, Slipper-Lac de Gras Stream, and two lake monitoring sites in Lac de Gras (S2 and S3; Figure 7.1-1). Within the King-Cujo Watershed, the AEMP monitors water downstream of the KPSF including Cujo Lake, Cujo Outflow Stream, Christine-Lac du Sauvage Stream, and two monitoring sites in Lac du Sauvage (LdS1 and LdS2; Figure 7.1-1). Monitoring is also conducted in Kodiak Lake, Kodiak-Little Stream, Lower PDC, and Grizzly Lake which are in close proximity to the mine (Figure 7.1-1). In addition, reference lakes and outflows are monitored including Vulture Lake and Vulture-Polar Stream (an internal reference located upstream of the LLCF and within the Koala Watershed), Nanuq Lake and Nanuq outflow (located approximately 26 km from the nearest possible mine influence) and Counts Lake and Counts outflow (located southeast of the Main Camp, approximately 5 km from the closest reach of Misery Road; Figure 7.1-1).

The following components of the aquatic ecosystem are monitored each year:

- hydrology (October to September);
- under-ice physical limnology (April/May);
- open water season physical limnology (August);
- ice-covered season lake water quality (April/May);



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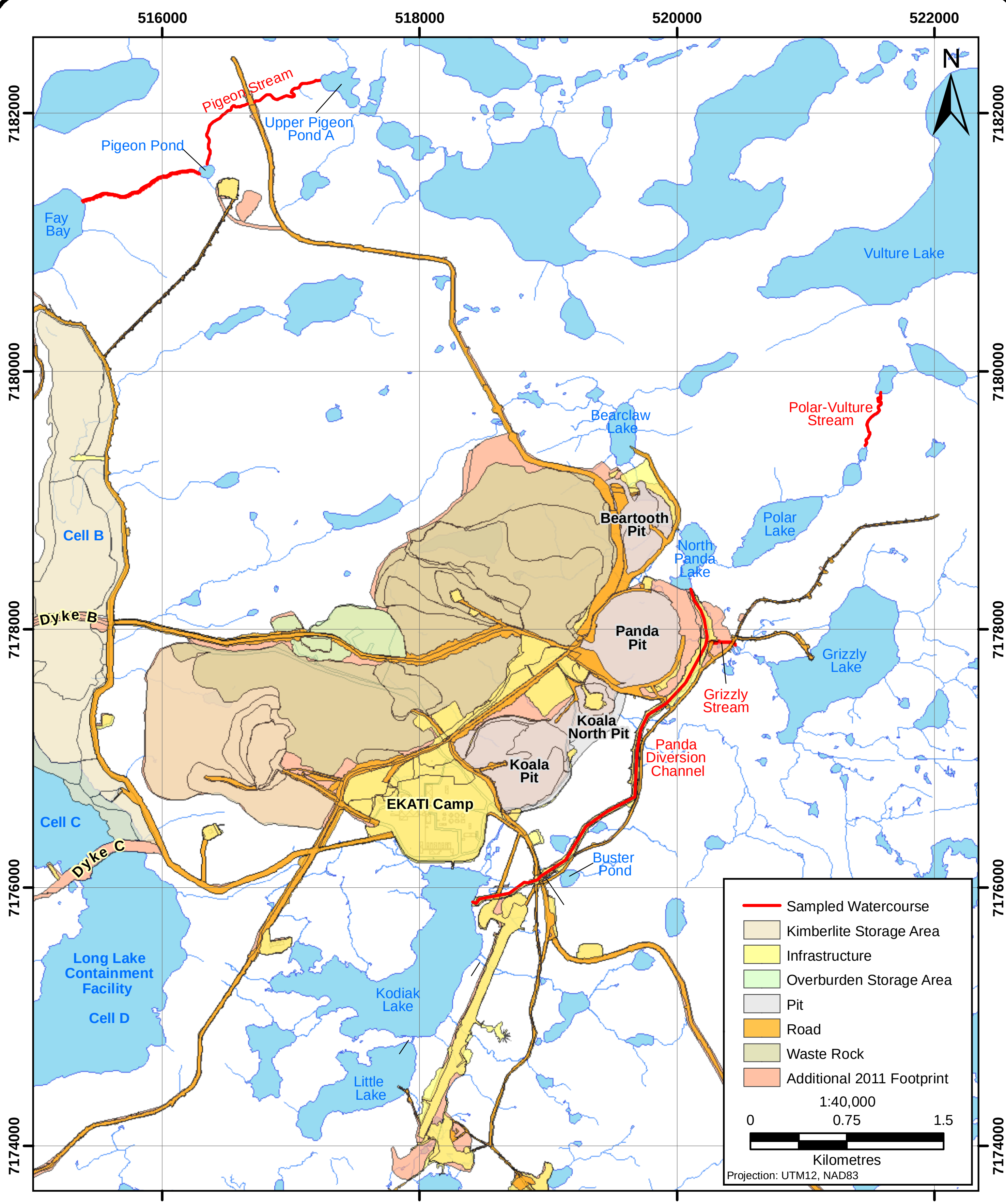
AEMP Lake and Stream Sampling Locations

FIGURE 7.1-1

Table of Contents

gis no.EKA-06-120 Job No. 648-121-01 September 05, 2012



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Panda Diversion Channel Monitoring Locations

FIGURE 7.1-2

- open water season lake water quality (August);
- open water season stream water quality (June to September);
- phytoplankton (August);
- zooplankton (August);
- lake benthos (August); and
- stream benthos (August 1 to September 1).

Sediment quality is assessed every three years at EKATI and was conducted in August 2011.

Meteorological data are collected year round at EKATI. Meteorological data collected between October 2010 and September 2011 are reported in the AEMP because they are directly related to hydrology at the site (see Section 3.1 of AEMP Part 2 - Data Report).

Evaluation of Effects

The variables of interest evaluated for the most recent AEMP (i.e., 2011) were those identified in the AEMP re-evaluation and the AEMP plan for 2010 to 2012 (Report 10). Evaluated variables are presented in Table 7.1-2.

Evaluation of the AEMP results relies on a hierarchy of steps (Figure 7.1-3). First, data were collected based on the AEMP plan for 2010 to 2012. The methods and results of the 2011 AEMP sampling program are reported in Part 2 - Data Report of the *2011 AEMP Report*. Data were then evaluated for quality. Any large dataset is likely to contain some outliers or questionable records caused by instrument failure, transcription errors, laboratory errors, etc. Thus, questionable data were identified and excluded prior to analysis. However, all of the data collected as part of the sampling program, including data that was excluded from subsequent analyses, are presented in Part 2 - Data Report of the *2011 AEMP Report* (Rescan 2012b).

The finalized dataset was then graphically and statistically analyzed to detect possible mine effects. For example, regression modelling was used to detect any changes that might be occurring in lakes and streams through time and also to determine whether temporal patterns differed between monitored and reference sites. Different regression models were applied to different variables depending on the number of years of data that was available and, in the case of water and sediment quality, the proportion of data that was greater than the analytical detection limit. If statistical analyses were not possible because assumptions or data requirements were not satisfied, variables were subjected to graphical analysis only. In such cases, data were examined for historical trends and spatial gradients.

The results of statistical and graphical analyses were then interpreted using best professional judgment. Graphical analysis was used to confirm and/or interpret conclusions reached by the statistical analysis. The result was an assessment of whether change had occurred and whether the change was “significant,” as defined by the statistical and/or graphical analyses.

Changes deemed significant were assessed to determine whether they were likely to be the results of mine activities, sampling activities, or natural variation. The identification of a change as a mine effect required the existence of plausible mechanisms that could link mine activities and change. For example, a mine effect on pH required that there be a clear spatial gradient in pH in the lakes and streams downstream of the LLCF. If reduced pH was found in one lake without corresponding changes in upstream lakes, the change was attributed to natural variation.

Table 7.1-2. Evaluated Variables for the 2011 AEMP

Physical Limnology	Water Quality	Sediment Quality	Aquatic Ecology
Under-ice dissolved oxygen	Physical/Ions	Nutrients	Phytoplankton
Secchi depth	pH	Total organic carbon	Chlorophyll *a* concentrations
	Total Alkalinity	Available phosphorus	Phytoplankton density
	Water hardness	Total nitrogen	Phytoplankton diversity
	Total dissolved solids	Metals	Relative densities of major phytoplankton taxa
	Chloride	Aluminum	Zooplankton
	Sulphate	Arsenic	Zooplankton biomass
	Potassium	Antimony	Zooplankton density
	Nutrients	Copper	Zooplankton diversity
	Total ammonia-N	Molybdenum	Relative densities of major zooplankton taxa
	Nitrite-N	Nickel	Lake Benthos
	Nitrate-N	Selenium	Lake benthos density
	Ortho-phosphate	Strontium	Lake benthos diversity
	Total phosphate	Zinc	Relative densities of major dipteran taxa
	Total organic carbon[1]		Stream Benthos
	Metals		Stream benthos density
	Total aluminum		Stream benthos dipteran diversity
	Total antimony		Relative densities of major dipteran taxa
	Total arsenic		Stream benthos Ephemeroptera, Plecoptera, Trichoptera diversity
	Total copper		
	Total iron		
	Total molybdenum		
	Total nickel		
	Total selenium		
	Total strontium		
	Total uranium		
	Total zinc		

[1] *Cujo Lake only.*

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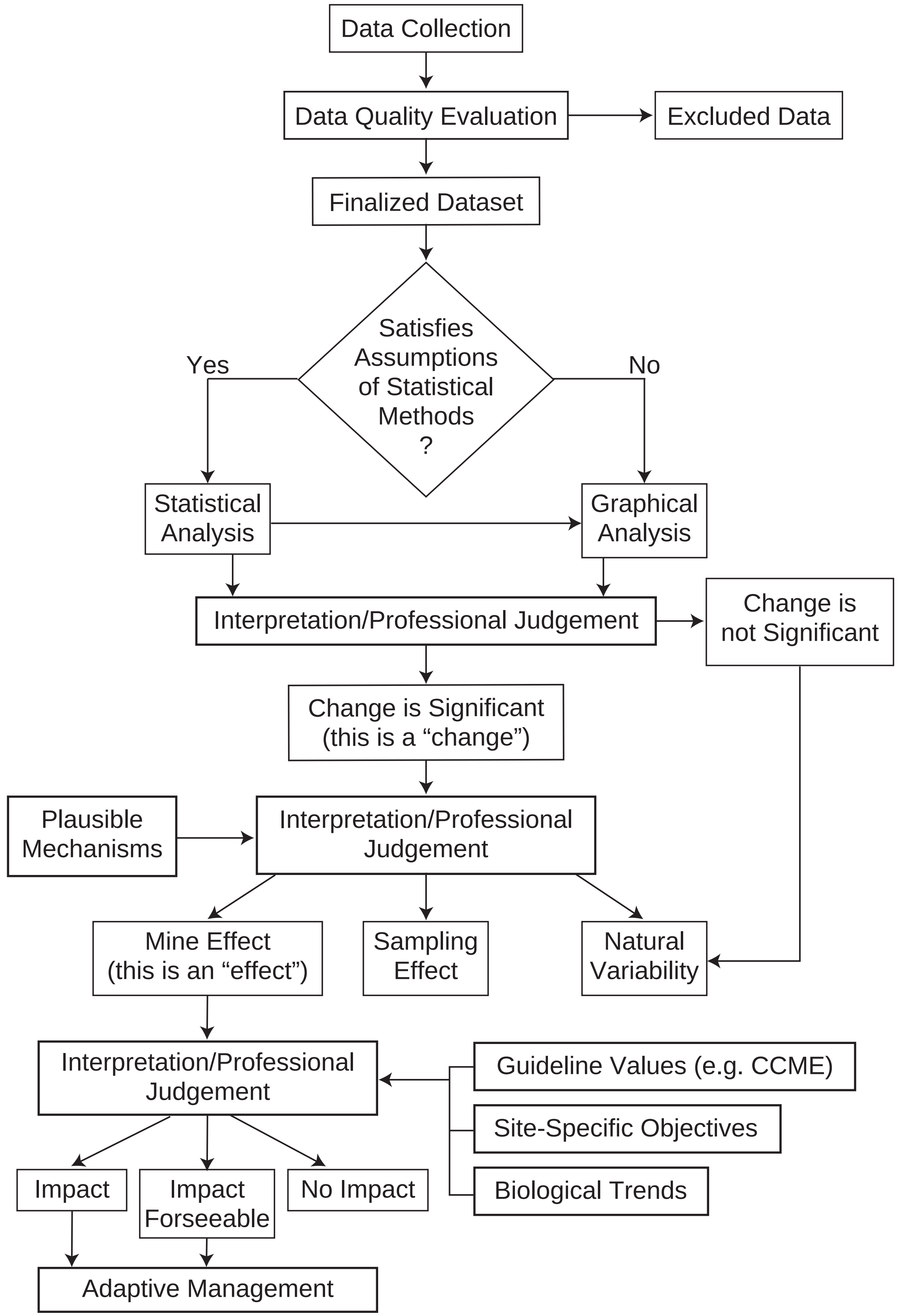

Figure 7.1-3

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Evaluation Framework for the 2011 AEMP

If a mine effect was detected, the extent to which the effect was having an impact on the environment was evaluated. Benchmark values (including applicable CCME guideline values for the protection of aquatic life and relevant SSWQOs) and biological trends were important in the determination of mine impacts. For example, if a biological effect (such as an increase in phytoplankton density) was associated with increasing concentrations of a water quality variable downstream of the LLCF for which a CCME guideline value or SSWQO was exceeded, the effects would likely be deemed an environmental impact. Impacts or foreseeable impacts would then lead to appropriate adaptive management measures.

7.1.2.2 Surveillance Network Program

The SNP is a water quality monitoring program required by the Water Licence for the EKATI mine site. The primary purpose of the SNP is to monitor compliance of mine operations with the discharge criteria of the Water Licence (see Reports 25, 40, and 59). The data are also used to support the AEMP by providing water quality data for the discharge from the LLCF (station 1616-30) and the KPSF (station 1616-43).

During the 2009 to 2011 reporting period, SNP stations in the Koala and King-Cujo watersheds were sampled for applicable water quality parameters defined in the Water Licence (Figure 7.1-4). The required sampling frequency varied among stations, ranging from weekly to annually. The required sampling variables also varied among stations depending on the purpose of each station. The results of the SNP monitoring are sent in a monthly report to the WLWB and to AANDC (formerly Indian and Northern affairs Canada). The results are also summarized and presented in the annual report on the Water Licences and Environmental Agreement (see Appendix B of Reports 25, 40, and 59). The data collected from 1616-30 and 1616-43 are also incorporated into the annual AEMP report (e.g., Report 56).

7.1.2.3 Fay Bay Monitoring Program

In May 2008, BHP Billiton identified and reported a release of approximately 4,465 m^3 of FPK to the shore and ice of Fay Bay adjacent to Cell B of the LLCF (Reports 19 and 35). Clean-up efforts occurred immediately following the release and resulted in the successful removal of approximately 85% of the total volume of released FPK.

A report was produced in 2009, providing details of the initial response and the effects to the receiving environment as a result of the PK release (Report 19; Plate 7.1-1).

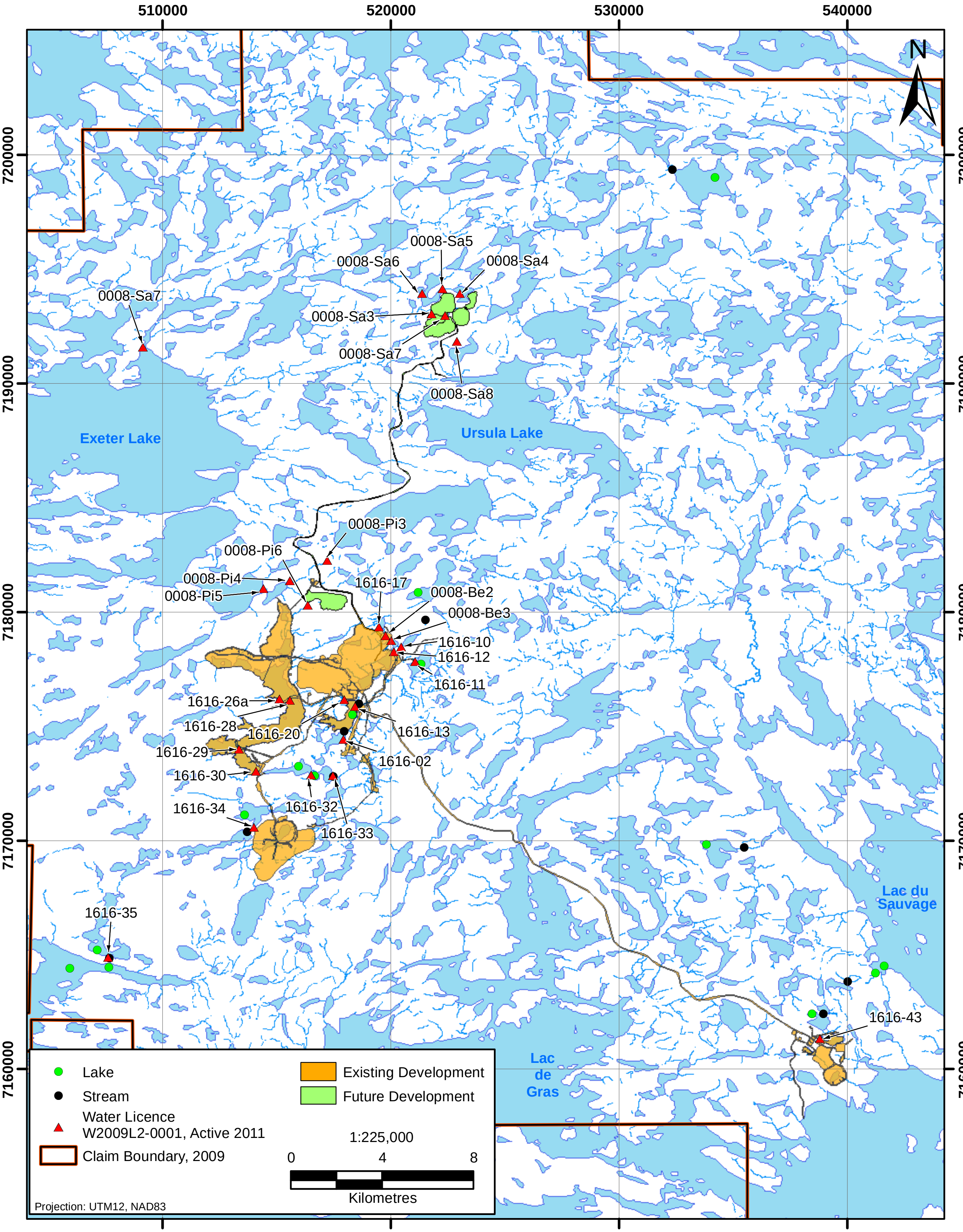
The Fay Bay Monitoring Program was continued into 2010 to assess the recovery of the aquatic environment and the area disturbed by the temporary access road used to recover the FPK (Report 35). For the 2010 AEMP, monitoring activities included measuring physical limnology, water quality, and the abundance and biological characteristics of the primary (phytoplankton) and secondary (zooplankton and benthos) producers at sites within Fay Bay, Fay-Upper Exeter, and Upper Exeter Lake South (ice covered season only). The reference sites for the AEMP were Nanuq and Counts lakes and their outflows.

7.1.2.4 Waste Rock and Waste Rock Storage Area Seepage Survey Program

As a condition of Water Licence W2009L2-0001, BHP Billiton is required to monitor WRSA seepage quality and characterize waste rock at EKATI. Findings of these monitoring programs are reported annually in the Waste Rock and Waste Rock Storage Area Seepage Survey reports (Reports 17, 31, and 48). A freshet report and an annual report which includes the freshet data are produced annually.

◎ Table of Contents

gis no. EKA-01-120 Job No. 0648-121-01 September 05, 2012



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Surveillance Network Monitoring Locations

FIGURE 7.1-4

(a)

(b)

Plate 7.1-1. (a) Fay Bay recovery, 2008 (b) Contingency silt curtains in water and completed Cell B "Ring Road", 2009.

Routine monitoring of waste rock seepage during freshet and fall was completed in 2009, 2010, and 2011 following established protocols (see Figures 7.1-5 to 7.1-8 for seep sampling locations for the 2011 program). Only seeps that discharge to the receiving environment (i.e., SEEP-313, SEEP-019, SEEP-322, SEEP-357, and SEEP-360) are discussed with respect to the effluent quality criteria. Waste rock sampling was carried out at the Beartooth and Fox pits in the 2009 reporting year. No waste rock sampling was carried out at any of the underground developments or the Fox Pit in any of the 2009 to 2011 reporting years, as per the updated Geochemical Characterization and Metal Leaching Management Plan (Report 46). Eight samples of CKR were collected in each of 2009 and 2010 and seven samples of CKR were collected in 2011. Sampling of Misery Pit waste rock following commencement of the Misery Pit push back in late 2011 is anticipated to be conducted annually as per Version 3 of the WROMP (Report 46).

7.1.3 Fish

7.1.3.1 AEMP Lakes

As part of the EKATI AEMP, there is a fish sampling component to be completed every five years with the last sampling occurring in August 2007. Fish are collected from nine lakes for analysis of community composition as well as tissue metal analysis and other biological characteristics (i.e., length, weight, and age). The fish component of the AEMP includes the following lakes: Kodiak, Leslie, Moose, Nema, Slipper, and Cujo lakes as well as the Nanuq, Counts, and Vulture reference lakes. Between 2009 and 2011 there were no fish studies conducted in AEMP lakes. Section 7.4.2 provides additional detail regarding the 2012 proposed fish sampling program as it relates to mitigation and understanding of historical effects (Report 37).

Table of Contents

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2011 Waste Rock Seepage Stations Panda/Koala/Beartooth Northeast

FIGURE 7.1-5

Table of Contents

gis no. EKA-09-036c

Job No. 648-121-01

July 03, 2012

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2011 Waste Rock Seepage Stations Panda/Koala/Beartooth Southwest

FIGURE 7.1-6

◎ Table of Contents

gis no. EKA-09-036b | Job No. 648-121-01 | July 03, 2012

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2011 Waste Rock Seepage Stations Fox Area

FIGURE 7.1-7

◎ Table of Contents

gis no. EKA-09-036a

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July 03, 2012

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2011 Waste Rock Seepage Stations Misery Area

FIGURE 7.1-8

7.1.3.2 Panda Diversion Channel Monitoring Program

The PDC was constructed in 1997 as compensation for the loss of stream habitat during the development of EKATI in accordance with an agreement between BHP Billiton and DFO. Under this agreement, BHP Billiton established a 10-year monitoring program from 1999 to 2008 to assess the effectiveness of the PDC in providing productive fish habitat. The principal focus was placed on monitoring Arctic grayling because it is the predominant fish species inhabiting the PDC. Following completion of the 10-year monitoring program BHP Billiton reduced the program in 2009 and 2010, focussing the monitoring on Arctic grayling spawners and their use of the PDC.

A 10-year summary report of all monitoring aspects of the PDC was prepared in 2010, covering years 1999 to 2008 (Report 11). In 2011, a number of physical and biological variables continued to be monitored as in previous years, including stream flow, water temperature, fish species, and biological characteristics of fish that migrated into and out of the PDC using box traps installed at both the upper and lower sections (Reports 34 and 50). Visual counts were also made of Arctic grayling spawners in the two natural reference streams: Pigeon and Polar-Vulture.

Additional variables were introduced in 2011 in order to address questions put forward by an independent reviewer (see Tonn 2010) as well as comments from DFO, and to allow for monitoring and comparison to data from earlier years. The 2011 report presents the results from the thirteenth year of fish monitoring in the PDC, and provides a rationale for the completion of the PDC Monitoring Program.

7.1.3.3 Nero-Nema Monitoring Program

Nero-Nema Stream is a short, wide stream that flows from Nero Lake to Nema Lake in the Koala Watershed. During the winter of 2002 to 2003, an open-span bridge for the Fox Access Road was installed over Nero-Nema Stream. The construction of this bridge resulted in a loss of fish habitat, necessitating compensation for the lost habitat. Addition of gravel within the stream was chosen as the means to increase fish habitat quality—specifically spawning habitat for Arctic grayling. From 2005 to 2007, eight Gravel Enhancement Pads (GEPs) were installed upstream and downstream of the bridge.

The general objective of the Nero-Nema Stream Monitoring Program was to evaluate the effectiveness and success of the GEPs as compensatory habitat (Report 30; Plate 7.1-2). As indicated in Section 4.2.3 of the Fisheries Authorization obtained for this site, the habitat is considered successful when it is proven to be functioning physically and ecologically as it was designed (DFO 2001).

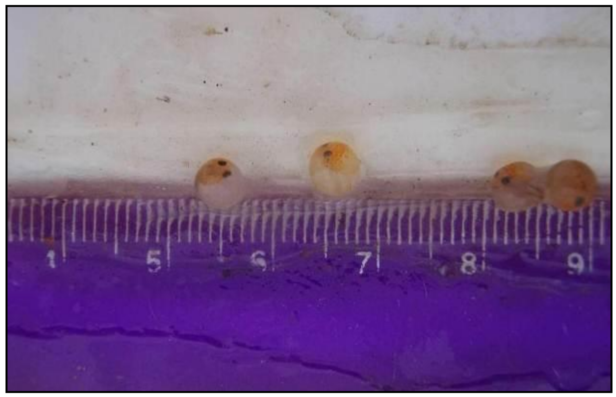
7.1.4 Community Involvement and Traditional Knowledge

TK holders from nearby communities have been invited to work with fisheries biologists to conduct the field recording of fish condition during the 2012 AEMP fish studies. External and internal assessments of collected fish are conducted for deformities, erosions, lesions, and tumours, as well as parasites. This is similar to the 2007 AEMP fish studies where elders from Yellowknives Dene First Nation, the North Slave Metis Alliance, Lutsel K'e Dene First Nation, and the KIA took part in fish community sampling in August and early September 2007. Following the 2007 fish sampling program, TK holders generally commented that round whitefish and lake trout were healthy looking, but noted that many lake trout from all lakes contained parasitic cysts.

(a)

(b)

(c)



(d)

Plate 7.1-2. (a) Nero-Nema stream crossing. (b) EKATI summer students conducting a visual spawner survey from the Nero-Nema Bridge. (c) Gravel Enhancement Pad E showing gravel dominant substrate and minimal siltation/fines. (d) Arctic grayling eggs with identifiable eyes collected on June 29, 2010.

7.2 PREDICTED AND OBSERVED EFFECTS

7.2.1 Surface Hydrology

The 1995 EIS predicted the following changes in surface hydrology:

- changes in drainage patterns due to construction of the PDC;
- loss of water storage due to dewatering of lakes overlying the Panda, Koala, Misery, Fox and Beartooth kimberlite pipes and those lakes dewatered for other purposes (e.g., Airport Lake and Long Lake);
- reduced water levels in Grizzly Lake due to extraction of potable water; and
- temporary changes in stream flow accompanying lake dewatering.

Effects not predicted in 1995 include:

- snow and ice blockages of the PDC.

7.2.1.1 Alteration to Drainage

The 1995 EIS predicted that there would be changes in drainage patterns due to construction of the PDC and LLCF. Local effects were observed on flow volumes in Koala Watershed with removal of Airport, Koala, Beartooth, Fox 1, and Panda lakes and conversion of Long Lake to the LLCF. In addition there was an alteration of flow volumes in King-Cujo Watershed with dewatering of Misery Lake and conversion of King Pond to the KPSF. However, all effects were temporary and there were no long-term effects to downstream lakes.

7.2.1.2 Water Storage Reduction

Loss of water storage for seven lakes due to dewatering of Panda, Misery, Koala, Fox 1, Leslie, Long, and Airport lakes was predicted in the 1995 EIS. A total of 891 ha of lake surface area were predicted to be lost. The partial or complete dewatering of Panda, Misery, Koala, Fox 1, Long, and Airport lakes were completed prior for a total loss of 165 ha of lake surface area.

No new pits were developed during the 2009 to 2011 reporting period; however, dewatering of Pigeon Pond and realignment of the stream around the open pit will precede removal of the cover material for the development of Pigeon Pit. It is anticipated that a total of 18,500 m^3 will be dewatered. The PSD will be constructed prior to dewatering activities and construction of the channel commenced in the late winter of 2011/2012. The experience gained at other EKATI pits during dewatering will be applied to the Pigeon site.

7.2.1.3 Reduced Water Levels

An increase in the maximum allowable annual extraction of potable water from Grizzly Lake from 150,000 m^3/year of potable water to 200,000 m^3/year was initiated between 2006 and 2008 (as defined by the Water Licence). However, the freshwater extraction from Grizzly Lake for the purpose of potable water has not increased since the inception of the new maximum (Table 3.1-2). A temporary drawdown of Bearclaw Lake in 2004 had some short-term and reversible effects.

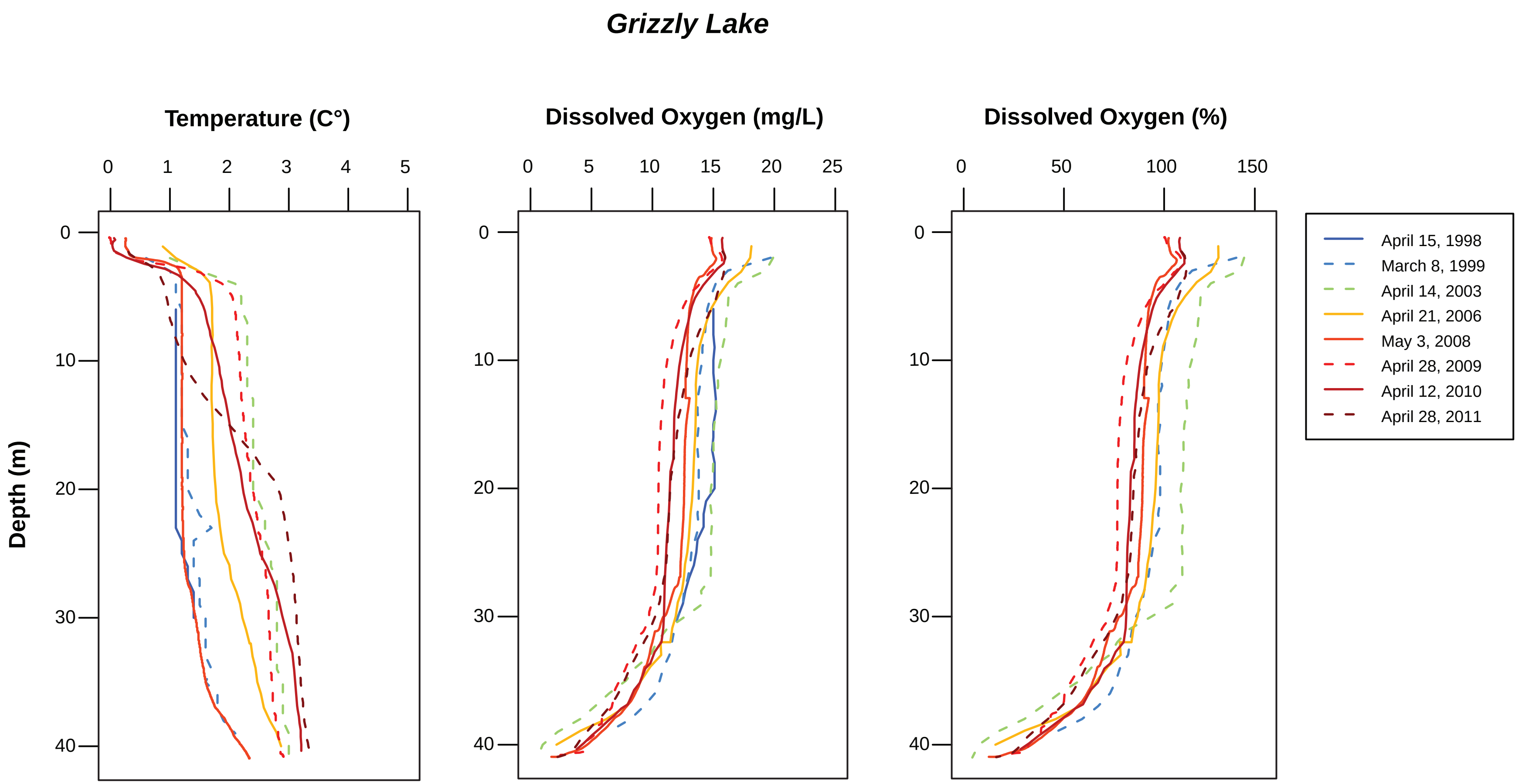
Effects of the freshwater extraction on Grizzly Lake water quality have been assessed as part of the AEMP (water quality has been monitored since 1998 and Grizzly Lake was added to the effects evaluation in 2009). To date no effects have been detected; however, the results of the 2011 AEMP indicated that the shape of the under-ice temperature profile has changed through time, with surface waters becoming cooler since 2006 (Figure 7.2-1). The cause of the change in Grizzly Lake is unclear. Despite changes in under-ice profiles, open water season temperature and dissolved oxygen profiles were similar to previous years in all lakes. Secchi depths were also similar to those observed in previous years.

7.2.1.4 Stream Flow Alteration

Historically, dewatering of lakes caused short-term changes in stream flow rates. In addition, flows from Panda and Koala lakes to Kodiak Lake were replaced by the PDC. In 2004, temporary drawdown of Bearclaw Lake due to sensor malfunction caused an increase in summer flows in the PDC resulting in a temporary increase in fish habitat in the channel.

Similar to other Arctic streams, the freshet period is generally the dominant feature of the annual hydrograph for EKATI streams. Following the freshet period, flows steadily decrease though July until the middle of August. Observed peak flow, which could be used as an indication of when melt occurs, has high natural inter-annual variability (Table 7.2-1; Table 7.2-2). Changes in stream flow at the Cujo Outflow and the Slipper-Lac de Gras hydrological stations are partially controlled by pumping at the KPSF and LLCF, respectively (Table 7.2-3). Changes in stream flow observed between 2009 and 2011 were considered within their natural variability (e.g., Report 56).

PROJECT # 0648-121-01 ILLUSTRATION # a35123n-EIR June 12, 2012



Note: Data collected and supplied by BHP Billiton Environment.

Figure 7.2-1

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Under-ice Dissolved Oxygen and Temperature Profiles for Grizzly Lake, 1998 to 2011

Figure 7.2-1

Table 7.2-1. Maximum Recorded Unit Yield (L/s/km^2) for AEMP Streams and Points of Regulated Discharge, 1995 to 2011

Year	Vulture-Polar	Lower PDC	Long Lake Outflow (1995, 1996) LLCF Discharge (1998-2010)	Slipper-Lac de Gras	King Pond	Cujo Outflow	Nanuq Outflow	Counts Outflow
1995	-	-	92 (Jun 14)	70.2 (Jun 10)	-	-	-	-
1996	-	-	32 (Jun 16)	29.1 (Jun 14)	-	-	-	-
1997	255.3 (Jul 3)	-	-	170.8 (Jun 3)	-	-	-	-
1998	21.1 (May 22)	-	63.2 (Apr)	117.1 (May 23)	-	-	4.4 (May 31)	16.3 (May 22)
1999	273.2 (May 29)	166.1 (Jun 3)	29.8 (Jul)	103.4 (Jun 5)	-	135.9 (Jun 5)	13.9 (Jun 10)	55.2 (Jun 10)
2000	95 (Jun 11)	85.1 (May 27)	15.2 (Jul)	86.9 (Jun 12)	-	214.3 (Jun 11)	17.2 (Jun 22)	67.8 (Jun 22)
2001	185.5 (Jun 7)	78.7 (Jun 12)	24.3 (Jun)	371 (Jun 8)	-	77.4 (Jun 7)	18.2 (Jun 22)	120.1 (Jun 7)
2002	69.7 (Jun 5)	40.2 (Jun 8)	15.4 (Jul)	37.2 (Jun 11)	106.3 (Sep)	154 (Sep 20)	14.2 (July 4)	15.3 (Jun 26)
2003	28.8 (Jun 2)	32.4 (May 31)	-	45.7 (May 31)	-	59 (Jun 5)	-	44.3 (Jun 12)
2004	124.5 (Jun 6)	47.9 (Jun 8)	10.8 (Feb)	93.4 (Jun 10)	11.4 (Sep)	93.9 (Jun 10)	-	28.6 (Jun 20)
2005	64.1 (Jun 6)	110.6 (Jun 5)	26.1 (Jun)	107.3 (Jun 6)	15.2 (Sep)	93.1 (Jun 8)	-	44.4 (Jun 16)
2006	83.6 (May 26)	63.9 (May 16)[1]	23.6 (Jun)	79.5 (May 21)	76.8 (Jul)	50 (May 21)	-	39 (Jun 6)
2007	81.7 (Jun 1)	85.7 (Jun 2)	20.7 (Jul)	56.2 (Jun 4)	42.7 (Jul)	59 (Jun 4)	-	37.1 (Jun 16)
2008	32.7 (Jun 3)	55.8 (May 28)	2.7 (Sep)	31.4 (Jun 5)	34.5 (Jul)	22.1 (Jun 5)	-	21.8 (Jun 17)
2009	102.6 (Jun 10)	60.5 (Jun 11)	14.2 (Jul)	55.3 (Jun 13)	25.6 (Sep)	55.8 (Jun 13)	-	53.1 (Jun 20)
2010	54.1 (Jun 4)	86.7 (Jun 3)	23.7 (Jul)	33.9 (Jun 5)	74.3 (Aug)	50.5 (Aug 14)	-	35.2 (Jun 22)
2011	11.4 (Jun 5)	19.5 (Jun 3)	32.0 (Jul)	16.5 (Jun 4)	81.4 (Sep)	57.2 (Sep 10)	-	24 (Jun 20)

Dashes indicate data not collected.

Table 7.2-2. Minimum Recorded Unit Yield (L/s/km^2) for AEMP Streams and Points of Regulated Discharge, 1995 to 2011

Year	Vulture-Polar	Lower PDC	Long Lake Outflow (1995, 1996) LLCF Discharge (1998-2010)	Slipper-Lac de Gras	King Pond	Cujo Outflow	Nanuq Outflow	Counts Outflow
1994	-	-	-	1.2 (Aug 15)	-	-	-	-
1995	-	-	2.7 (Aug 6)	5.0 (Aug 27)	-	-	-	-
1996	-	-	1.0 (Aug 7)	0.7 (Aug 7)	-	-	-	-
1997	1.1 (Aug 20)	-	-	2.2 (Aug 22)	-	-	6.6 (Aug 21)	6.1 (Aug 19)
1998	0.9 (Aug 5)	-	0.0 (Jun)	2.2 (Aug 5)	-	-	2.7 (Aug 21)	0.7 (Aug 22)
1999	2.5 (Aug 16)	0.6 (Aug 16)	3.4 (Oct)	6.2 (Aug 22)	-	0.4 (Aug 17)	5.5 (Aug 25)	1.8 (Aug 22)
2000	2.0 (Aug 13)	1.9 (Aug 13)	4.3 (Sep)	5.1 (Aug 14)	-	0.1 (Aug 14)	7.1 (Aug 13)	-
2001	2.9 (Aug 23)	0.8 (Aug 23)	6.3 (Aug)	0.7 (Aug 22)	-	1.0 (Aug 17)	-	9.8 (Aug 24)
2002	4.0 (Aug 9)	0.6 (Aug 9)	0.0 (Jun)	2.9 (Jul 3)	0.0 (Jul - Aug)	0.7 (Aug 6)	10.0 (Aug 22)	7.1 (Aug 9)
2003	1.0 (Aug 22)	0.2 (Aug 22)	3.9 (Jul)	1.7 (Aug 22)	0.6 (Jun)	4.2 (Jul 5)	-	4.5 (Aug 22)
2004	3.7 (Sep 3)	3.3 (Sep 3)	0.0 (Apr - Jun)	0.6 (Sep 3)	0.0 (Jan - Jun)	0.6 (Aug 25)	-	4.0 (Jun 15)
2005	4.3 (Aug 7)	1.1 (Aug 7)	0.0 (Jan - Jun)	1.6 (Aug 7)	0.0 (Jan - Aug)	0.7 (Aug 28)	-	0.2 (Aug 25)
2006	4.1 (Aug 22)	2.3 (Aug 22)	0.0 (Jan - May)	7.9 (Aug 22)	0.0 (Jan - Jul)	0.6 (Jul 16)	-	2.8 (Sep 18)
2007	0.7 (Sep 16)	0.8 (Sep 17)	0.0 (Jan - May)	3.1 (Sep 6)	0.0 (Jan - May)	0.5 (Aug 25)	-	1.2 (Sep 16)
2008	2.5 (Aug 13)	1.9 (Aug 10)	0.0 (Jan - Jul)	1.7 (Aug 13)	0.0 (Jan - May)	0.7 (Aug 13)	-	1.8 (Aug 13)
2009	1.4 (Sep 16)	1.2 (Sep 6)	0.0 (Jan - Jun)	1.3 (Sep 17)	0.0 (Jan - May)	0.0 (Aug 24)	-	1.9 (Sep 7)
2010	0.8 (Sep 13)	1.3 (Sep 13)	0.0 (Jan - Jun)	1.7 (Aug 22)	0.0 (Jan - Jun)	5.3 (Sep 13)	-	1.1 (Jun 10)
2011	2.9 (Aug 15)	1.2 (Aug 14)	0.0 (Jan - Jun)	3.6 (Aug 15)	0.0 (Jan - Jul)	0.0 (Aug 30)	-	3.0 (Aug 15)

Dashes indicate data not collected.

Table 7.2-3. Proportion of Total Flow as a Result of Pumping

	Proportion of Total Flow					
	Slipper Lac de Gras			Cujo Outflow		
	2009	2010	2011	2009	2010	2011
Long Lake Containment Facility	43%	34%	50%	-	-	-
King Pond Settling Facility	-	-	-	71%	91%	86%

Note: Dashes indicate not applicable.

Flow patterns are also evaluated in Pigeon Stream and the PDC in support of the PDC Monitoring Program. In 2011, flow patterns were similar between the two streams and the Vulture-Polar reference stream. Above-freezing temperatures in early to mid-May led to an earlier freshet period than average, with peak flows occurring between May 29 and June 3. Rain events in mid-August and early September contributed additional runoff during the year. Water temperatures in all streams, consistent with previous years, followed the expected dome-shaped seasonal cycle, with low temperatures measured in the early summer, higher temperatures midsummer, and falling temperatures later in the year. As expected, the average cumulative difference in degree days between the PDC and Pigeon Stream and Polar-Vulture Stream also followed a dome-shaped cycle, with PDC temperatures generally lower than reference streams for the majority of the summer, except for the early and later parts of the summer. Such differences in degree days likely affect the relationship between achieved growth and day of year of Arctic grayling fry. The current re-sloping efforts of the banks of the canyon section of the PDC should improve thermal conditions of the PDC, ultimately improving fish growth conditions.

7.2.1.5 Snow and Ice Blockages in the PDC

Although not predicted in the 1995 EIS, a short-term blockage in the PDC is a potential effect that could result in a subsequent rise in water levels in North Panda and Polar lakes. This effect first occurred in the spring of 1999; however, as a result of snow being cleared annually in early spring, this effect did not occur between 2009 and 2011.

7.2.2 Water Quality and Aquatic Life Other than Fish

The 1995 EIS predicted the following changes in water quality and aquatic life other than fish:

- loss of aquatic habitat due to lake dewatering;
- addition of stream habitat due to construction of the PDC;
- modification of aquatic habitat by silt from construction of mine infrastructure;
- local negligible residual effects as a result of increase in TSS. Aluminum and nickel concentrations are expected to be elevated in discharged water but will not surpass receiving water criteria;
- elevated concentrations of aluminum, ammonia, and TSS in seepage from the Panda/Koala WRSA; and
- negligible effects with respect to changes in sediment quality.

Effects not predicted in 1995 include:

- eutrophication of Kodiak Lake and resulting changes to aquatic resources;
- runoff from the ammonia nitrate storage building;
- changes in under-ice temperature and dissolved oxygen profiles in lakes downstream of the LLCF;

- changes to aquatic habitat and water quality in Fay Bay and Fay-Upper Exeter Stream as a result of a PK release into Fay Bay;
- 16 water quality variables have changed in evaluated lakes and streams in the Koala Watershed or Lac de Gras;
- 14 water quality variables have changed in the evaluated lakes and streams in the King-Cujo Watershed or Lac du Sauvage; and
- changes to aquatic assemblages.

7.2.2.1 Aquatic Habitat

Aquatic habitat was lost or modified in six dewatered lakes (Airport, Koala, Beartooth, Fox 1, Misery, and Panda lakes) and outlet streams.

The PDC was constructed as compensation for the lost stream habitat. The PDC has been colonized by benthos, periphyton, and vascular and non-vascular plants and provides habitat for Arctic grayling and other species of fish. The PDC continues to provide migration habitat as well as spawning and rearing habitat for a wide range of fish species.

There were short-term and localized effects to the aquatic habitat of Fay Bay following the unauthorized discharge. The results of monitoring indicated that Fay Bay water clarity diminished for a short period due to suspended particulates, but returned to baseline levels during the summer of 2008. The results of the PK distribution survey indicated that the PK was observed in both littoral zones (less than 2 m) and deep water habitats; however, only a small proportion of benthic habitat was affected (i.e., the majority of the survey area had less than 5 mm of PK deposited). In addition the PK did not cover rare or critical fish habitat in Fay Bay (see also 7.2.3.1- Fay Bay).

7.2.2.2 Habitat Modification

Temporary and localized effects were predicted in 1995 with regards to habitat modification by enhanced sedimentation related to the PDC construction and construction of mine infrastructure (e.g., dams and roads). The 1995 EIS also predicted that there would be reduced benthos in Kodiak Lake near the outlet of the PDC in the spring of 1997 as a result of habitat modifications. However, this effect was temporary and benthos studies suggest that the production capacity of the PDC as fish habitat improves as time lapses since inception of the PDC.

The 1995 EIS did predict that sediment transport from the PDC into Kodiak Lake would occur soon after the PDC was opened in 1997. Although this effect was mitigated over time, after a high rainfall event in the summer of 2010 a small portion of the East channel wall sloughed, resulting in a release of sediment into Kodiak Lake. Silt curtains were deployed to minimize the amount of sediment released at the site of the slough, and at the outlet to Kodiak Lake to control sediment that entered from the PDC. In 2011 there was a short lived increase in TSS in the PDC following June rain events and as a result of construction activities related to the re-sloping of the canyon banks (see Section 7.4.8).

The most recent PDC monitoring report indicated no discernable or obvious changes in water quality variables including total nitrogen, total phosphorus, total dissolved solids, TSS, or total organic carbon that have been observed in the PDC or reference streams over monitoring years. Concentrations of key water quality variables (nutrients and TSS) in the PDC were consistent with levels seen in the two natural streams.

The 2011 AEMP results also indicated that there were no water quality variables that showed changes in Kodiak Lake and the Lower PDC in 2011. Although a change in total aluminum concentrations was detected in the Lower PDC in 2010, this was as a result from anomalously elevated concentrations of total aluminum in 2010 which were not observed in 2011. A decreasing trend in total copper concentrations was detected in the Lower PDC in 2010, however total copper concentrations in 2011 were comparable to those observed in the Lower PDC when monitoring began in 2000.

7.2.2.3 Changes in Water Quality

It was anticipated in 1995 that there would be local negligible residual effects as a result of increase in TSS in lakes and streams downstream of mine infrastructure. In addition, aluminum and nickel concentrations were expected to be elevated in discharged water but were not anticipated to surpass receiving water criteria. Historically, increases in some evaluated water quality variables were evident (including pH, sulphate, nitrate, potassium, TDS, total arsenic, total molybdenum, and total nickel) in lakes downstream of the LLCF and the KPSF. In addition, there have been some cases where concentrations in the receiving environment have exceeded relevant CCME guidelines for the protection of aquatic life (CCME 2007). For example, copper slightly exceeded the CCME guideline in Kodiak Lake but there was no evidence of adverse biological effects.

Although not predicted in 1995, a residual effect of an eutrophication episode in Kodiak Lake was evident in 1998 and was caused by temporary diversion of treated sewage effluent. The effect had largely disappeared by 2002 and Kodiak Lake had become a regularly monitored station of the AEMP. An ecological risk assessment of elevated concentrations of copper in Kodiak Lake showed the concentrations were too low to cause significant ecological effects and were on the decline since 2001. Since 2002, Kodiak Lake was also assessed for elevated concentrations of ammonia, nitrate, and nitrite as a result of leakage from the Ammonium Nitrate Storage Building. Mitigation efforts to reduce the amount of total ammonia, nitrate, and nitrite entering Kodiak appear to be successful.

The results of the 2011 AEMP form the basis of the current water quality effects in the EKATI receiving environment. The graphical and regression analyses completed in 2011 provide an indication of changes in water quality since monitoring began (e.g., Figure 7.2-2). Thus, only the 2011 effects analyses are presented here. However, incidences of when a guideline value (e.g., CCME) was exceeded in the receiving environment for the three relevant monitoring years are presented.

Under-ice temperature profiles indicated a trend towards cooling in all lakes downstream of the LLCF as far as Nema Lake. A warming trend was detected in Kodiak Lake, along with corresponding changes in dissolved oxygen profiles.

Under-ice DO concentrations were greater than the CCME guideline value of 6.5 mg/L throughout the majority of the water column at all monitored sites in the King-Cujo Watershed and Lac du Sauvage. In Cujo Lake, DO measurements were below CCME guidelines at depths greater than approximately 4 m beginning at the end of March and continuing through to the last sampling date during the ice-covered season. Historically, however, DO concentrations in Cujo Lake have been less than the CCME guideline value through the majority of the water column during the ice-covered season.

The 2011 changes in water quality in lakes downstream of the LLCF are summarized in Figure 7.2-3. Twenty-three water quality variables were evaluated in the 2011 AEMP for the Koala Watershed and Lac de Gras. Of these, concentrations of 16 variables have changed in lakes and streams in the Koala Watershed or Lac de Gras (Figure 7.2-3).

- pH (downstream to Site S3 in Lac de Gras);

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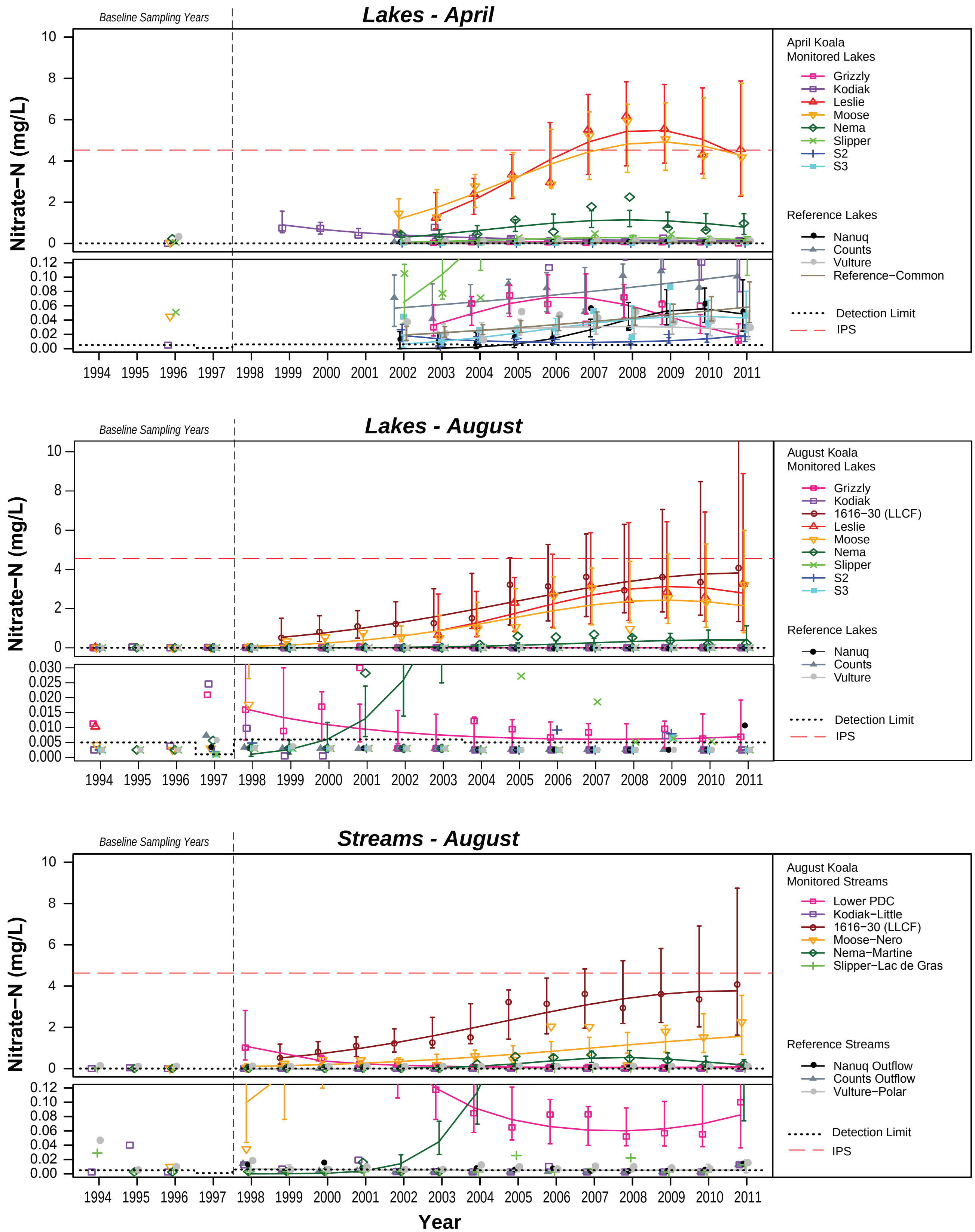

Notes: Symbols represent observed mean values.
Solid lines represent fitted curves.
Error bars indicate upper and lower 95% confidence intervals of the fitted means.
SSWQO = $e^{0.9518 \times \ln(\text{hardness}) - 2.032}$. IPS = 4.7 mg/L

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An Example of the Results of the AEMP Effects Analysis - Observed and Fitted Means for Nitrate-N Concentrations in Koala Watershed Lakes and Streams and Lac de Gras, 1994 to 2011

Figure 7.2-2

Water Quality

	Grizzly	Lower PDC	Kodiak	Kodiak-Little	Leslie	Moose	Moose-Nero	Nema	Nema-Martine	Slipper	Slipper-Lac de Gras	Lac de Gras S2	Lac de Gras S3
					LLCF → Downstream								
Under-ice Temperature	◆	●	◆	●	◆	—	●	◆	●	—	●	—	—
Under-ice Dissolved Oxygen	—	●	◆	●	—	—	●	—	●	—	●	—	—
Secchi Depth	—	●	—	●	—	—	●	—	●	—	●	—	—
pH	*	—	*	—	▲ 0-25%	▲ 0-25%	▲ 0-25%	▲ 0-25%	▲ 0-25%	▲ 0-25%	▲ 0-25%	▲ 0-25%	▲ 0-25%
Alkalinity	—	—	—	—	▲ 26-50%	▲ 51-75%	▲ 26-50%	▲ 26-50%	▲ 26-50%	▲ 26-50%	▲ 0-25%	—	—
Hardness	—	—	—	—	▲ 76-100%	▲ 76-100%	▲ 76-100%	▲ 76-100%	▲ 76-100%	▲ 76-100%	▲ 26-50%	▲ 26-50%	▲ 26-50%
Total Dissolved Solids	—	—	—	—	▲ 76-100%	▲ 76-100%	▲ 76-100%	▲ 76-100%	▲ 76-100%	▲ 76-100%	▲ 76-100%	▲ 76-100%	▲ 26-50%
Chloride	—	—	—	—	▲ 76-100%	▲ 76-100%	▲ 76-100%	▲ 76-100%	▲ 76-100%	▲ 76-100%	▲ 76-100%	▲ 76-100%	▲ 76-100%
Sulphate	—	—	—	—	▲ 76-100%	▲ 76-100%	▲ 76-100%	▲ 76-100%	▲ 76-100%	▲ 76-100%	▲ 76-100%	▲ 26-50%	▲ 26-50%
Potassium	—	—	—	—	▲ 76-100%	▲ 76-100%	▲ 76-100%	▲ 76-100%	▲ 76-100%	▲ 76-100%	▲ 76-100%	▲ 26-50%	▲ 26-50%
Total Ammonia-N	—	—	—	—	▲ 76-100%	▲ 0-25%	▲ 0-25%	▲ 76-100%	—	—	—	—	—
Nitrite-N	—	—	—	—	▲ 26-50%	▲ 26-50%	▲ 76-100%	▲ 0-25%	—	—	—	—	—
Nitrate-N	—	—	—	—	▲ 26-50% *	▲ 76-100% *	▲ 76-100%	▲ 76-100%	▲ 76-100%	—	—	—	—
Ortho-phosphate-P	—	—	—	—	—	—	—	—	—	—	—	—	—
Total Phosphate	—	—	—	—	*	*	—	*	—	*	—	—	—
Total Organic Carbon	—	—	—	—	—	—	—	—	—	—	—	—	—
Total Aluminum	*	*	—	—	—	—	—	—	—	—	—	—	—
Total Antimony	—	—	—	—	▲ 0-25%	▲ 26-50%	▲ 26-50%	▲ 26-50%	▲ 26-50%	▲ 0-25%	▲ 0-25%	—	—
Total Arsenic	—	—	—	—	▲ 0-25%	▲ 26-50%	—	—	—	—	—	—	—
Total Copper	*	*	*	*	—	—	—	*	*	*	*	*	*
Total Iron	—	*	—	—	—	—	—	—	—	—	—	—	—
Total Molybdenum	—	—	—	—	▲ 76-100%	▲ 76-100%	▲ 76-100%	▲ 76-100%	▲ 76-100%	▲ 76-100%	▲ 76-100%	▲ 76-100%	▲ 76-100%
Total Nickel	—	—	—	—	▲ 76-100%	▲ 76-100%	▲ 76-100%	▲ 26-50%	▲ 26-50%	▲ 0-25%	—	—	—
Total Selenium	—	—	—	—	—	—	—	—	—	—	—	—	—
Total Strontium	—	—	—	—	▲ 76-100%	▲ 76-100%	▲ 76-100%	▲ 76-100%	▲ 76-100%	▲ 76-100%	▲ 76-100%	▲ 76-100%	▲ 26-50%
Total Uranium	—	—	—	—	▲ 76-100%	▲ 76-100%	▲ 76-100%	▲ 26-50%	▲ 0-25%	—	—	—	—
Total Zinc	—	—	—	—	—	—	—	—	—	—	—	—	—

Sediment Quality

	Grizzly	Lower PDC	Kodiak	Kodiak-Little	Leslie	Moose	Moose-Nero	Nema	Nema-Martine	Slipper	Slipper-Lac de Gras	Lac de Gras S2	Lac de Gras S3
					LLCF → Downstream								
Total organic carbon	●	●	—	●	—	—	●	—	●	—	●	—	—
Available phosphorus	●	●	—	●	—	—	●	—	●	—	●	—	—
Total nitrogen	●	●	—	●	—	—	●	—	●	—	●	—	—
Aluminum	●	●	—	●	—	—	●	—	●	—	●	—	—
Antimony ^	●	●	—	●	◆	◆	●	◆	●	◆	●	—	—
Arsenic	●	●	—	●	*	*	●	*	●	*	●	*	*
Copper	●	●	—	●	—	—	●	—	●	—	●	—	—
Molybdenum	●	●	—	●	▲ 26-50%	▲ 76-100%	●	▲ 76-100%	●	▲ 76-100%	●	—	—
Nickel	●	●	—	●	—	—	●	—	●	—	●	—	—
Selenium	●	●	—	●	—	—	●	—	●	—	●	—	—
Strontium ^	●	●	—	●	◆	◆	●	◆	●	◆	●	◆	◆
Zinc	●	●	—	●	—	—	●	—	●	—	●	—	—

Biology

	Grizzly	Lower PDC	Kodiak	Kodiak-Little	Leslie	Moose	Moose-Nero	Nema	Nema-Martine	Slipper	Slipper-Lac de Gras	Lac de Gras S2	Lac de Gras S3
					LLCF → Downstream								
Chlorophyll *a* Concentration	●	●	—	●	—	—	●	—	●	—	●	—	—
Phytoplankton Density	●	●	—	●	—	—	●	—	●	—	●	—	—
Phytoplankton Diversity	●	●	—	●	▼ 51-75%	—	●	—	●	—	●	—	—
Relative Densities of Major Phytoplankton Taxa	●	●	—	●	◆	◆	●	◆	●	◆	●	—	—
Zooplankton Biomass	●	●	—	●	—	—	●	—	●	—	●	—	—
Zooplankton Density	●	●	—	●	—	—	●	—	●	—	●	—	—
Zooplankton Diversity	●	●	—	●	▼ 51-75%	▼ 0-25%	●		●	—	●	—	—
Relative Densities of Major Zooplankton Taxa	●	●	—	●	◆	◆	●	◆	●	—	●	—	—
Lake Benthos Density	●	●	—	●	—	—	●	—	●	—	●	—	—
Lake Benthos Dipteran Diversity	●	●	—	●	—	—	●	—	●	—	●	—	—
Lake Benthos Dipteran Relative Density	●	●	—	●	—	—	●	—	●	—	●	—	—
Stream Benthos Density	●	●	—	●	●	●	—	●	—	●	—	●	●
Stream Benthos Dipteran Diversity	●	●	—	●	●	●	—	●	—	●	—	●	●
Stream Benthos Dipteran Relative Density	●	●	—	●	●	●	—	●	—	●	—	●	●
Stream Benthos EPT Diversity	●	●	—	●	●	●	—	●	—	●	—	●	●

Notes:

+The direction and degree of change was inferred from historical data. For water quality data, differences were assessed relative to data from 2000 (August lakes and streams), 2002 (April lakes), the first year in which data was collected (i.e., TOC = 2005; chloride in streams = 2001). The season in which the greatest change occurred (i.e. April or August) is represented in the table. For sediment quality data, differences were assessed relative to the first year in which data was collected (i.e. 2005). For phytoplankton and zooplankton data, differences were assessed relative to the first year in which data was collected (i.e. 2003 for Leslie Lake) or to baseline years (Moose Lake).

+For water and sediment quality data, % change was calculated as 1-(historical concentration/current concentration). For biology data, % change was calculated as (current concentration/historical concentration).

** Indicates that the upper bound of the 95% CI exceeded the SSWQO, IPS, or CCME guideline value during the ice-covered or open water season.*

^ Concentrations were not compared to historical data because only two years of data exist.

Legend:

Increased over time in comparison to reference lakes/streams or different from a constant+
▲ 0-25% ▲ 26-50% ▲ 51-75% ▲ 76-100%

Decreased over time in comparison to reference lakes/streams or different from a constant+
▼ 0-25% ▼ 26-50% ▼ 51-75% ▼ 76-100%

— Did not change over time or differ significantly over time from reference lakes/streams

● Variable was not sampled at this lake/stream

◆ Changed over time

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Figure 7.2-3

Summary of Effects in the Variables Evaluated for the Koala Watershed and Lac de Gras, 2011

- total alkalinity (downstream to Slipper-Lac de Gras)
- water hardness (downstream to Site S3 in Lac de Gras);
- Under-ice temperature profiles indicated a trend towards cooling in all lakes downstream of the LLCF total dissolved solids (downstream to Site S3 in Lac de Gras);
- chloride (downstream to Site S3 in Lac de Gras);
- sulphate (downstream to Site S3 in Lac de Gras);
- potassium (downstream to Site S3 in Lac de Gras);
- total ammonia-N (downstream to Nema Lake);
- nitrite-N (downstream to Nema Lake);
- nitrate-N (downstream to Nema-Martine);
- total antimony (downstream to Slipper-Lac de Gras);
- total arsenic (downstream to Moose Lake);
- total molybdenum (downstream to Site S3 in Lac de Gras);
- total nickel (downstream to Slipper Lake);
- total strontium (downstream to Site S3 in Lac de Gras); and
- total uranium (downstream to Nema-Martine).

For each of the variables evaluated in the AEMP, a summary of statistical and graphical analyses is provided with an associated table and figure. For example, the summary provided for nitrate-N was (Table 7.2-4; Figure 7.2-2; Rescan 2012b):

> ***Summary**: Statistical and graphical analyses suggest that nitrate-N concentrations have increased in monitored lakes and streams downstream of the LLCF as far as Nema-Martine as a result of mine operations. Increased nitrate-N concentrations downstream from the LLCF are likely associated with the oxidation of ammonia, and then nitrite, from blast-residue in PK. The upper 95% confidence interval of the fitted mean nitrate-N concentration exceeded Environment Canada's Ideal Performance Standard of 4.7 mg/L (Guy 2008) in Leslie Lake and Moose Lake in April and August 2011. However, nitrate-N concentrations were less than the hardness-dependent SSWQO for nitrate-N at all sites in 2011.*

CCME guidelines for the protection of aquatic life exist for 11 of the evaluated water quality variables, including pH, total ammonia-N, nitrite-N, aluminum, arsenic, copper, iron, nickel, selenium, uranium, and zinc (CCME 2007). In addition, BHP Billiton recently established SSWQO for six variables, including chloride, potassium, sulphate, nitrate-N, total molybdenum and total vanadium (Elphick et al. 2011; Report 52, Report 54, Report 53, Report 47 and Report 55). Nitrate-N concentrations are also compared to Environment Canada's Ideal Performance Standard of 4.7 mg/L (Guy 2008). Total phosphate-P concentrations are compared to lake-specific benchmark trigger values that were established using guidelines set out in the Canadian Guidance Framework for the Management of Phosphorus in Freshwater Systems, the Ontario Ministry of Natural Resources, and Environment Canada (Ontario Ministry of Natural Resources 1994; CCME 2004; Environment Canada 2004b).

Table 7.2-4. Statistical Results of Nitrate-N Concentrations in Lakes and Streams in the Koala Watershed and Lac de Gras

	Month	Lake / Stream	Lakes / Streams Removed from Analysis	Model Type (LME/Tobit)	Model Fit	Significant Monitored Contrasts[1]			Statistical Report Page No.[2]
						Model Fit = 1	Model Fit = 3	Model Fit = 2	
Nitrate	Apr	Lake	-	Tobit	3	-	Grizzly, Kodiak, Leslie, Moose, Nema, Slipper, S2	Grizzly, Kodiak	143
	Aug	Lake	Counts, Nanuq, Vulture, Kodiak, Slipper, S2, S3	Tobit	1	Moose, Nema	-	-	149
	Aug	Stream	Counts Outflow, Nanauq Outflow, Kodiak-Little, Slipper-Lac de Gras	Tobit	1	Lower PDC, 1616-30 (LLCF), Moose-Nero, Nema-Martine	-	-	154

Notes: Dashes indicate not applicable.
LME is Linear Mixed Effects Regression
[1]: Refers to the best fit model (LME or tobit) for each variable in the reference and monitored lakes and streams that were sampled in the Koala Watershed and Lac de Gras in April (lakes only) and August. See Part 1 Effects Analysis of the 2011 AEMP.
[2]: Refers to the page number of Part 3 Statistical Analysis of the 2011 AEMP.

A review of water quality guidelines in Canada and the United States, and of literature in the Ecotox database, was recently completed and the results provided in Appendix 1 of the *Water Quality Modelling of the Koala Watershed* report (Report 51). The resulting table of preliminary long-term water quality benchmark values formed the basis of Effluent Quality Criteria evaluation during EKATI's water licence renewal process and for comparison to the 2011 AEMP water quality results (Table 7.2-5). In 2010 and 2009 BHP Billiton established SSWQOs for chloride and molybdenum only and instead compared water quality to applicable CCME guidelines and the Ideal Performance Standard for nitrate-N.

Table 7.2-5. EKATI Water Quality Benchmarks Used for the AEMP Effects Analysis

Variable	Source	Benchmark Value	Notes
Physical/Ion			
pH	CCME	6.5 to 9 pH units	
Chloride	SSWQO	116.1 * ln(hardness) – 204.1	Hardness as mg/L $CaCo_3$;(Elphick et al. 2011)
Sulphate	SSWQO	$e^{(0.4163 \times \ln(\text{hardness}) + 4.878)}$	Hardness as mg/L $CaCO_3$
Potassium	SSWQO	41	
Nutrients/Organics			
Total Ammonia-N	CCME	Dependent on pH and temperature (see Table 2.3-3)	
Nitrate-N	SSWQO or Ideal Performance Standard	$e^{(0.9518 [\ln(\text{hardness})] - 2.032)}$ or 4.7	Hardness as mg/L $CaCO_3$
Nitrite-N	CCME	0.06	
Total Phosphate-P	CCME	Trigger value or if phosphorus concentrations increase more than 50% over the average level during baseline years (see Table 2.3-4)	

(continued)

Table 7.2-5. EKATI Water Quality Benchmarks Used for the AEMP Effects Analysis (completed)

Variable	Source	Benchmark Value	Notes
Total Metals			
Aluminum	CCME	0.005 or 0.1	pH < 6.5 or pH ≥ 6.5
Arsenic	CCME	0.005	
Copper	CCME	$e^{(0.8545 [ln(hardness)] - 1.465)}$*0.2/1000 (minimum is 0.002 mg/L regardless of water hardness)	Hardness as mg/L $CaCO_3$
Iron	CCME	0.300	
Molybdenum	SSWQO	19.38	
Nickel	CCME	$e^{(0.76 [ln(hardness)] - 1.06)}$/1000 (minimum is 0.025 mg/L regardless of water hardness)	Hardness as mg/L $CaCO_3$
Selenium	CCME	0.001	
Uranium	CCME	0.015	
Zinc	CCME	0.03	Hardness as mg/L $CaCO_3$

Note: Units are mg/L unless otherwise specified.

Table 7.2-6 provides a summary of water quality variables that have exceeded the above benchmarks in lakes downstream of the LLCF, KPSF, and/or reference lakes (only sites sampled as part of or included in the AEMP). At the time of reporting the SSWQO for vanadium was not available but was available for the recent submission of the Water Licence renewal. The relevant AEMP reports (e.g., Rescan 2012b) provide the details regarding if the exceedance was related to the sample concentration, the fitted mean, or 95% confidence intervals of the fitted mean. In addition the relevant AEMP reports provide the percentage of samples exceeding the relevant benchmark as well as the factor by which the benchmark was exceeded. If exceedances were also observed in reference lakes it was concluded that elevated concentrations were naturally occurring. It was concluded that nitrate-N and molybdenum were related to mine activities between the 2009 to 2011 reporting period (Table 7.2-6). Summary of SNP sample frequency and discharge criteria are provided in the EKATI Environmental Agreement and Water Licence Annual Reports (Reports 25, 40, and 59) and the results of sampling are submitted to the WLWB on a monthly basis.

Table 7.2-6. Summary of Water Quality Variable Exceedances at AEMP Sites, 2009 to 2011

Year	Downstream of LLCF?	Downstream of KPSF?	Reference Lakes or Streams and Others[1]	Conclusions
2011	• pH • nitrate-N • total phosphate-P • total aluminum • total copper • total iron	• pH • total phosphate-P • total aluminum • total copper	• pH • total phosphate-P • total aluminum • total copper • total iron	Total nitrate-N exceedances are likely related to mine activities.
2010	• nitrate-N • total molybdenum	• pH • total iron	• pH • total iron • total aluminum • total copper	Nitrate-N and total molybdenum exceedances are likely related to mine activities.
2009	• total copper • nitrate-N • total molybdenum	n/a	• pH • total aluminum • total copper	Nitrate-N and total molybdenum exceedances are likely related to mine activities.

Notes: n/a indicates that no water variables exceeded relevant benchmarks.
[1] Includes Kodiak Lake, Kodiak-Little, Grizzly Lake and Lower PDC.

Effects were detected in 2011 for 14 variables in the evaluated lakes and streams in the King-Cujo Watershed and Lac du Sauvage (Report 56; Figure 7.2-4). In three cases (total copper, total ammonia-N, and total iron), concentrations have returned to baseline concentrations in recent years, with no mine effects detected in 2011 (Figure 7.2-4). Concentrations remain elevated above baseline or reference concentrations in 11 cases (Figure 7.2-4):

- pH (downstream to Christine-Lac du Sauvage);
- total alkalinity (downstream to Christine-Lac du Sauvage);
- water hardness (downstream to Christine-Lac du Sauvage);
- total dissolved solids (downstream to Christine-Lac du Sauvage);
- chloride (downstream to Cujo Outflow);
- sulphate (downstream to Christine-Lac du Sauvage);
- potassium (downstream to Christine-Lac du Sauvage);
- total organic carbon (downstream to Cujo Outflow);
- total molybdenum (downstream to Cujo Outflow);
- total strontium (downstream to Christine-Lac du Sauvage); and
- total uranium (downstream to Cujo Outflow).

The *2008-2009 Fay Bay Monitoring Program* report indicated that only localized effects within Fay Bay and Fay-Upper Exeter Stream remained in 2009 (Report 19). The 2010 Fay Bay aquatic monitoring program and effects analysis indicated that some effects remain three years after the unplanned PK release; however, affected variable concentrations are decreasing toward baseline concentrations. Water quality variables that continued to be affected following the 2010 monitoring include:

- pH (Fay Bay to Fay-Upper Exeter);
- alkalinity (Fay Bay to Fay-Upper Exeter);
- total dissolved solids (Fay Bay to Fay-Upper Exeter);
- chloride (Fay Bay);
- potassium (Fay Bay to Fay-Upper Exeter);
- ammonia-N (Fay Bay);
- total chromium (Fay-Upper Exeter);
- total molybdenum ((Fay Bay to Fay-Upper Exeter);
- total nickel (Fay Bay to Fay-Upper Exeter);
- total strontium (Fay Bay to Fay-Upper Exeter).

In general, the 2010 Fay Bay Monitoring Program sites had low metal and nutrient concentrations and only one CCME guideline was exceeded. In February 2010, two samples from Fay Bay Site 5 had copper concentrations greater than the CCME guideline. These samples exceeded the guideline by a mean factor of 1.63 and represented 25% of the samples collected during the ice covered season. None of the other evaluated variables exceeded a CCME guideline or available SSWQOs (see Report 35).

PROJECT # 0648-121-01 ILLUSTRATION # a36359w-EIR June 12, 2012

Water Quality

(KPSF → Downstream)

	Cujo Lake	Cujo Outflow	Chirstine-Lac du Sauvage	Lac du Sauvage LdS1	Lac du Sauvage LdS2
Under-ice Temperature	—	●	●	—	●
Under-ice Dissolved Oxygen	—	●	●	—	●
Secchi Depth	—	●	●	—	●
pH	▲ 0-25%	▲ 0-25%	▲ 0-25%	—	*
Alkalinity	▲ 51-75%	▲ 76-100%	▲ 26-50%	—	—
Hardness	▲ 76-100%	▲ 76-100%	▲ 51-75%	—	—
Total Dissolved Solids	▲ 76-100%	▲ 76-100%	▲ 76-100%	—	—
Chloride	▲ 51-75%	▲ 51-75%	—	—	—
Sulphate	▲ 76-100%	▲ 76-100%	▲ 76-100%	—	—
Potassium	▲ 76-100%	▲ 76-100%	▲ 51-75%	—	—
Total Ammonia-N	—	—	—	—	—
Nitrite-N	—	—	—	—	—
Nitrate-N	—	—	—	—	—
Ortho-phosphate-P	—	—	—	—	—
Total Phosphate	*	—	—	*	*
Total Organic Carbon	▲ 0-25%	▲ 0-25%	—	—	—
Total Aluminum	—	—	—	—	*
Total Antimony	—	—	—	—	—
Total Arsenic	—	—	—	—	—
Total Copper	*	*	*	*	*
Total Iron	—	—	—	—	—
Total Molybdenum	▲ 76-100%	▲ 76-100%	—	—	—
Total Nickel	—	—	—	—	—
Total Selenium	—	—	—	—	—
Total Strontium	▲ 76-100%	▲ 76-100%	▲ 51-75%	—	—
Total Uranium	▲ 76-100%	▲ 76-100%	—	—	—
Total Zinc	—	—	—	—	—

Sediment Quality

(KPSF → Downstream)

	Cujo Lake	Cujo Outflow	Chirstine-Lac du Sauvage	Lac du Sauvage LdS1	Lac du Sauvage LdS2
Total organic carbon	—	●	●	—	—
Available phosphorus	—	●	●	—	—
Total nitrogen	—	●	●	—	—
Aluminum	—	●	●	—	—
Antimony	—	●	●	—	—
Arsenic	*	●	●	*	*
Copper	—	●	●	—	—
Molybdenum	—	●	●	—	—
Nickel	—	●	●	—	—
Selenium	—	●	●	—	—
Strontium	—	●	●	—	—
Zinc	—	●	●	—	—

Biology

(KPSF → Downstream)

	Cujo Lake	Cujo Outflow	Chirstine-Lac du Sauvage	Lac du Sauvage LdS1	Lac du Sauvage LdS2
Chlorophyll *a* Concentration	—	●	●	—	●
Phytoplankton Density	▼ 0-25%	●	●	—	●
Phytoplankton Diversity	▼ 76-100%	●	●	—	●
Relative Densities of Major Phytoplankton Taxa	◈	●	●	—	●
Zooplankton Biomass	—	●	●	—	●
Zooplankton Density	—	●	●	—	●
Zooplankton Diversity	—	●	●	—	●
Relative Densities of Major Zooplankton Taxa	—	●	●	—	●
Lake Benthos Density	—	●	●	—	●
Lake Benthos Dipteran Diversity	—	●	●	—	●
Lake Benthos Dipteran Relative Density	—	●	●	—	●
Stream Benthos Density	●	—	—	●	●
Stream Benthos Dipteran Diversity	●	—	—	●	●
Stream Benthos Dipteran Relative Density	●	—	—	●	●
Stream Benthos EPT Diversity	●	—	—	●	●

Notes:

+The direction and degree of change was inferred from historical data. For water quality data, differences were assessed relative to data from 2000 (August lakes and streams), 2002 (April lakes), the first year in which data was collected (i.e., TOC = 2005; chloride in streams = 2001). The season in which the greatest change occurred (i.e. April or August) is represented in the table. For sediment quality data, differences were assessed relative to the first year in which data was collected (i.e. 2005). For phytoplankton and zooplankton data, differences were assessed relative to the first year in which data was collected (i.e. 1999 for Cujo Lake).

+For water and sediment quality data, % change was calculated as 1-(historical concentration/current concentration). For biology data, % change was calculated as (current concentration/historical concentration).

** Indicates that the upper bound of the 95% CI exceeded the SSWQO, IPS, or CCME guideline value during the ice-covered or open water season.*

Legend:

Increased over time in comparison to reference lakes/streams or different from a constant+

▲ 0-25% ▲ 26-50% ▲ 51-75% ▲ 76-100%

Decreased over time in comparison to reference lakes/streams or different from a constant+

▼ 0-25% ▼ 26-50% ▼ 51-75% ▼ 76-100%

— Did not change over time or differ significantly over time from reference lakes/streams

● Variable was not sampled at this lake/stream

◈ Changed over time

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Figure 7.2-4

Summary of Effects in the Variables Evaluated for the King-Cujo Watershed and Lac du Sauvage, 2011

7.2.2.4 Changes in Sediment Quality

Historically, changes in sediment quality in receiving lakes have been deemed negligible. Observed sediment quality has been variable, which is likely due to natural processes rather than mine activities. However, in 2005 mine effects related to molybdenum concentrations in sediments of Leslie, Moose, Nema, and Slipper lakes were detected. This was assumed to be due to deposition of molybdenum-bound particulates and was related to increases in total molybdenum in the water column caused by LLCF effluent.

In 2008, the molybdenum concentrations in both mid-depth and deep-depth sediments were found to have increased in the lakes downstream of the LLCF discharge. Although arsenic concentrations in the mid- and deep-depth sediments of some of the monitored lakes exceeded the CCME guideline, this guideline was also exceeded in the reference lakes (CCME 2002). It was concluded that arsenic concentrations in lake sediments were not affected by mine activities.

In 2011, total antimony, total molybdenum, and total strontium showed evidence of change in the Koala Watershed lakes sediments (Figure 7.2-3). None of the evaluated sediment parameters showed evidence of change in the King-Cujo Watershed or Lac du Sauvage (Figure 7.2-4). CCME guidelines for the protection of aquatic life exist for three of the evaluated sediment parameters, including arsenic, copper, and zinc (CCME 2002). In general, the 95% confidence intervals around mean sediment quality parameter concentrations were less than their respective CCME guideline values. Arsenic concentrations in sediments were an exception, with concentrations exceeding CCME guideline values at both mid and deep depths in all monitored lakes except at mid depth in Moose and Nema lakes. CCME guidelines for arsenic concentrations in sediments were also exceeded at both depths in all reference lakes except at deep depth in Vulture Lake. Thus, elevated arsenic concentrations in lake sediments downstream of the LLCF are not related to mine activities. In 2011 there were no cases of the 95% confidence intervals around mean sediment quality parameter concentrations exceeding their respective CCME guideline values (Figures 7.2-3 and 7.2-4).

Following the unplanned release of PK into Fay Bay, the area of PK deposition in Fay Bay was mapped (Report 19). The mapping indicated that the PK was deposited in Fay Bay in decreasing thickness moving away from the zone of entry and no PK was found downstream in Fay-Upper Exeter. The PK was observed in both littoral zone (less than 2 m) and deep-water habitats; however, the PK was not observed in rare or critical fish habitat in Fay Bay. The overall physical composition of the sediments (including sediment collected from the zone of entry) did not differ when compared to baseline conditions. Metal concentrations tended to be greatest in sediments collected from the zone of entry; however, concentrations were generally in the range of baseline conditions for Fay Bay and reference lakes. The following sediment quality variables were found to have changed in mid- and shallow-depth sites in Fay Bay following the PK release:

- total available phosphate-P (mid-depth); and
- total nitrogen.

In addition, there was a small increase in both total organic carbon and total mercury concentrations in sediments collected from Fay Bay that may be related to the PK release. It was concluded that the PK release did not affect the overall chemical nature of the sediment in Fay Bay (except for some nutrients) and no further sediment sampling in Fay Bay was recommended.

7.2.2.5 Changes to Aquatic Assemblages

Although not predicted in the 1995 EIS, there have been a number of effects related to aquatic assemblages (i.e., phytoplankton, zooplankton, and benthos) as a result of changes in water quality or sediment quality.

Results from the 2011 water and sediment quality analyses in the Koala Watershed and Lac de Gras suggest that adverse changes might be expected in biological communities downstream of the LLCF as far as Moose Lake. Four changes in biological variables were documented in 2011 (Figure 7.2-3):

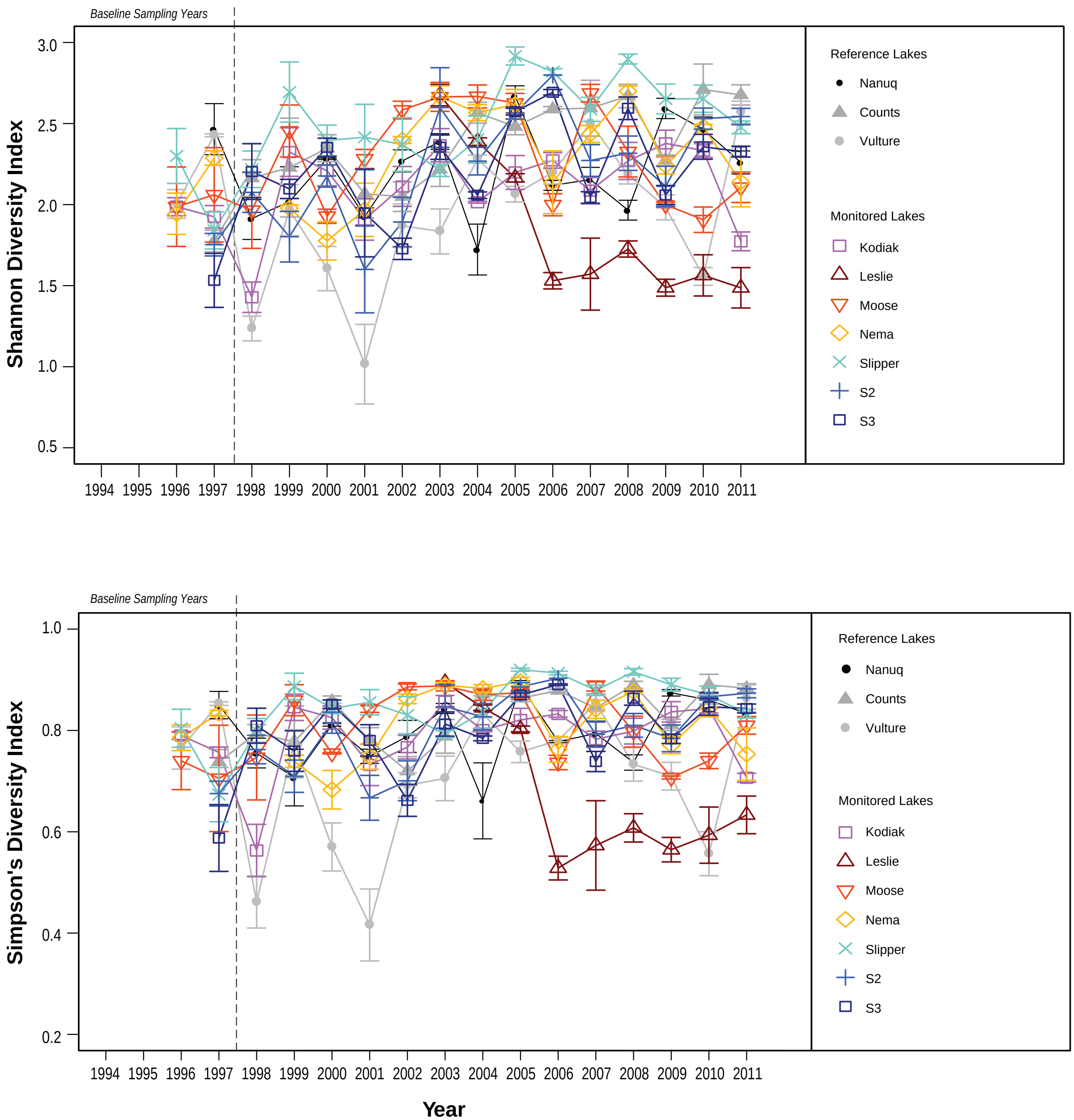
- decreased phytoplankton diversity in Leslie Lake (Figure 7.2-5);
- altered taxonomic composition of phytoplankton assemblages in Leslie, Moose, Nema, and Slipper lakes (Figure 7.2-6);
- decreased zooplankton diversity in Leslie and Moose lakes (Figure 7.2-7); and
- altered taxonomic composition of zooplankton assemblages in Leslie, Moose, and Nema lakes (Figure 7.2-8).

The decline in diversity was associated with changes in the taxonomic composition of the phytoplankton community in Leslie Lake. In fact, phytoplankton community composition has shifted in all lakes downstream of the LLCF as far as Nema Lake, with a decrease in the relative densities of cyanophytes (blue-green algae) and increase in the proportion of Bacillariophyceae (diatoms) through time. These shifts are likely related to the increase in nitrate concentrations following the onset and subsequent expansion of underground mining operations in 2002. More recently, phytoplankton community composition has shifted a second time in Leslie Lake. Specifically, there has been a reduction in the proportion of diatoms and increase in the relative density of chlorophytes (green algae), which are usually rare in sub-Arctic freshwater systems in the NT. This more recent shift in phytoplankton community composition in Leslie Lake is likely related to the addition of phosphorous in the LLCF, which began in 2009 and continued through 2010 and 2011 as an adaptive management response to increased nitrate concentrations (e.g., Report 49).

In contrast to the patterns observed in monitored lakes, phytoplankton community composition has been relatively stable through time in reference lakes. Thus, the observed shifts in phytoplankton community composition, in combination with the corresponding spatial gradient in nitrogen concentrations, suggest that mining operations have affected phytoplankton community composition downstream of the LLCF as far as Nema Lake. The changes in phytoplankton community composition have not adversely affected diversity indices in any lake other than Leslie Lake.

Although zooplankton biomass and density have been stable through time in all monitored and reference lakes, zooplankton diversity has declined in lakes downstream of the LLCF as far as Moose Lake. The decrease in zooplankton diversity in Leslie and Moose lakes was associated with a shift in community composition that extended as far as Nema Lake. In these lakes, cladocerans (particularly *Holopedium gibberum*) and rotifers (particularly *Conohilus* sp. and *Kellicottia longispina*) have been replaced by cyclopoid copepods. The changes in zooplankton community composition are likely related to two aspects of changes in water quality. First, rotifers and cladocerans are generally sensitive to changes in water quality. For example, many rotifers are intolerant of conductivity greater than 400 µs/cm, which is in the range of values observed in lakes immediately downstream of the LLCF. Cladocerans are particularly sensitive to chloride toxicity and although chloride concentrations were below the SSWQO at all sites in 2011, the SSWQO is designed to protect 95% of species against long term exposure and some of the more sensitive species may be affected at levels below the SSWQO (Elphick et al. 2011). Second, the observed changes in phytoplankton community composition, on which zooplankton feed, are likely related to changes in nitrate and phosphorous concentrations. The link between changes in the diversity and composition of zooplankton communities and changes in water quality suggest that changes in zooplankton communities are likely mine effects.

Table of Contents



Notes: Symbols represent observed mean values.
Error bars indicate standard error of the observed means.

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Figure 7.2-5

Average Diversity Indices for Phytoplankton in Koala Watershed Lakes and Lac de Gras, August 1996 to 2011

◎ Table of Contents

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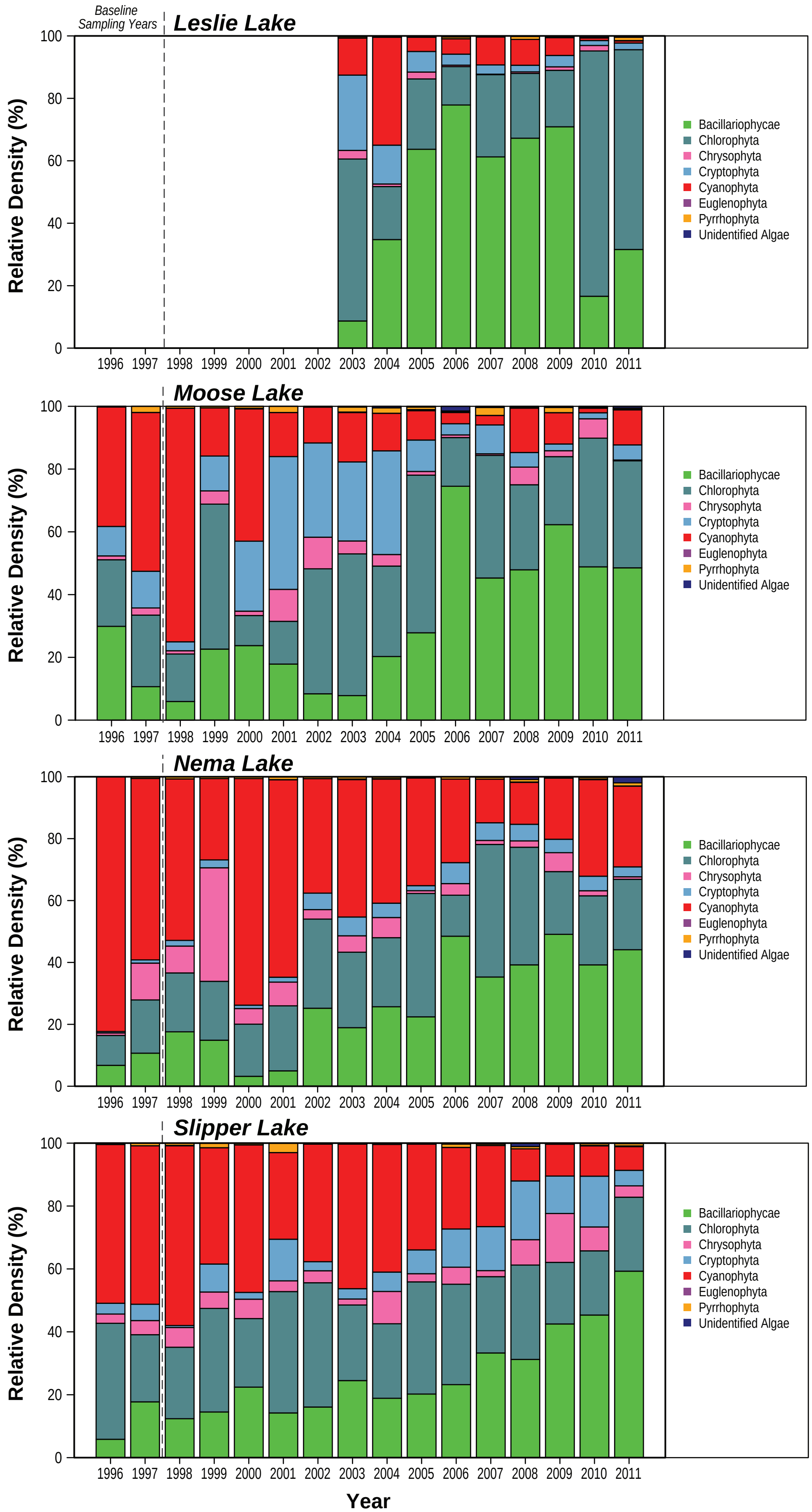

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Figure 7.2-6

Average Diversity Indices for Phytoplankton in Leslie, Moose, Nema and Slipper Lakes, August 1996 to 2011

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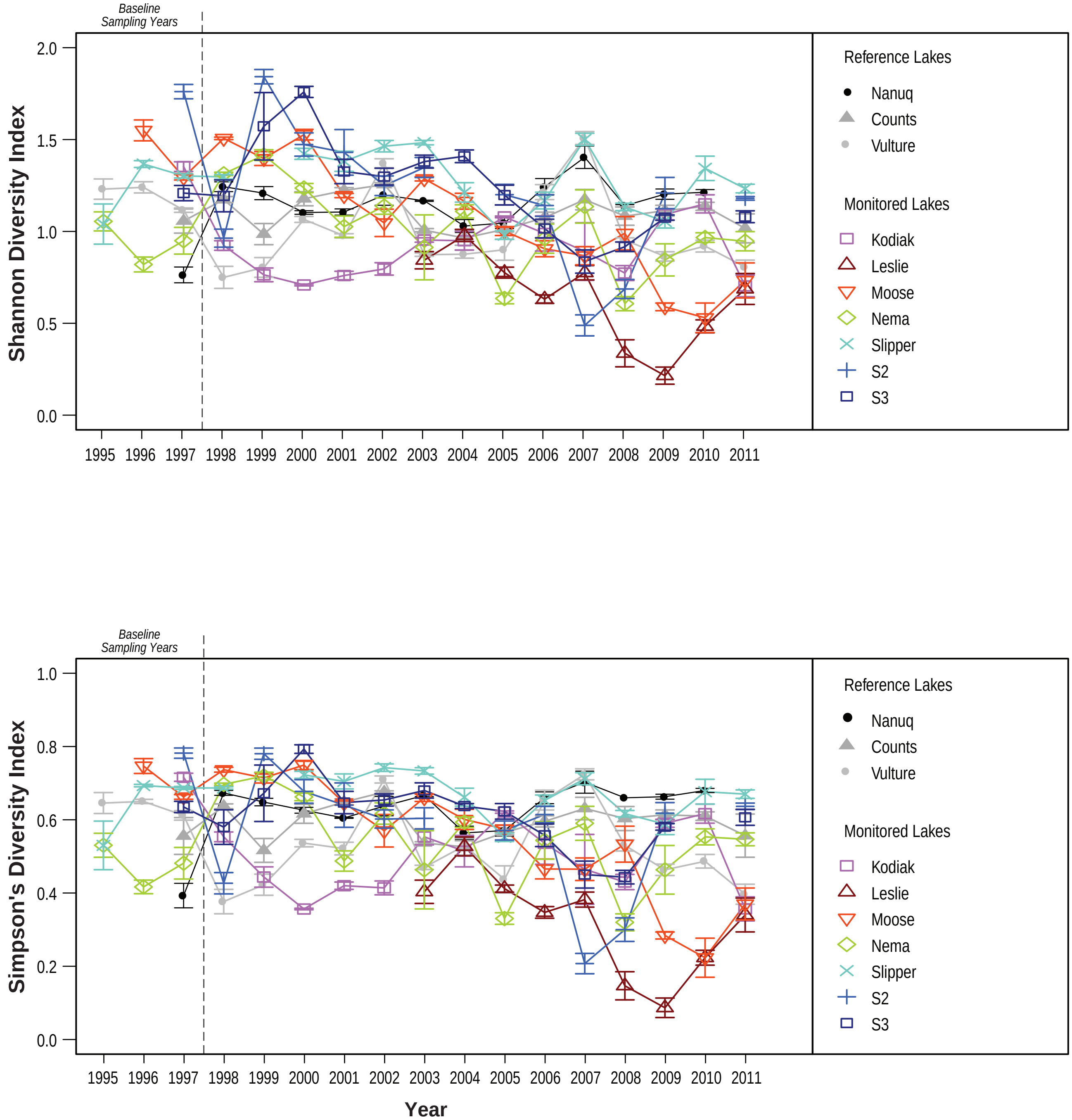

Notes: Symbols represent observed mean values.
Error bars indicate standard error of the observed means.

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Figure 7.2-7

Average Diversity Indices for Zooplankton in Koala Watershed Lakes and Lac de Gras, August 1995 to 2011

PROJECT # 0648-121-01 ILLUSTRATION # a37170f June 12, 2012

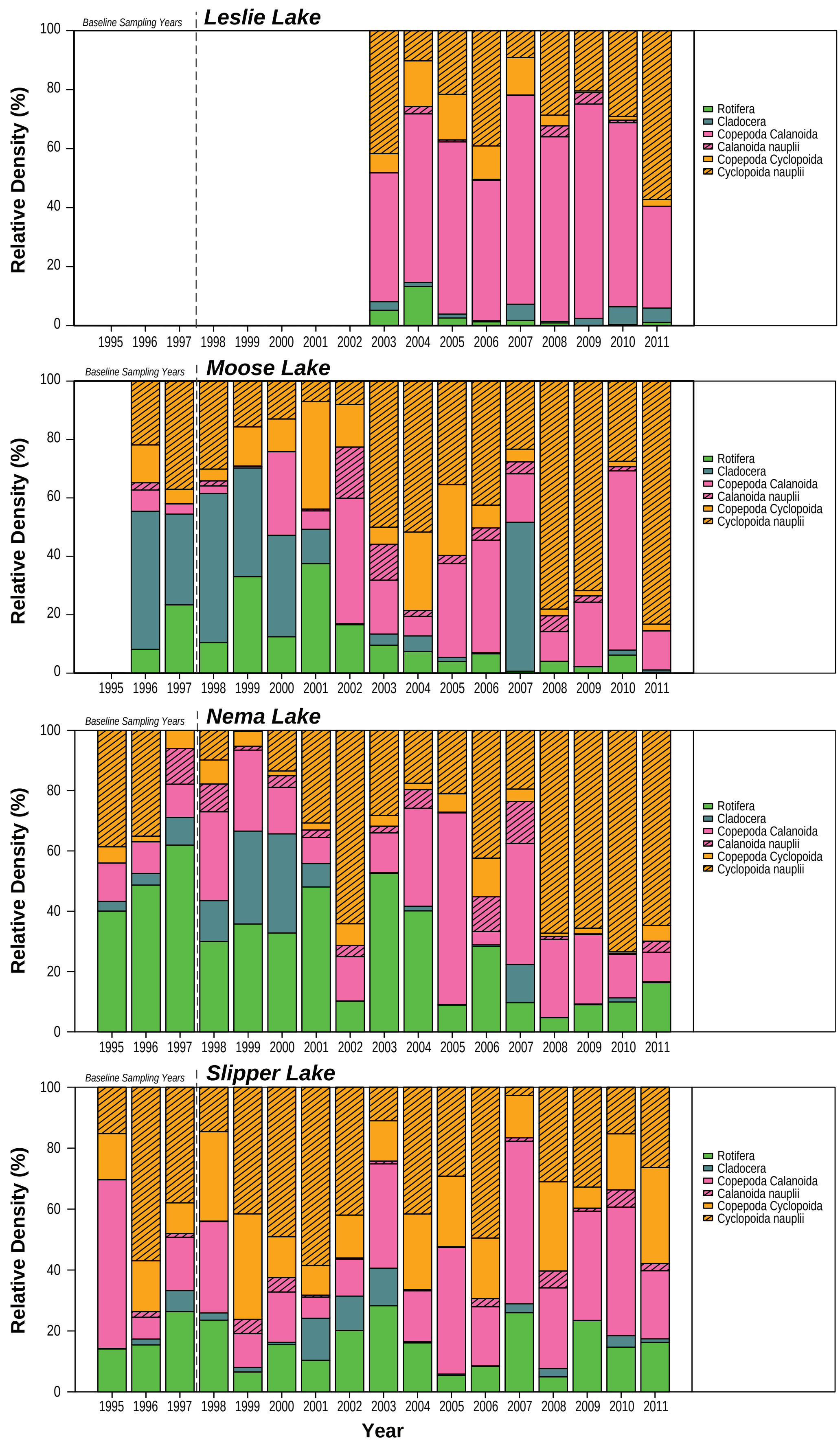

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Figure 7.2-8

Relative Densities of Zooplankton Taxa in Leslie, Moose, Nema and Slipper Lakes, 1995 to 2011

Benthos community compositions in lakes downstream of the LLCF have been variable among sampling years; however, no effects were detected (Report 56). No mine effects were detected with respect to stream benthos density, dipteran diversity, Ephemeroptera, Plecoptera, Trichoptera diversity, or dipteran community composition.

Three changes in biological variables downstream of the KPSF were observed in 2011:

- decreased phytoplankton density in Cujo Lake (Figure 7.2-9);
- decreased phytoplankton diversity in Cujo Lake (Figure 7.2-10); and
- change in phytoplankton community composition in Cujo Lake (Figure 7.2-11).

The decrease in phytoplankton density and diversity in Cujo Lake was associated with an increase in the relative density of cryptophytes in 2011. Cryptophytes are generally present in low densities in freshwater lakes, but are prone to sudden, short population spikes that usually follow blooms in the densities of other algal species (Wetzel 2001). Whether the increase in cryptophytes, and associated reduction in phytoplankton diversity, in Cujo Lake in 2011 represents a post-bloom population spike, an anomalous year, or the beginning of a new trajectory in community composition in Cujo Lake is unclear at this time. Thus it was concluded that the changes in phytoplankton community composition was not a mine effect.

A close examination of zooplankton species compositions suggests that the rotifer *Conochilus sp*. and the cladoceran *Holopedium gibberum*, have been largely absent from Cujo Lake since 2002. A similar trend was observed in lakes downstream of the LLCF. While *Conochilus sp.* returned to Cujo Lake in 2011, some genera of cladocerans have increased in numbers (*Bosmina*) or invaded (*Ceriodaphnia*, *Chydorus*) Cujo Lake in the last two to three years. The reason for the change in composition of cladoceran genera remains unclear. Regardless, zooplankton biomass, density, diversity, and overall community composition have remained relatively stable through time in Cujo Lake and site LdS1 in Lac du Sauvage.

No mine effects were detected in Cujo Lake, site LdS1 in Lac du Sauvage or Cujo Outflow with respect to benthos density, dipteran diversity, Ephemeroptera, Plecoptera, Trichoptera diversity, or dipteran community composition.

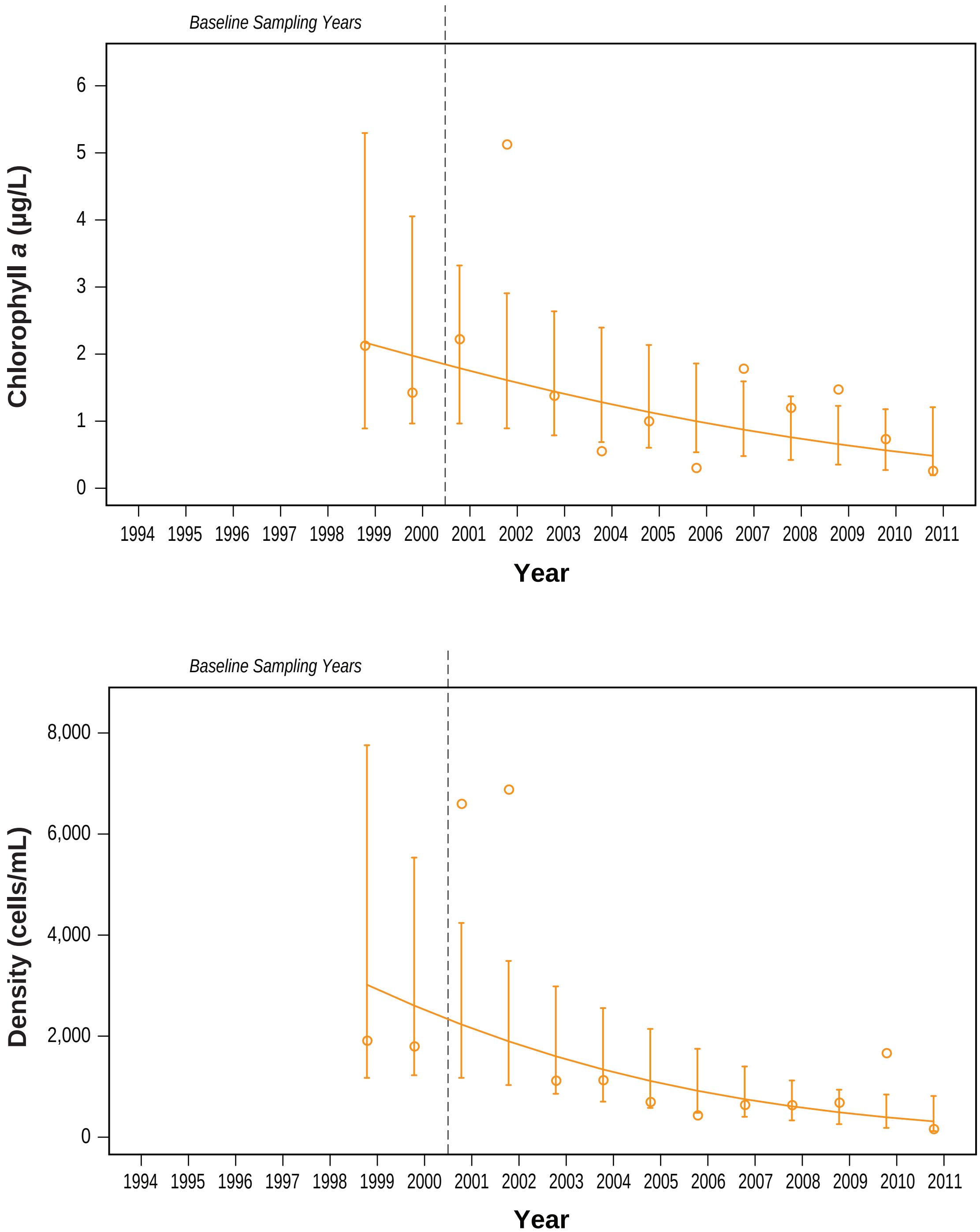
The phytoplankton communities at Fay Bay sites have changed since baseline years; however, similar changes have been observed at the reference lakes. The zooplankton community has largely returned to baseline conditions after the initial changes observed in 2008. However, zooplankton biomass remains elevated due to an increased proportion of large daphnids that is likely related to greater primary productivity and more nutritious algae in comparison to baseline years. There was little evidence to suggest PK effects on benthic communities in Fay Bay following the 2009 monitoring. The high variability in benthic community numbers and community composition associated with shallow sites and the small number of years of before and after the PK release monitoring likely limited the extent of the conclusions. The 2010 results indicated that the benthos community at Fay Bay remains unaffected by the unplanned PK release.

7.2.2.6 Changes in Water Quality of Waste Rock Seepage

Historically the following effects have been documented relative to the results of the waste rock seepage monitoring:

- elevated aluminum, ammonia, TSS, sulphate, hardness and conductivity, and reduced pH in seepage from the Panda WRSA;
- dissolved aluminum has exceeded discharge criterion at SEEP-018/019 from the Panda/ Beartooth WRSA because of pH reductions;

PROJECT # 0648-121-01 ILLUSTRATION # a37172f June 12, 2012



Notes: Symbols represent observed mean values.
Solid lines represent fitted curves.
Error bars indicate upper and lower 95% confidence intervals of the fitted means.

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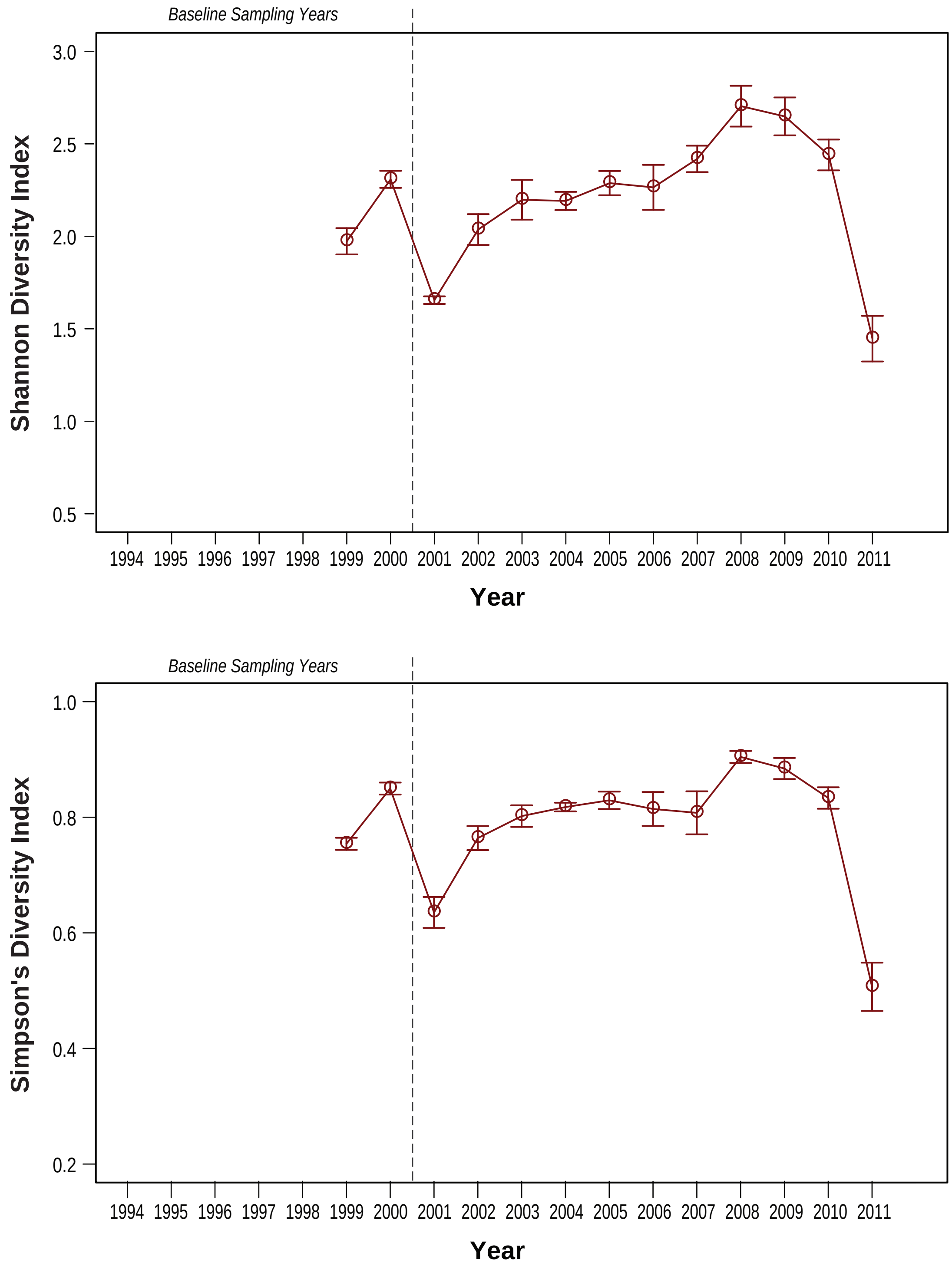
Figure 7.2-9

Observed and Fitted Means for Phytoplankton Density in Cujo Lake, August 1994 to 2011

PROJECT # 0648-121-01 ILLUSTRATION # a37173f June 12, 2012



Notes: Symbols represent observed mean values.
Error bars indicate standard error of the observed means

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Figure 7.2-10

Average Diversity Indices for Phytoplankton in Cujo Lake, August 1996 to 2011

PROJECT # 0648-121-01 ILLUSTRATION # a37174f July 3, 2012

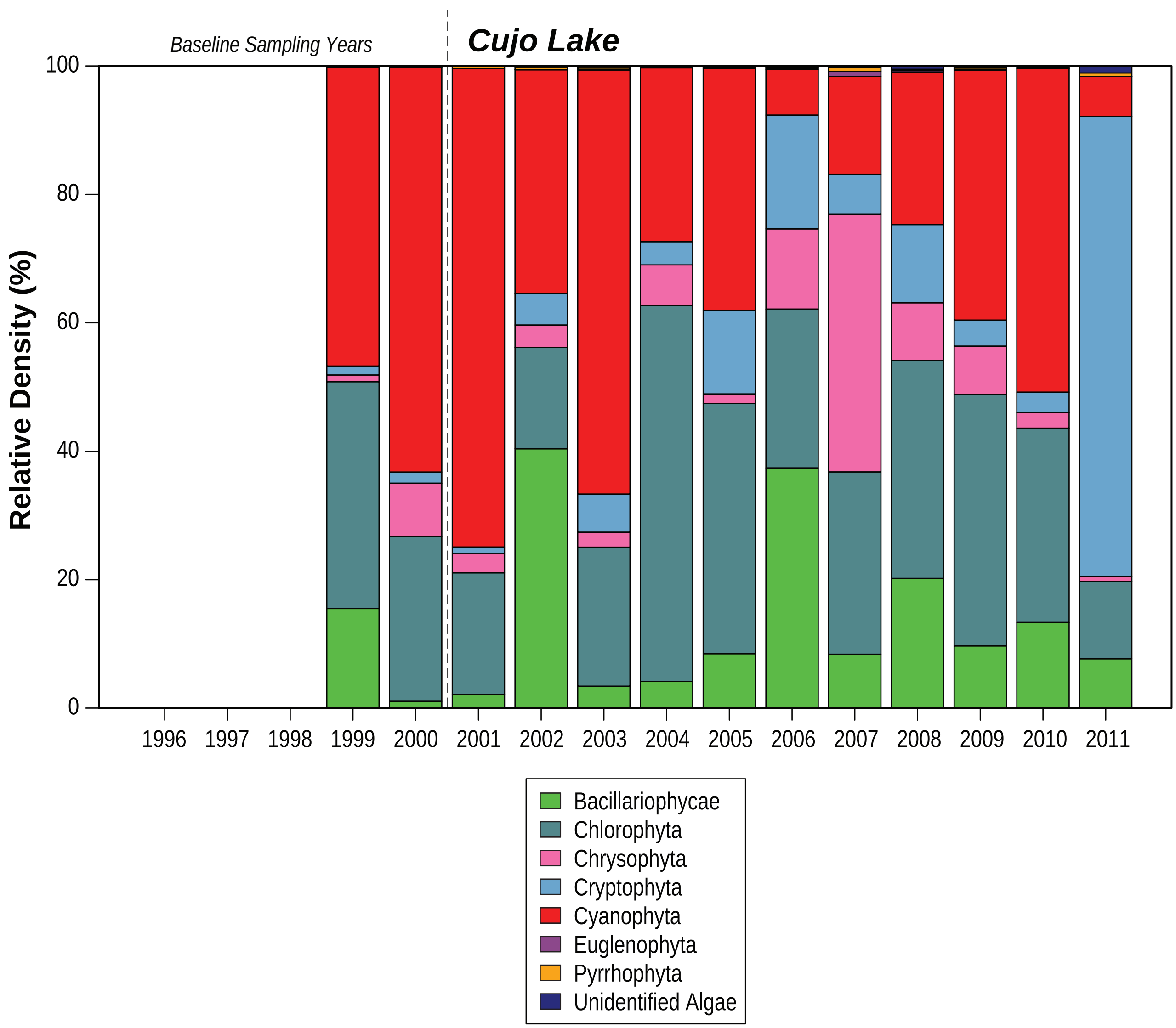

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Figure 7.2-11

Average Phytoplankton Density by Taxonomic Group for Cujo Lake, 1995 to 2011

- elevated aluminum and reduced pH in seepage from the CKRSA; and
- between 2006 and 2008, there was only one incident where water quality did not meet the discharge criterion of the Water Licence for seeps draining into the receiving environment. SEEP-081 in the Misery area and draining into Cujo Lake had a field pH below the lower limit, but it was likely this was a reflection of the natural variability in pH of surface water in contact with naturally acidic tundra soils. Several sites which form the Panda/Koala, Misery, and Fox monitoring stations had slightly acidic pHs and, for some (SEEP-018/019), elevated concentrations of aluminum. SEEP-018/19 had elevated aluminum concentrations but concentrations were within the Water Licence discharge criterion between 2006 and 2008.

Seepage monitoring stations around the Panda/Koala/Beartooth WRSA in 2009 generally showed similar results to previous years, with many parameters showing decreased concentrations compared to 2008. Although decreased, the continued presence of elevated sulphate, metals, and nitrogen species at these locations indicates ongoing leaching of waste rock weathering products and blast residues. Seepage chemistry at SEEP-019 showed decreased concentrations for many parameters relative to 2008, including total aluminum and nickel and all monitoring results for SEEP-019 were within the permitted ranges specified in Water Licence MV2009L2-0001. SEEP-357 also drains into Bearclaw Lake and the 2009 seepage chemistry results indicated the water was within the permitted ranges specified in Water Licence MV2009L2-0001.

These effects were also evident in 2010, where leaching of explosives residues from the Panda/Koala/Beartooth WRSA was found in elevated in SEEP-331, SEEP-018B, and SEEP-352 (ammonia concentration ranged between 0.5 mg and 1.2 mg N/L). SEEP-331, SEEP-018B, SEEP-019, and SEEP-352 with moderate sulphate (50 to 164 mg/L) show evidence of slight interaction with the waste rock. Moderate magnesium contents (5 to 43 mg/L) suggest that the interaction is predominantly with granitic waste rock, with perhaps a minor contribution from kimberlite weathering. SEEP-352 with high TSS and some total metals greater than dissolved metals has a suspended load likely reflecting dust in this high-traffic area. SEEP-019, and to a lesser extent SEEP-018B, show evidence in the bi-weekly sampling of removal of waste rock upstream, leading to spikes in TSS and total and dissolved metal concentrations in July. These had decreased substantially by early August. The only exceedance of water licence criteria for these seeps was SEEP-019, which exceeded the maximum concentration for any grab sample for TSS. This was a one-off exceedance in 2010 related to removal of waste rock upstream.

In 2011, ammonia concentrations (up to 0.18 mg N/L) had dropped slightly from 2010 or previous results, indicating reduced leaching of explosives residues from the WRSA. In the fall of 2011, increased sulphate, magnesium, calcium, and molybdenum in several seeps suggested leaching of small amounts of kimberlite in the WRSA or Sable Road bed caused by prolonged heavy rainfall, while the active layer was at its maximum extent. This was most evident in SEEP-357 and SEEP-018B. 2011 monitoring results were within the water licence criteria with the exception of TSS in the September 29 sample at SEEP-019 (29 mg/L), and the June 12 sample at SEEP-357 (51 mg/L). In both cases, the TSS are thought to result from material picked up locally within the tundra or channel bed, rather than material washed out of the WRSA. Aluminum at SEEP-019 which was above WL criteria from 2001 through 2005 has continued to decline in concentration since then. Peak aluminum in 2011 was 0.37 mg/L.

West of the Panda/Koala/Beartooth WRSA, in the vicinity of the CKRSA, seepage results in 2009 were within the range of previously-observed values, and many parameters showed decreased concentrations compared to 2008. However, in 2010 and 2011 SEEP-329 and SEEP-343 with elevated ammonia showed evidence of leaching of explosives residues from the CKRSA. In 2010, SEEP-348 (fall only) and SEEP-355A (fall and freshet) contained low levels of total extractable hydrocarbons (C10-C30) or total petroleum hydrocarbons (C5-C30). SEEP-329, SEEP-343, SEEP-348, and SEEP-355A showed an increase in sodium compared to other major ions. This feature of CKRSA seepage reflects the changing chemistry of CKR as a result of a greater proportion of Fox kimberlite ore being processed in 2010 and 2011, which contains higher concentrations of sodium than Panda/Koala/Beartooth kimberlite ore. Non-halogenated volatiles were detected in the fall sample at SEEP-012 (0.005 mg/L benzene, 0.0026 mg/L toluene, and 0.0035 mg/L total xylenes). These parameters have not previously been detected in CKRSA seepage. Hydrocarbons were detected in the fall sample from SEEP-329 (0.15 mg/L total extractable hydrocarbons C10-30).

Monitoring of seeps from the Fox WRSA in 2009 indicated that concentrations for all parameters remain low and typically near background levels. The water quality results from two new seeps established in 2010, SEEP-362 and SEEP-360, indicated a degree of influence from the WRSA, including minor leaching of blast residues and leaching of granitic waste rock with a small kimberlite component. In addition, the 2010 monitoring indicated that SEEP-362, SEEP-360 and SEEP 304 (at freshet only) had TSS above the detection limits and several total metal concentrations greater than dissolved metal concentrations. The same was observed to a lesser extent at SEEP-354. In 2011, elevated TSS (up to 180 mg/L), aluminum (up to 10 mg/L), iron (up to 9.9 mg/L), and silicon (up to 24 mg/L), with total concentrations significantly higher than dissolved concentrations, indicate that SEEP-360 (and to a lesser extent SEEP-362), are washing fine grained granitic material out of the WRSA at freshet, and depositing it on downstream rocks and vegetation. This effect, however, continues for less than 50 m from the WRSA. SEEP-360 disappears into a grassy swamp well before it reaches the lake downstream. In 2009, sulphate concentrations remained very low; however, slightly elevated concentrations of total molybdenum and manganese at SEEP-302 and SEEP-311 suggest that the drainage at these locations is influenced by kimberlite weathering. Elevated total aluminum at SEEP-311 reflected the influence of the nearby haul road. Increases in total arsenic or both total and dissolved arsenic were observed during 2010 over previous years at most seeps from the Fox WRSA. The concentrations are still low and lower that at a reference location. In 2011, SEEP-367 on the west side of the Fox WRSA showed elevated concentrations of sulphate, sodium, molybdenum, and uranium. All licensed parameters at all stations in the Fox area were within the acceptable ranges specified in Water Licence MV2009L2-0001 in 2009; however, in 2010 water collected from SEEP-360 exceeded the maximum concentration for any grab sample for TSS. Water licence criteria were exceeded at SEEP-322 for TSS at freshet (34 mg/L), at SEEP-360 for TSS (180 mg/L) and total Al (10 mg/L) at freshet, and at SEEP-313 for field pH (4.7) at freshet.

Most seepage results of the Misery area seepage surveys conducted in 2009 were within previously observed ranges for all parameters, and many parameters showed decreased concentrations relative to 2008 results. Concentrations of many parameters at SEEP-052, downgradient to the west side of the Misery WRSA, continue to remain elevated, particularly nickel and zinc, although concentrations decreased relative to 2008. SEEP-075B on the east side of the WRSA had trace flow and showed increases in sulphate, calcium, magnesium, and nickel to concentrations at or near historic maxima for that location, and higher than currently observed at SEEP-052. In 2010, slightly elevated sulphate (up to 96 mg/L) in seepage from the Temporary Kimberlite Ore Storage Area (SEEP-081) indicated possible leaching of residual kimberlite material or the granite pad, but metal concentrations were low and not significant. At SEEP-081, concentrations have stabilized since kimberlite ore was removed from the Temporary Kimberlite Ore Storage Area in 2007, but have not declined. Residual kimberlite is weathered and fine grained with a large surface area, and even small volumes appear to impact the drainage. At SEEP-066, sulphate was the highest recorded at the seep, likely a result of prolonged heavy rainfall prior to the fall sampling, leaching kimberlite in the WKSA. SEEP-052 with elevated Ni and other trace ion concentrations showed evidence of leaching of sulphides in Misery area metasediment. Increases in total arsenic, or both total and dissolved arsenic, were observed during 2010 over previous years at most seeps. With the exception of SEEP-052, the concentrations are still low and lower that at a reference location. All water quality parameters measured at the two seeps in the Misery area that report to the receiving environment (SEEP-059 and SEEP-081) were within the acceptable ranges specified in Water Licence MV2009L2-0001. However, in 2010 and 2011, field pH in the fall at SEEP-081 was outside the Water Licence criteria but within the range of previous results at this station and other stations with a strong tundra influence.

The main effects during the 2009 to 2011 seepage survey were:

- Panda/Koala/Beartooth WRSA showed evidence of leaching of blast residues and ongoing waste rock and kimberlite weathering. Elevated TSS and total metals greater than dissolved metals at SEEP-019 and SEEP-357 may be a result of material picked up locally from the tundra or channel bed, rather than material washed out of the WRSA.
- CKRSA showed evidence of leaching of blast residues.
- Fox WRSA showed evidence of leaching of blast residues and granitic waste rock and some kimberlite weathering. Total metals greater than dissolved metals and elevated TSS at SEEP-360 are likely a result of fine grained granitic material washed out of the WRSA at freshet, and depositing it on downstream rocks and vegetation.
- Misery WRSA showed evidence of leaching of residual kimberlite from the Temporary Kimberlite Ore Storage Area, as well as sulphides from Misery area metasediments.

7.2.3 Fish

The 1995 EIS predicted the following effects on fish habitat and fish:

- loss of fish habitat due to lake dewatering;
- addition of fish habitat due to construction of the PDC;
- changes in fish biology as a result of biological sampling; and
- exposure to hydrocarbons.

Effects not predicted in 1995 include:

- loss of fish habitat and habitat enhancement in Nero-Nema Stream; and
- incidence of fish parasitism related to mine impacts.

7.2.3.1 Habitat Loss

The 1995 EIS indicated that there would be a loss of lake and stream habitat due to dewatering of lakes. The PDC was expected to provide adequate compensation and the loss of this lake habitat was by direct payment to DFO for use in habitat restoration activities in the NT (see Section 4.2.3 regarding *Fisheries Act* Authorizations). In addition, loss of fish habitat necessitating compensation was a result of encroachment of bridge abutments on the Nero-Nema streambed.

<u>PDC</u>

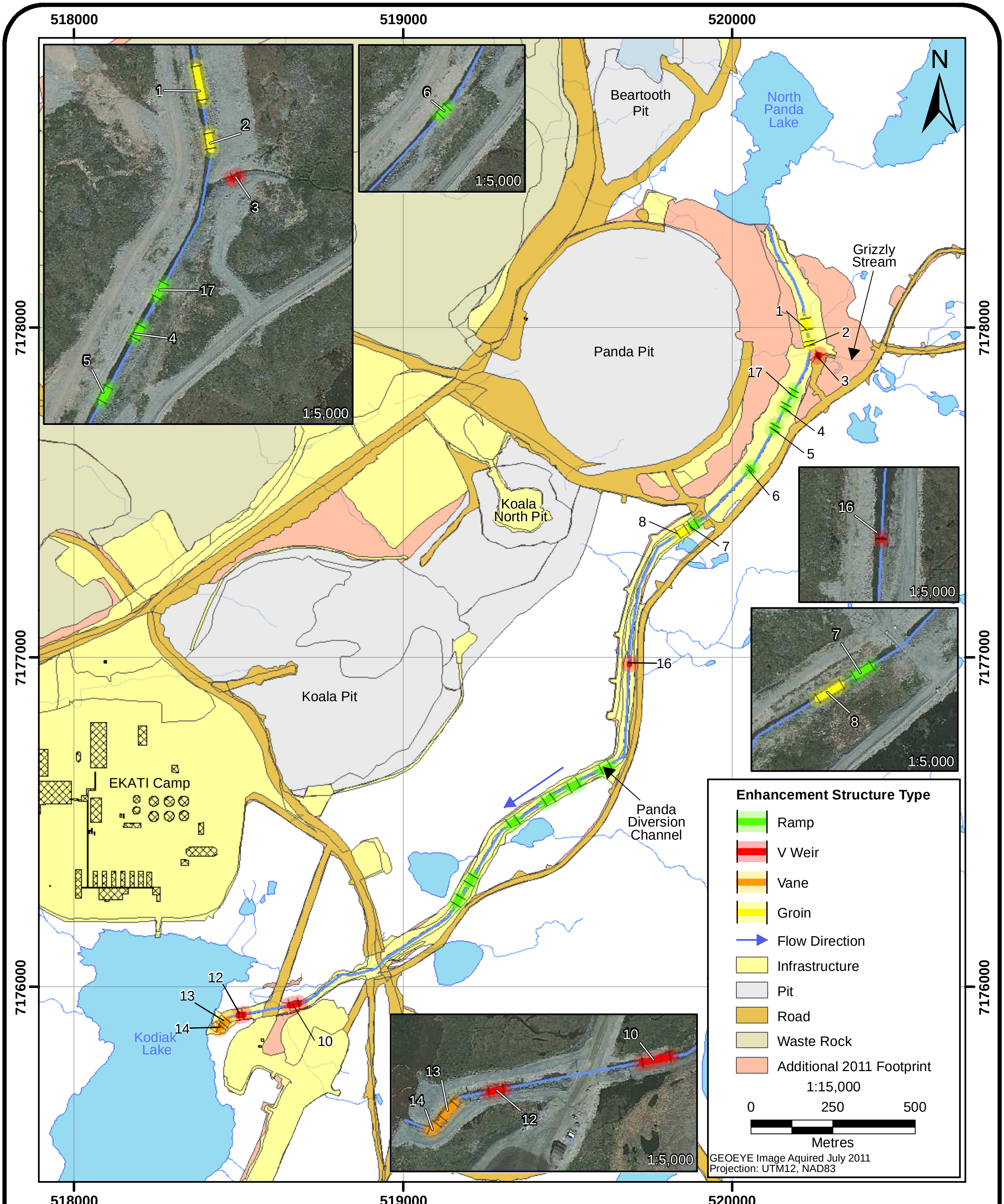
Both the historical and most recent results acquired during the thirteenth year of monitoring indicate that the PDC has become “seasoned” over time (Report 50). Specifically, riparian vegetation has increased along its banks and benthos productivity has improved since its inception. In addition, the effects of the habitat enhancement structures were positive and are serving their intention of creating habitat for fish residing in the PDC. The PDC is therefore serving its purpose as defined in the compensation agreement: it continues to provide rearing, feeding, or spawning habitat for up to seven fish species in addition to serving as a migration corridor for lake trout and Arctic grayling between

Kodiak Lake and North Panda Lake. Specifically, the results of the PDC Monitoring Program with regards to fish habitat have indicated the following:

1. The overall function of habitat enhancement structures is to create increased habitat heterogeneity (Figures 7.2-12 and 7.2-13). This heterogeneity was assessed in the PDC by measuring physical habitat characteristics (flow, depth, substrate) as well as productivity (benthos) and fish usage. The majority of habitat enhancement structures were still intact in their initially designed form, providing habitat complexity and additional cover for fish species. The function of less stable structures was not compromised. Ramp structures affected surrounding mean water velocities while weirs, vanes, and groins did not significantly affect mean water velocities, but rather increased variability in velocity within each structure. Significantly increased variability of water velocities within habitat structures indicates the presence of microhabitats which may provide a wider range of rearing habitats for fish species.
2. Culvert assessments conducted in the PDC in 2011 revealed that all three culverts posed no potential barrier to fish passage at the time of the assessment. Substrates within the culverts were still present, and their condition and placement appeared stable and consistent with original designs. Depths and velocities were high and low enough, respectively, to facilitate the movement of fish species as small as juvenile burbot and slimy sculpin.
3. Benthic biomass was largely made up of insect larvae (94%), which are important to foraging Arctic grayling fry. Overall, although the PDC had lower benthos densities than in Pigeon Stream, its biomass and community structure did not differ significantly from either reference stream, indicating that the PDC had similar productivity values for fish habitat and has "seasoned" over time.
4. Fish utilization was not significantly different between structures and non-structure reference areas within the PDC; however, this may indicate that the positive effects of the structures may extend beyond their actual footprint (overflow effect) in the stream. Comparisons of the PDC and reference streams (Pigeon and Polar-Vulture) revealed that the benthos communities were generally quite similar between the PDC and the reference streams. There were no significant differences between the streams for benthos biomass. However, Pigeon Stream had significantly higher benthos densities (largely composed of small nematode species) than the PDC.
5. Analyzed infrared images (e.g., Figure 7.2-14) indicated that the estimated area of vegetation cover within the riparian zone (i.e., a buffer of 3 m on either side of the water) had almost tripled within the last ten years (i.e., the estimated area covered by vegetation increased from 2,320 m^2 to 6,364 m^2). This represented approximately 17% riparian zone coverage in 2010 compared to 6% in 2001. Vegetation has established along the channel primarily in areas with finer-grained substrate, where historical seeding with native grass cultivars and forbs occurred, and/or in areas planted with willow cuttings or bundles along the water margins (Plate 7.2-1). Emergent vegetation, composed primarily of transplanted Arctic pendant grass, was recorded along approximately 8.9% of the channel, but was mostly limited to original planted areas.

Specifically the results of the PDC Monitoring Program with regards to serving as a fish spawning and migration corridor included:

- Six fish species (Arctic grayling, slimy sculpin, lake chub, burbot, round whitefish, and lake trout) were sampled from the PDC in 2011. A total of 171 Arctic grayling (170 mm), of which 122 were newly tagged in 2011 and 49 (29%) were tagged over the previous three years (2008 to 2010), were captured in the PDC. This is a slight decrease from 2010; however, the number falls within the range of observed values from prior years, indicating that a large proportion of fish return to the PDC year after year for additional feeding or spawning opportunities.



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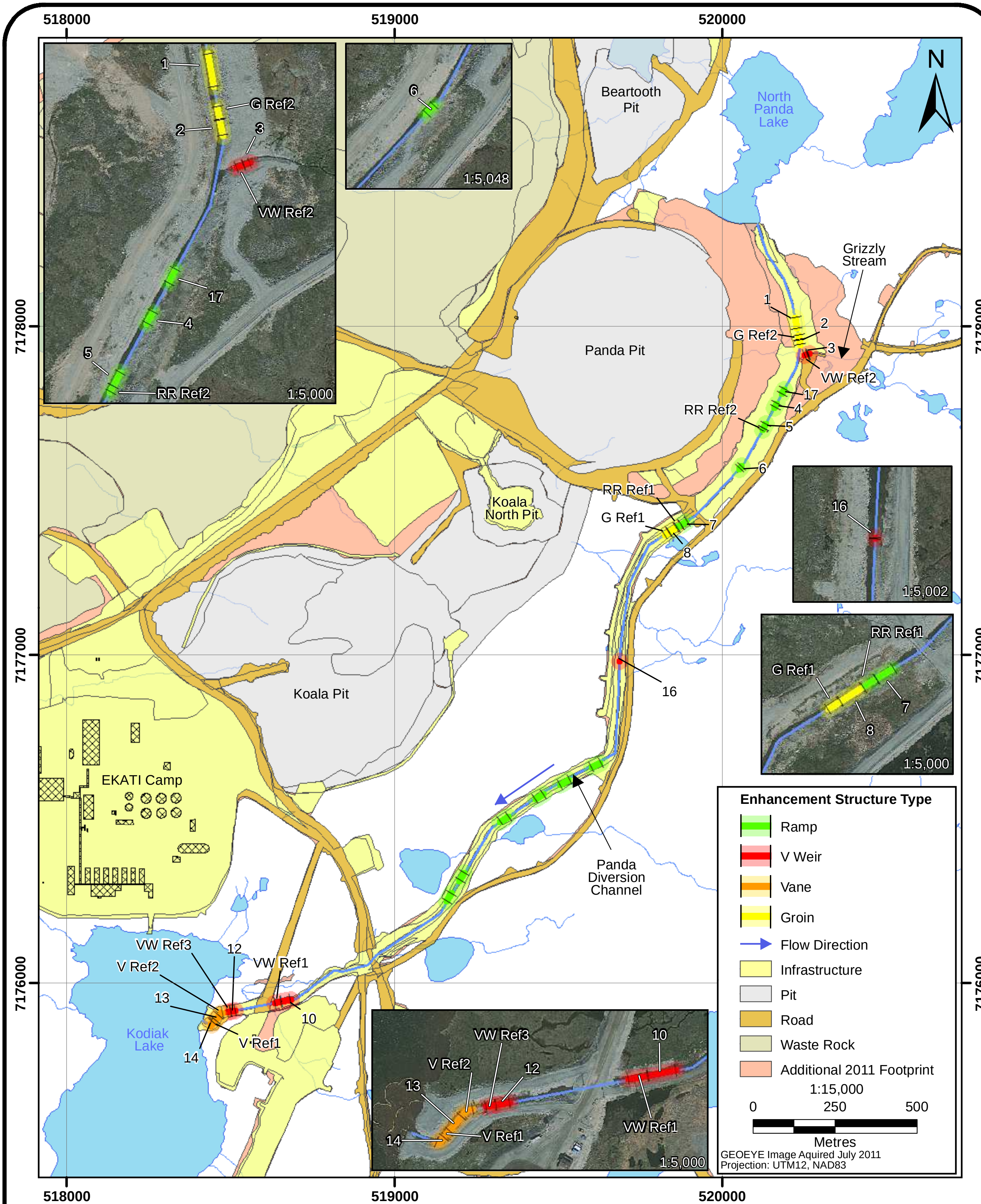
Location of Habitat Enhancement Structures Surveyed in 2011

FIGURE 7.2-12



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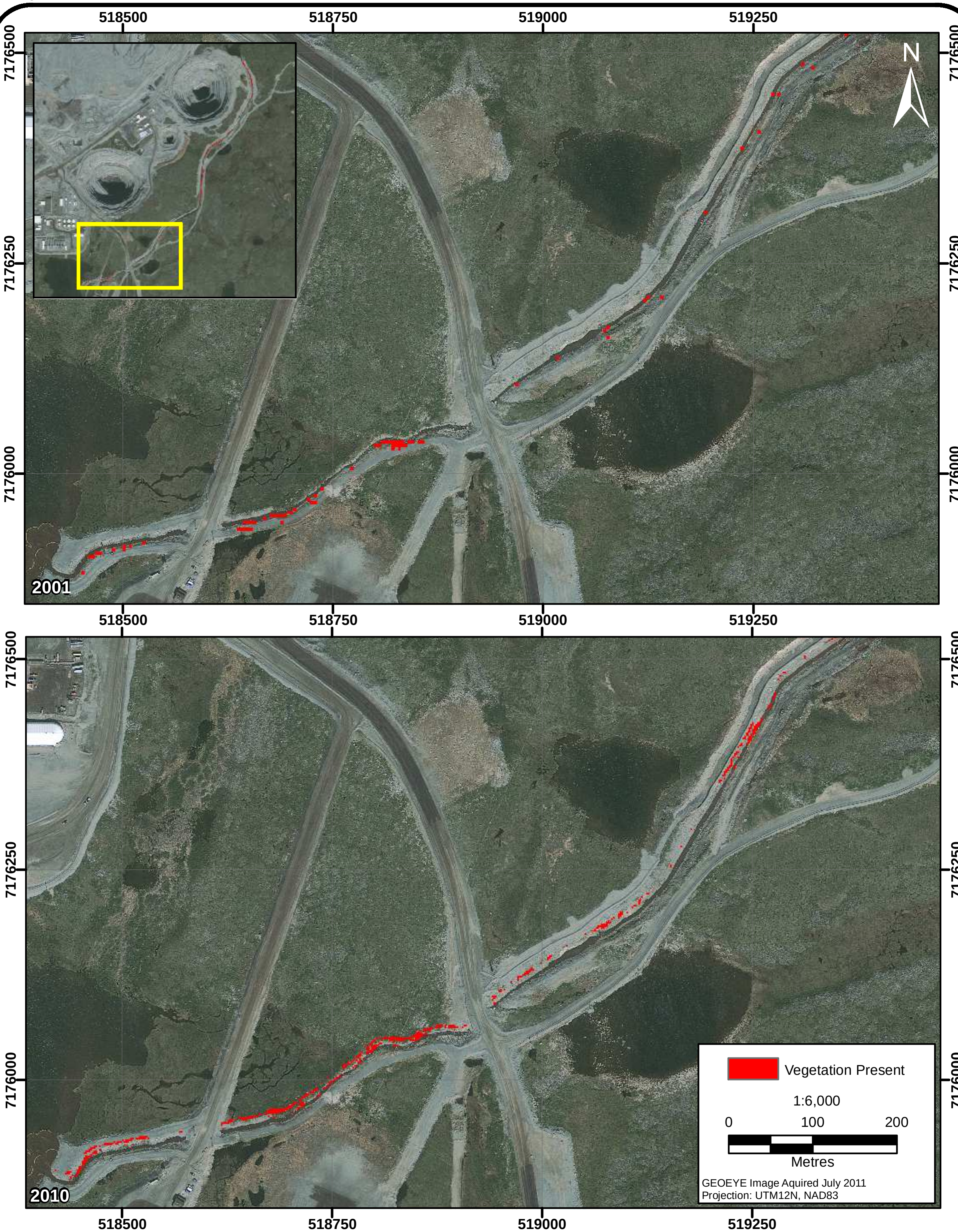
Location of Habitat Enhancement Structure Fish Population Surveys in 2011

FIGURE 7.2-13

gis no. EKA-06-123 Job No. 0648-121-01 July 03, 2012



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Vegetation Identified from Satellite Imagery along the Panda Diversion Channel, 2001 and 2010

FIGURE 7.2-14

◎ Table of Contents

2001 | **2011**

(a) 0300 – 0400

(b) 0900 – 0925

(c) 1050 – 1120

(continued)

Plate 7.2-1. View of stations along the PDC where Diamond-leaf willow cuttings and Arctic pendant grass sprigs had been transplanted and slopes seeded with forbs and native-grass cultivars in 1998 to 2000.

2001	2011


(d) 1460 – 1480


(e) 3225 – 3300


(f) 3330

Plate 7.2-1 (completed). View of stations along the PDC where Diamond-leaf willow cuttings and Arctic pendant grass sprigs had been transplanted and slopes were seeded with forbs and native-grass cultivars in 1999 and 2000.

- Seventy-six Arctic grayling were classified as spawners either through external spawning characteristics and/or size (greater or equal to 300 mm) in the PDC. Spawner numbers in 2011 were the highest observed since 2008 (with a range from 39 to 76), and were similar to 2007 (n = 83). As observed in previous years, spawner numbers were greater in the PDC than numbers observed during visual surveys conducted in either Pigeon Stream (maximum daily count of 10 out of a total 64 observations) or Polar-Vulture (maximum daily count of four out of a total 16 observations).

In 2003, 19.2% of all Arctic grayling fry outmigrants had their adipose fins clipped to allow monitoring of the rate of fish returning to the PDC in later years. All fish that were clipped in 2003 would be aged eight or older in 2011. A total of five age eight or older (confirmed by aging) Arctic grayling were captured in 2011, and of those fish, one (or 20%) had a clipped adipose fin (Plate 7.2-2). This concurs with the expected number of returns (about one fish or 19.2% of those originally clipped). Three (2%) of the tagged Arctic grayling were considered "through-migrants," continuing to show that the PDC is being used as a migration corridor between Kodiak Lake and North Panda Lake by Arctic grayling. Two tagged fish remained within the PDC for over 50 days, indicating the PDC is suitable for adult feeding.

Plate 7.2-2. An Arctic grayling with a clipped adipose fin was captured in the Panda Diversion box traps, 2011.

Nero-Nema Stream

The results of the 2010 Nero-Nema Monitoring Program suggest that habitat modification, as a result of the encroachment, is functioning as designed (Report 30). The sites with GEPs as compensatory habitat will continue to enhance the fish habitat at Nero-Nema Stream in future years. The most recent Nero-Nema monitoring report provides data that demonstrates that the compensation habitat is functioning physically and ecologically. It summarizes results of Arctic grayling spawner, egg, and fry surveys for 2010 and compares results to data collected in the previous four years.

The following evidence from 2009 and 2010 supports the conclusion that Arctic grayling spawners used the compensatory gravel habitat which was added to Nero-Nema Stream:

- Arctic grayling spawners were observed in close proximity to GEP E (and GEP F in 2009). After correction of the number of spawner-days for visual under-counting and the duration of their residence, a total of 23 Arctic grayling spawners were estimated to have used Nero-Nema Stream in 2010.

- Arctic grayling and/or longnose sucker eggs were found at all GEPs in either one or both years (2009 and 2010) except for GEP D. Ninety eggs were collected in 2010, of which 12 were identified as likely Arctic grayling, and 78 as likely longnose sucker.
- Arctic grayling fry were counted in close proximity to GEPs B, D, E, and F (and GEPs A and C in 2009). In 2010, the maximum number of fry observed (3,286) was higher than observed in any of the previous four years.

In response to DFO comments, surface area of 9 m^2 of coarse gravel was added to the existing GEP A, B, and F at the Nero-Nema crossing on September 6, 2011. This addition will compensate for GEP D, which has not functioned as designed, and will fulfill the commitments under section 5 to 8 of Fisheries Authorization SC01168.

The presence of periphyton observed on the compensatory substrate of the GEPs further contributes to the productivity of Nero-Nema Stream. These results show that the habitat is functioning as designed and, due to the fact that gravel has not migrated, these sites will continue to enhance the fish habitat at Nero-Nema Stream in future years.

Fay Bay

The 2008 to 2009 Fay Bay Monitoring Program (Report 19) also discussed potential effects on the fish community and the potential effects of the unplanned release to the near shore fish habitat. This discussion provided a summary table for the comparison of fish community variables and parameters for lake trout and round whitefish between baseline years and post-event data collected in 2008. Although 22 lake cisco were captured of the 106 total during the 2008 fish assessment, they were not included in the fish community and biology analysis and not considered in the fish habitat assessment. Historically, lake cisco have not always been captured in Fay Bay (2001—34 of 85 total; 2002—0 of 27 total; 2005—0 of 55 total; 2006—10 of 53 total; 2007—0 of 38 total). Thus they were not considered a focal species for the Fay Bay assessment. However, following review of the monitoring program by IEMA, further research on the potential effects to lake cisco were requested.

A brief literature review indicated the following information with regards to spawning and life-history of lake cisco. Typically, lake cisco spawn in shallow waters less than 10 m with no apparent preference for substrate type (Dryer and Beil 1964). While most of the 1 to 5 mm thick PK deposits in the southern basin of Fay Bay occurred between 2 and 5 m depths, this area is only a portion of the total spawning area available to lake cisco in Fay Bay. While a small area of Fay Bay that may be used for spawning by lake cisco could have been affected by the spill, the life history of characteristics of lake cisco make it unlikely that this would represent an impact at the population level. Lake cisco exhibit early maturity and are a long lived species (20 or more years) with the capacity for strong year classes even at low adult stock sizes. These characteristics make lake cisco populations resilient to short term events that affect entire year classes. Since the present case describes a short term event over a small proportion of the available spawning habitat in Fay Bay, it is not likely that lake cisco would have been affected by this event.

7.2.3.2 Changes in Fish Biology as a Result of Biological Sampling

Impacts from biological sampling was predicted to be negligible in the 1995 EIS. Historical effects included:

- loss of 60 burbot following the drawdown of Bearclaw Lake;
- some mortality caused by sampling baseline and reference lakes and streams, and monitoring of the PDC and AEMP lakes;

- in 2007, catch per unit effort of round whitefish and lake trout was lower when compared to 2002 and baseline sampling in several AEMP lakes (monitored and reference); and
- the 2007 AEMP monitoring results indicated that average length, weight, age, and growth rate of lake trout increased relative to the baseline, as did average age of round whitefish populations.

The next fish sampling year as part of the AEMP is in 2012. Thus, current effects related to the changes in fish biology will be discussed in the next edition of the EIR. Section 7.4.2 discusses the proposed monitoring program to address historical effects including the use of sentinel species to reduce lake trout mortalities.

7.2.3.3 Exposure to Hydrocarbons

The 1995 EIS indicated that, assuming spills and leaks will be contained quickly, the probability of fish exposure to hydrocarbon is low, and the resulting impact on aquatic life will be negligible. Prior to 2007, no effects of hydrocarbon exposure were detected in fish. However, during the 2007 sampling program, bile metabolites indicative of exposure to hydrocarbons were greater in fish from Leslie Lake than in fish from Nanuq and Moose lakes. Differences were not significant and there was no evidence that hydrocarbons influenced fish biology, or ecology. A follow-up study was conducted in 2008 (Report 6) and concluded that lake trout and round whitefish in Cell E of the LLCF and Leslie Lake had greater concentrations of the bile metabolites indicative of hydrocarbon exposure (phenanthrene and benzo[a]pyrene) when compared to fish collected from a reference lake (Nanuq Lake). However, there was no evidence of hydrocarbons in water or sediment samples collected from Cell E or Leslie Lake in 2009. Water and sediment samples were again collected in 2010 (Report 32) and 2011 (Report 56) to address the source of hydrocarbons; however, the results did not indicate a consistent or significant hydrocarbon contamination of waterbodies around the mine site, nor were they indicative of a point source for hydrocarbon release into the aquatic environment.

This effect will be further evaluated in the next edition of the EIR (see Section 7.4.7).

7.2.3.4 Parasite Infections

Although not predicted in the 1995 EIS, the 2007 AEMP Fish Monitoring Program indicated that infection rates of slimy sculpin by *Ligula intestinalis* were greater in monitored lakes than reference lakes in 2007. However, this trend was not evident during a follow-up study conducted in 2008. In that latter Special Effects Study (Cell E Fish Study; Report 6), the results suggested that patterns of ligulosis infection are not related to a lake that a sculpin inhabits but other factors associated with the parasite lifecycle. Although infection status is not related to lake water quality or location downstream of the LLCF, ligulosis will be considered in any future studies with slimy sculpin (see Section 7.4.2).

7.3 LONG-TERM PREDICTIONS

7.3.1 Regression Models

Conclusions about the impact of EKATI on water quality and aquatic life other than fish are drawn from regression analysis and analysis of the observed and fitted value plots for all evaluated outlined lakes and streams. These analyses allow for the comparison of trends in monitored lakes and streams and reference lakes and streams over time rather than simple comparisons to baseline data only.

The resulting time series regression curves (e.g., Figure 7.3-1) assist in establishing current effects in addition to assessing potential effects if mitigation or management activities are not implemented. For example, sulphate was identified as a potential contaminate of concern as a result of the AEMP regression analysis. The 2009, 2010, and 2011 AEMP results indicated that sulphate concentrations have increased in all monitored lakes and streams that are downstream of the LLCF as a result of mine operations. Sulphate may enter aquatic systems from atmospheric sources including sulphur dioxide, which is formed by the combustion of fossil fuels and dissolves to form acid rain. In high concentrations, sulphate is toxic to many aquatic organisms, including invertebrates and fish. Thus in 2011 BHP Billiton conducted a literature review on the toxicity of sulphate for aquatic organisms specific to the EKATI environment. The result was a SSWQO for sulphate, which will form the benchmark for future aquatic effects assessments conducted at EKATI.

7.3.2 Koala Watershed Water Quality Model

Water quality in lakes and streams at EKATI have been evaluated annually since 1994 (baseline) in the Koala Watershed. The annually collected information has provided a long-term dataset for a water quality prediction model for the LLCF, which was originally developed in 2004 and recently updated in 2011 (Report 51). The model has been used to identify water quality concerns and to evaluate water management options for the EKATI site.

The 2011 model was calibrated against observed data and run for a base case future scenario to February 2020. The model predictions were compared to recently developed water quality benchmark values for receiving waters.

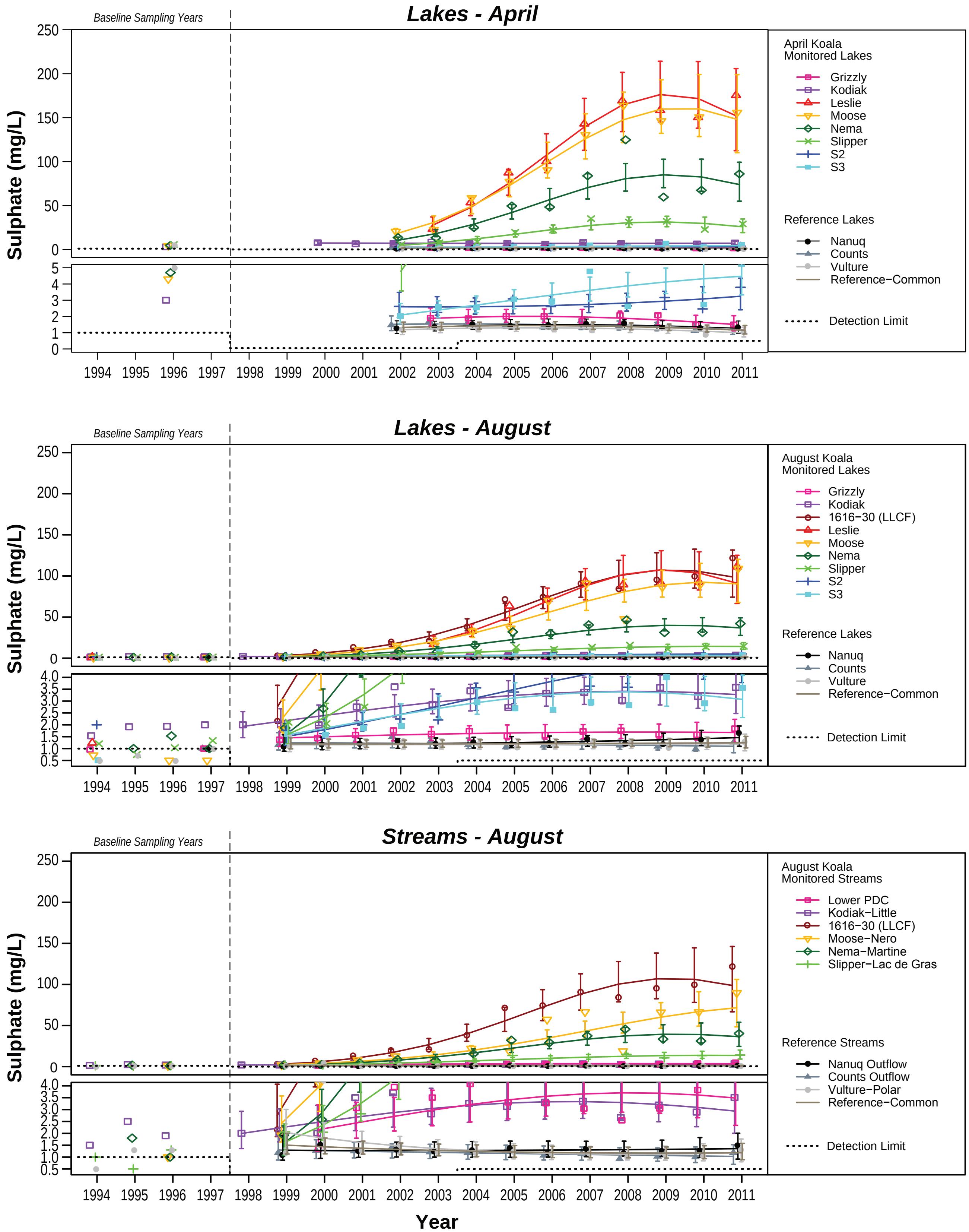
For most parameters, the model produces predictions for the historical period (2000 to end 2010) that match very well with observed concentrations in Cell D, Cell E, Leslie Lake, Moose Lake, Nema Lake, and Slipper Lake. The model is able to predict the inter-annual variations in concentrations (i.e., modelling the rate of concentration increases over time), and it also provides good fits to the seasonal variations in water quality throughout the year, with dilution and lower concentrations in freshet (June, July), rising concentrations in summer months with lower natural runoff (August, September), and rising concentrations in winter months due to ice exclusion processes (October through April, after which ice begins to melt).

Water quality predictions were made for 30 water quality variables. The model results indicate that for eight parameters there is a risk that concentrations in the lakes lying downstream of the LLCF could exceed at least 75% of the water quality benchmark from the end of 2010 to February 2020. Model summary sheets for each of the water quality variables (e.g., Figures 7.3-2 to 7.3-6) were provided in Appendix 4 of the *Water Quality Modelling of the Koala Watershed* (Report 51). The information in the summary sheets provides essential information for future and current mitigation and management alternatives for the LLCF (e.g., Figure 7.3-2).

7.3.3 AEMP Three Year Re-evaluation

As a condition of Water Licence W2009L2-0001, Part J, item 1, the EKATI AEMP requires re-evaluation every three years. A re-evaluation was completed in January 2010 (Report 10), which reviewed the performance of the AEMP between 2007 and 2008. The 2009 re-evaluation report, including a list of 33 recommendations, was submitted to the WLWB and presented to stakeholders at workshops in February 2010. The final recommendations were incorporated into a plan for the 2010 to 2012 AEMP (Report 16).

PROJECT # 0648-121-01 ILLUSTRATION # a35323n-EIR June 12, 2012



Notes: Symbols represent observed mean values.
Solid lines represent fitted curves.
Error bars indicate upper and lower 95% confidence intervals of the fitted means.
SSWQO = $e^{(0.4163 \times \ln(\text{Hardness}) + 4.878)}$.

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Observed and Fitted Means for Sulphate Concentrations in Koala Watershed Lakes and Streams and Lac de Gras, 1994 to 2011

Figure 7.3-1

Chloride

Sources of Parameter in LLCF

Historical 2000 – end 2010		***Future Estimated Based on Mine Plan (Jan 2011 – Feb 2020)***	
Process Plant	22%	Process Plant	20%
Sump	12%	Sump	9%
Underground	66%	Underground	0%
Runoff	0%	Runoff	0%
Beartooth Pit Reclaim	0%	Beartooth Pit Reclaim	71%

Key Comments Related to Modelling Work

Historically the key loading for Chloride has been underground water. However, the Base Case model run includes discharge of underground water to Beartooth pit starting in June 2009 and discharge of FPK slurry to Beartooth pit starting in September 2012. At present (2011) the main loading of Chloride is from the Process Plant discharge. Going forward, once Beartooth pit is filled, excess water from the pit will need to be decanted and used in the process Plant as reclaim water. Hence, Chloride loadings stored in Beartooth pit will enter the LLCF with the Process Plant discharge at that time causing the peak in Chloride concentrations in the LLCF and downstream lakes predicted for 2019/2020.

Water Quality Benchmark

116.6 x ln(hardness) - 204.1 mg/L, relationship is limited to hardness range up to 160 mg/L. (Site Specific WQO)

Leslie Lake (mg/L)				Slipper Lake (mg/L)			
Historical Period (incl. Cell E data)		Best Estimate future peak concentration	Percentage of Benchmark	Historical Period		Best Estimate future peak concentration	Percentage of Benchmark
Highest observed	Median 2009/2010			Highest observed	Median 2009/2010		
140	110	383	99%	24.5	12	85.8	28%

Comment on Model Fit to Observed Data

Good quality calibration with observed data, although model over-predicts observed concentrations slightly.

Summary

Historical concentrations for downstream lakes have not exceeded the benchmark. The model predicts concentrations for Leslie and Moose lakes do not exceed the benchmark, but do exceed 75% of the benchmark within the lifetime of the mine. For Nema and Slipper lakes future concentrations are predicted to remain below 75% of the benchmark.

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Chloride Model Worksheet Excerpt - Predictions in Receiving Environment as Percentage of Benchmark

Figure 7.3-2a

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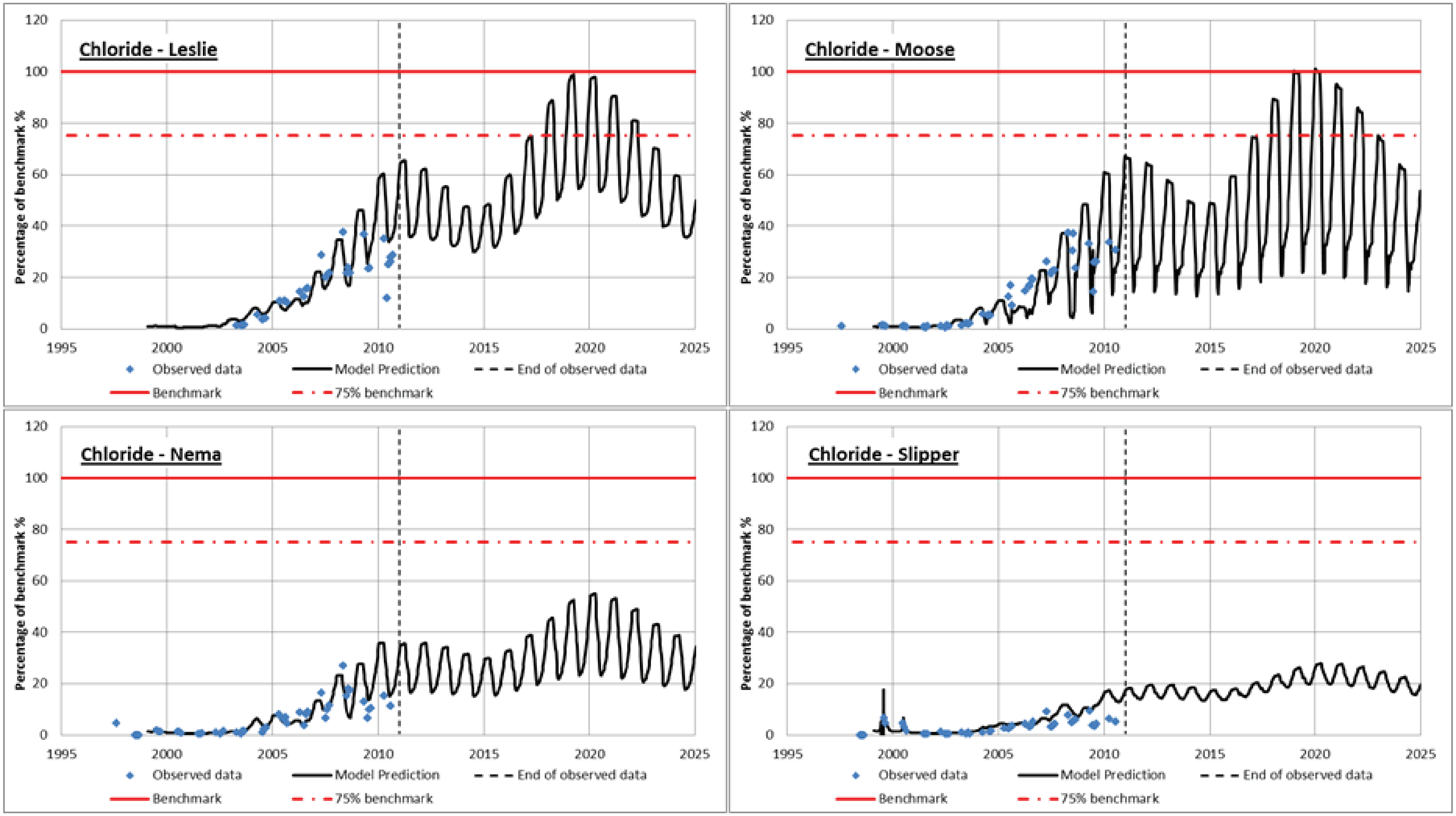

Figure 7.3-2b

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Chloride Model Worksheet Excerpt - Predictions in Receiving Environment as Percentage of Benchmark

Figure 7.3-2b

Nitrate-N

Sources of Parameter in LLCF

Historical 2000 – end 2010		*Future Estimated Based on Mine Plan (Jan 2011 – Feb 2020)*	
Process Plant	63%	Process Plant	55%
Sump	31%	Sump	27%
Underground	6%	Underground	0%
Runoff	0%	Runoff	0%
Beartooth Pit Reclaim	0%	Beartooth Pit Reclaim	17%

Key Comments Related to Modelling Work

Key loading of Nitrate is from the Process Plant discharge, with concentrations showing an increase since 2005 with processing of underground kimberlite.

Nitrate is not modelled to decay over time as calibration work indicates no requirement for decay of the parameter in the LLCF.

The Base Case model run includes discharge of underground water to Beartooth pit starting in June 2009 and discharge of FPK slurry to Beartooth pit starting in September 2012. Once Beartooth pit approaches 30 m from spill level, free water is decanted to Process Plant for use as reclaim water.

Water Quality Benchmark

$e^{(0.9518[\ln(\text{hardness})]-2.032}$ mg/L , relationship is limited to hardness range up to 160 mg/L. (Site specific WQO)

Leslie Lake (mg/L)				Slipper Lake (mg/L)			
Historical Period (incl. Cell E data)		Best Estimate future peak concentration	Percentage of Benchmark	Historical Period		Best Estimate future peak concentration	Percentage of Benchmark
Highest observed	Median 2009/2010			Highest observed	Median 2009/2010		
5.4	3.5	9.22	56%	0.48	0.059	2.08	36%

Comment on Model Fit to Observed Data

Good fit with observed data.

Summary

Historical concentrations and model predictions for downstream lakes are below 75% of the benchmark.

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Nitrate-N Model Worksheet Excerpt - Predictions in Receiving Environment as Percentage of Benchmark

Figure 7.3-3a

PROJECT # 0648-121-01 ILLUSTRATION # a37176f June 12, 2012

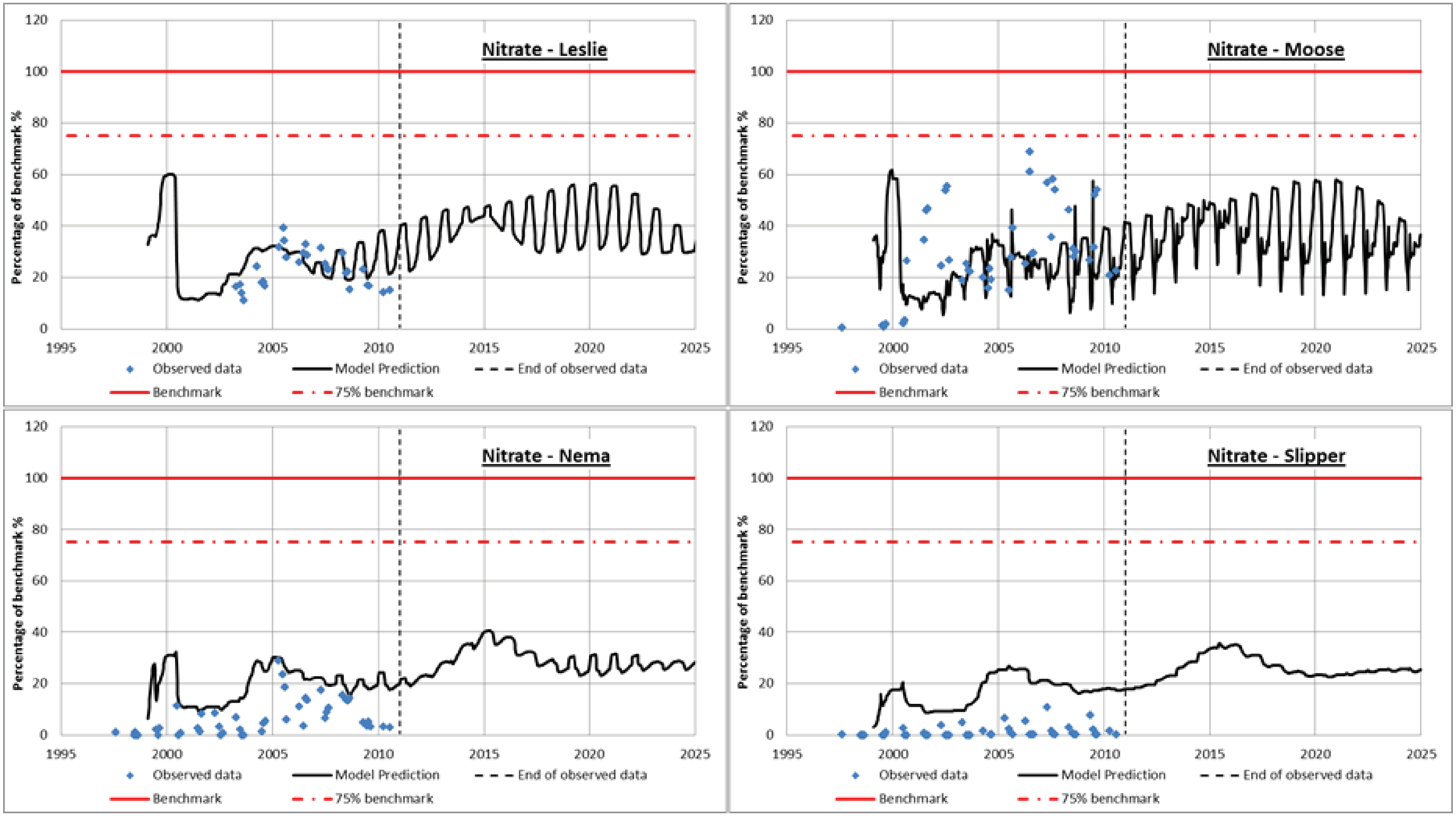

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Figure 7.3-3b

Nitrate-N Model Worksheet Excerpt - Predictions in Receiving Environment as Percentage of Benchmark

Figure 7.3-3b

Phosphate-P

Sources of Parameter in LLCF

Historical 2000 – end 2010		*Future Estimated Based on Mine Plan (Jan 2011 – Feb 2020)*	
Process Plant	32%	Process Plant	35%
Sump	12%	Sump	25%
Underground	38%	Underground	0%
Runoff	18%	Runoff	27%
Beartooth Pit Reclaim	0%	Beartooth Pit Reclaim	12%

Key Comments Related to Modelling Work

Historically inputs of Phosphate are distributed between the Process Plant discharge, underground water and natural runoff. However, Phosphate was added to Cell D of the LLCF in summer 2009, 2010, 2011 as part of a fertilisation study. These additional loadings produced marked increases in phosphate in Cell D and Cell E.

There are losses of Phosphate within the LLCF due to its uptake as a nutrient and it is modelled using a first order decay equation (similar to that used for ammonia and nitrate). The decay rate used in the modelling was calculated through calibration. A time varying decay rate was required to produce a calibrated model, with a higher rate of decay (half-life of 2.1 months) during the period of fertiliser addition and a lower rate of decay (half-life of 11.1 months) at other times. A time varying decay rate is reasonable as overall update dynamics of Phosphate by plankton will be different during an induced bloom compared to the natural oligotrophic state of the LLCF. The lower natural decay rate is used in the model for the period post-2012, when no additional fertiliser addition is modelled.

It should be noted that Phosphate concentrations have not been monitored in the Process Plant discharge since January 2006.

The Base Case model run includes discharge of underground water to Beartooth pit starting in June 2009 and discharge of FPK slurry to Beartooth pit starting in September 2012. Once Beartooth pit approaches 30 m from spill level, free water is decanted to Process Plant for use as reclaim water.

Water Quality Benchmark

Canadian Guidance Framework for the Management of Phosphorus in Freshwater Systems for oligotrophic lakes set out a framework to determine acceptable levels of phosphorous nutrient. These guidelines are based on potential changes to nutrient and trophic status of water bodies and not on toxicity. For oligotrophic lakes total phosphorus should be below 0.01 mg/L and should not be allowed to increase more than 50% over the baseline levels without further assessment; Leslie Lake = 0.0096 mg/L; Moose Lake = 0.0077 mg/L ; Nema Lake = 0.0091 mg/L; Slipper Lake = 0.01 mg/L. It should be noted that these limits are based on baseline monitoring during the open water season and do not take into account winter ice exclusion processes. As a result they are only valid for the open water season.

Leslie Lake (mg/L)				Slipper Lake (mg/L)			
Historical Period (incl. Cell E data)		Best Estimate future peak concentration	Percentage of Benchmark	Historical Period		Best Estimate future peak concentration	Percentage of Benchmark
Highest observed	Median 2009/2010			Highest observed	Median 2009/2010		
0.045	0.0043	0.00864	90%	0.012	0.0046	0.0105	104%

Comment on Model Fit to Observed Data

Reasonable calibration with observed data was achieved using first order decay and a calibrated decay rate of 4.2 months, however, predictions for Cell E and downstream lakes for the period of the fertilization study appear to be over predicted compared to observed data.

Summary

Model predictions indicated that results for Cell E and Leslie Lake exceed the benchmark; however; results for Slipper did not exceed 75% of the benchmark. The modelled exceedances of phosphate in downstream lakes are associated with phosphate amendments made to Cell D as part of a fertilization study in 2008, 2009 and 2010. The modeling results indicate that over the short term these phosphate will return to concentrations below 75% of the benchmark.

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Figure 7.3-4a

Phosphate-P Model Worksheet Excerpt - Predictions in Receiving Environment as Percentage of Benchmark

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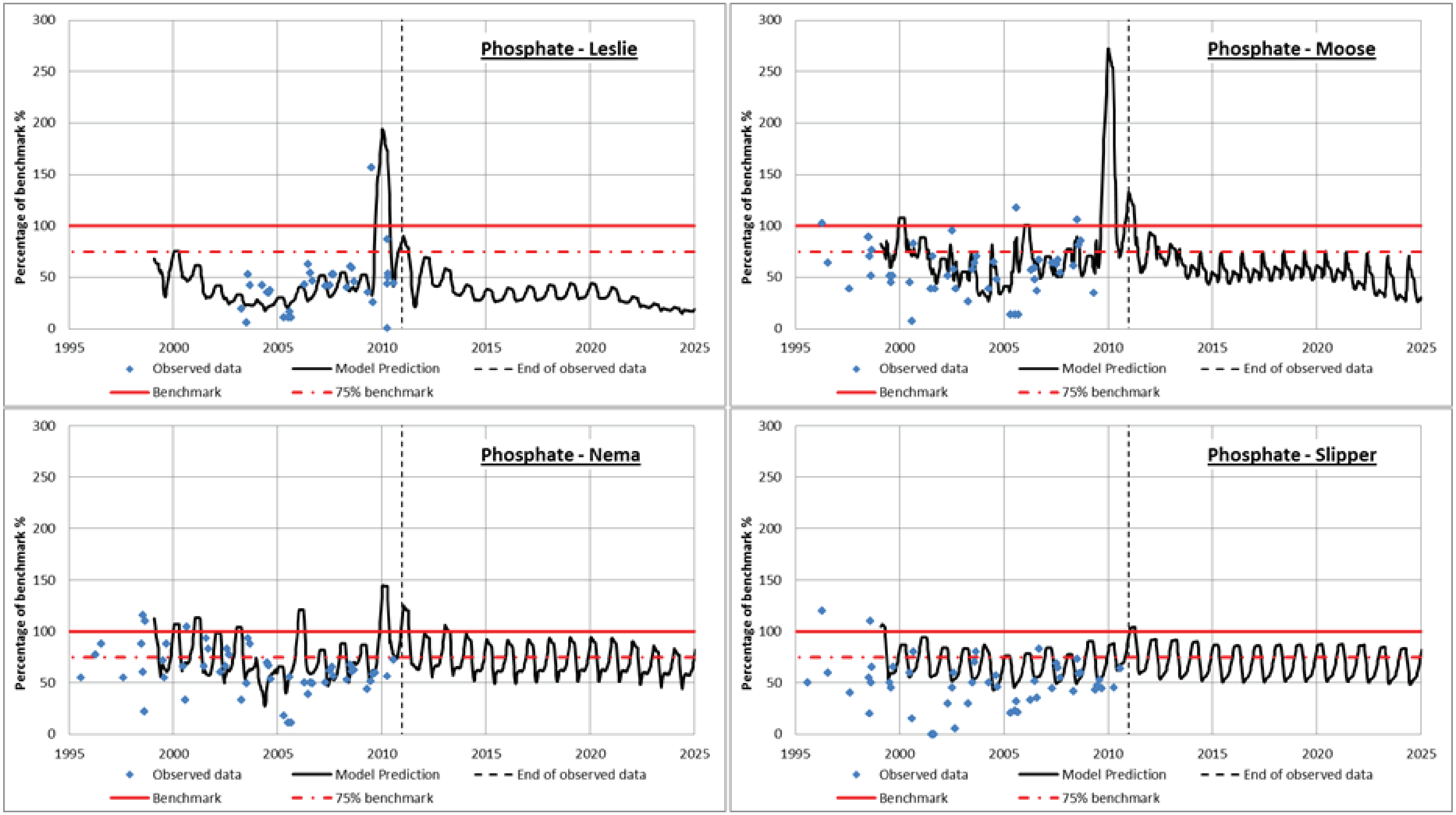

Figure 7.3-4b

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Phosphate-P Model Worksheet Excerpt - Predictions in Receiving Environment as Percentage of Benchmark

Figure 7.3-4b

Aluminium

Sources of Parameter in LLCF

Historical 2000 – end 2010		*Future Estimated Based on Mine Plan (Jan 2011 – Feb 2020)*	
Process Plant	54%	Process Plant	50%
Sump	3%	Sump	1%
Underground	0%	Underground	0%
Runoff	42%	Runoff	37%
Beartooth Pit Reclaim	0%	Beartooth Pit Reclaim	11%

Key Comments Related to Modelling Work

Many concentrations in sump and Process Plant discharge are below detection limit making future prediction difficult to quantify accurately. PPD concentrations show increase in loadings of Aluminium since 2008.

The Base Case model run includes discharge of underground water to Beartooth pit starting in June 2009 and discharge of FPK slurry to Beartooth pit starting in September 2012. Once Beartooth pit approaches 30 m from spill level, free water is decanted to Process Plant for use as reclaim water.

Water Quality Benchmark

0.1 mg/L (CCME guideline)

Leslie Lake (mg/L)				Slipper Lake (mg/L)			
Historical Period (incl. Cell E data)		Best Estimate future peak concentration	Percentage of Benchmark	Historical Period		Best Estimate future peak concentration	Percentage of Benchmark
Highest observed	Median 2009/2010			Highest observed	Median 2009/2010		
0.99	0.025	0.143	143%	0.049	0.016	0.0771	77%

Comment on Model Fit to Observed Data

Reasonable fit between observed and predicted concentrations; however, there is variability in observed Aluminium concentrations with some high values. This is likely a result of use of total metals data for observed concentrations. For most metals dissolved metals = total metals at EKATI; however, for some metals such as Aluminium this is not the case and samples with higher than average TSS can produce high particulate metals (and therefore total metals) concentrations. These cannot be predicted by the model.

Summary

For Cell E, Leslie, Moose and Nema lakes, the model predicts concentrations of Aluminium that exceed the benchmark value within the lifetime of the mine. For Slipper Lake the model predicts Aluminum concentrations below the benchmark value, but above 75% of the benchmark value within the lifetime of the mine.

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Aluminum Model Worksheet Excerpt - Predictions in Receiving Environment as Percentage of Benchmark

Figure 7.3-5a

PROJECT # 0648-121-01 *ILLUSTRATION #* a37183f June 12, 2012

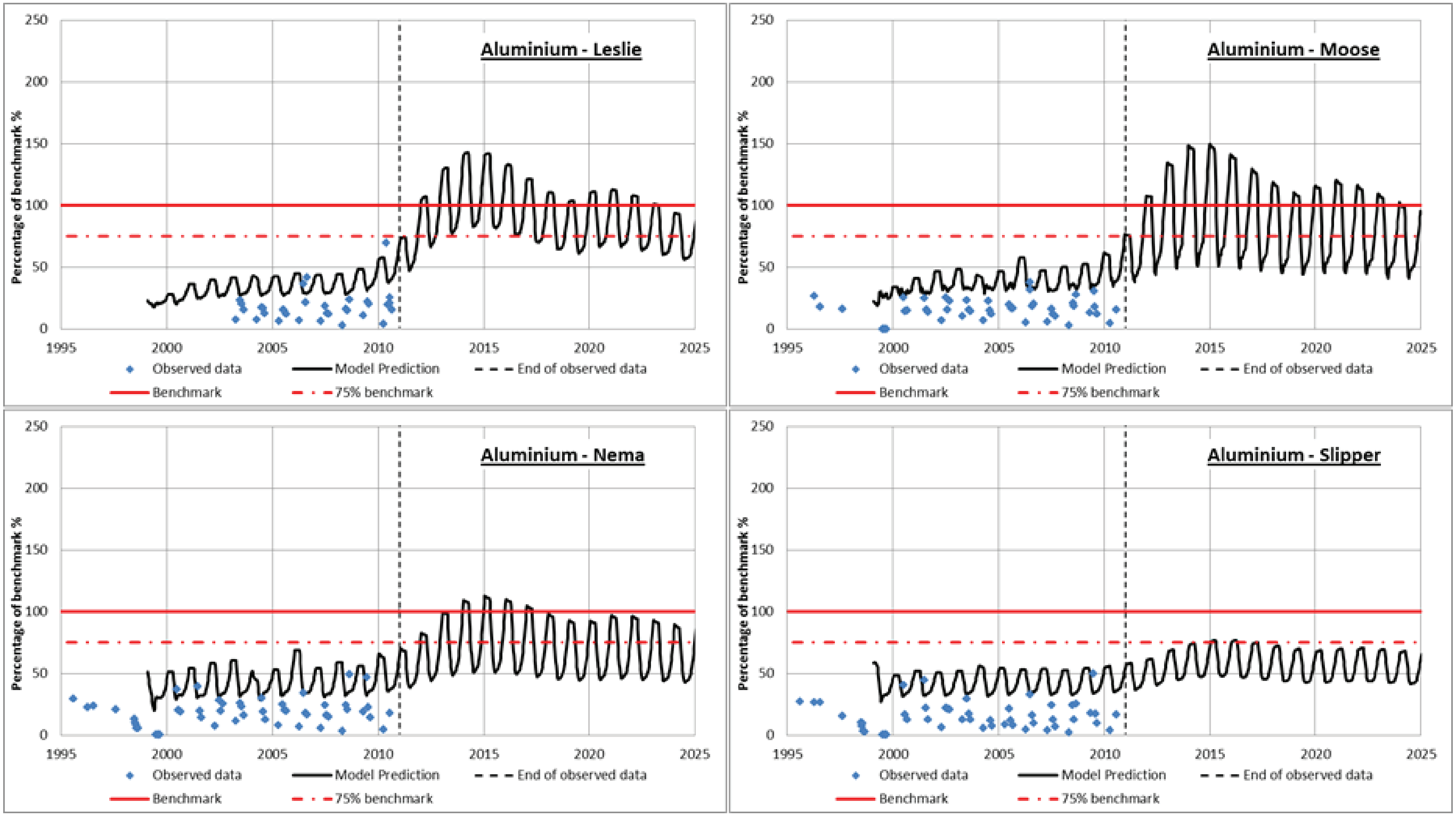

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Figure 7.3-5b

Aluminum Model Worksheet Excerpt - Predictions in Receiving Environment as Percentage of Benchmark

Molybdenum

Sources of Parameter in LLCF

Historical 2000 – end 2010		***Future Estimated Based on Mine Plan (Jan 2011 – Feb 2020)***	
Process Plant	85%	Process Plant	67%
Sump	6%	Sump	8%
Underground	9%	Underground	0%
Runoff	0%	Runoff	0%
Beartooth Pit Reclaim	0%	Beartooth Pit Reclaim	25%

Key Comments Related to Modelling Work

Nearly all loadings to LLCF are from Process Plant discharge, with Process Plant discharge concentrations having decreased over time.

The Base Case model run includes discharge of underground water to Beartooth pit starting in June 2009 and discharge of FPK slurry to Beartooth pit starting in September 2012. Once Beartooth pit approaches 30 m from spill level, free water is decanted to Process Plant for use as reclaim water.

Water Quality Benchmark

19 mg/L (Site Specific WQO).

Leslie Lake (mg/L)				Slipper Lake (mg/L)			
Historical Period (incl. Cell E data)		Best Estimate future peak concentration	Percentage of Benchmark	Historical Period		Best Estimate future peak concentration	Percentage of Benchmark
Highest observed	Median 2009/2010			Highest observed	Median 2009/2010		
0.094	0.068	0.163	<1%	0.0075	0.0049	0.03	<1%

Comment on Model Fit to Observed Data

Good fit with historical data in Cell E, Leslie, Moose and Nema. Over-prediction of observed data in Slipper Lake.

Summary

Historical concentrations and model predictions for downstream lakes are significantly below 75% of the benchmark.

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Molybdenum Model Worksheet Excerpt - Predictions in Receiving Environment as Percentage of Benchmark

Figure 7.3-6a

PROJECT # 0648-121-01 ILLUSTRATION # a37184f June 12, 2012

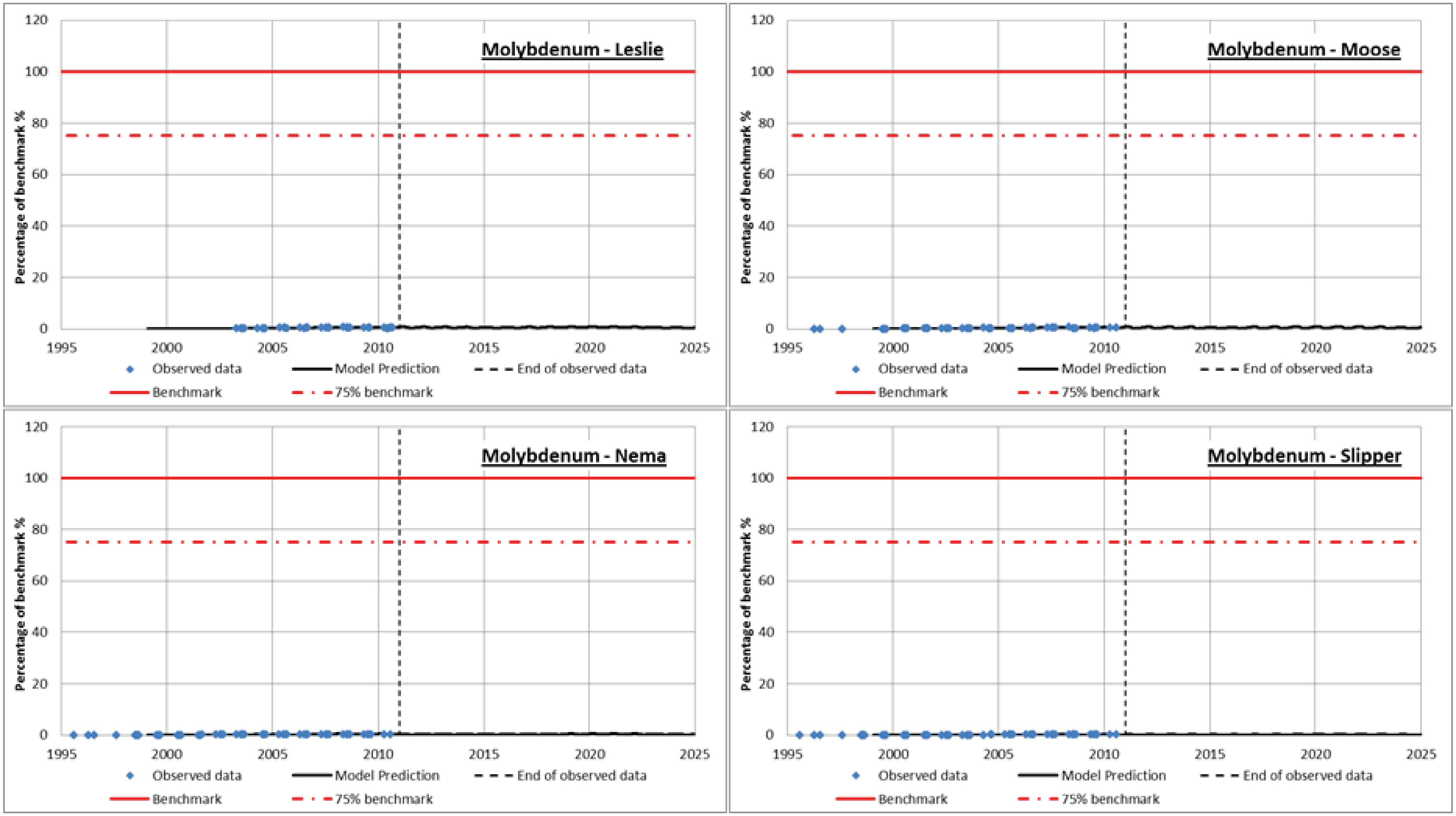

Figure 7.3-6b

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Molybdenum Model Worksheet Excerpt - Predictions in Receiving Environment as Percentage of Benchmark

Figure 7.3-6b

The focus of the three year review is to provide a second look at the AEMP data to identify spatial and temporal patterns. A principal component analysis was used as an exploratory tool to determine if any patterns existed in the water quality and sediment quality datasets. Multivariate analysis included a PCA regression and Bray-Curtis to assess the relationship of environmental variables and biological communities. The results of these statistical analyses play a role in defining the variables evaluated in the annual AEMP. For example the results of the 2009 PCA and multivariate analysis indicated that water quality variables associated with hardness as well as total phosphate-P, copper, iron, and aluminum were found to be important variables for assessing water quality in receiving lakes, in addition to their influence on aquatic biological communities.

The three-year review also provides a discussion based on regulator comments regarding field sampling methods, quality assurance and quality programs, annual statistical evaluation methods used in the AEMP and improvements to the taxonomic analysis.

A key change in field sampling was the elimination of July and September lake water quality sampling from the AEMP plan beginning in 2010. Open water lake sampling was conducted in August and in triplicate. Stream water quality sampling continued to be conducted in June, July, August, and September at traditional AEMP stream locations in addition to Leslie-Moose Stream. The additional stream (Leslie-Moose) and time period (July) supplemented the interpretation of the lake data.

Lake sediment samples were collected using a Kajak-Brinkhurst (K-B) core sampler and Ekman grab during the 2011 AEMP as a result of the 2009 three-year review. Recent reviews of the EKATI sampling methodology have suggested that by using the Ekman grab it is not possible to isolate the most recent sedimentation deposits for analysis, and the chemical composition reported may reflect the mean composition over several (greater than three) years of deposition. In essence, recent deposition that may be mine-related could be diluted with the majority of the 2 cm thick sample slice from the grab that is taken for analysis. The desired thickness of a sediment sample to best estimate recent chemical composition will depend on sedimentation rates. The results of the 2011 sediment quality analysis indicated that for most evaluated variables the concentrations were greater in the samples collected using a coring method (K-B corer) and spatial patterns downstream of the LLCF were similar in samples collected using the Ekman and K-B corer. The 2012 AEMP re-evaluation will review the use of a K-B corer for the sediment quality program at EKATI.

7.3.4 Panda Diversion Channel

A summary of the results of components measured in the PDC over the duration of the 13 years of monitoring is presented in Table 7.3-1.

Nutrients in the PDC have remained consistent over the years, although the levels are typically higher than those seen in the reference streams. Periphyton has also remained consistent in terms of density and taxonomic diversity, while density and diversity for benthos have increased. Habitat structures have increased the density of benthos, especially within the rocky ramps.

Vegetation monitoring in 2011 indicated that the channel is successfully naturalizing both in the planted/seeded areas and the control areas. The majority of the channel has either intermittent or continuous vegetation. The canyon has less vegetation due to unstable steep banks; however, this vegetation will more easily establish once the re-sloping activities (cutting back of banks) are completed. Instream vegetation is slower to establish, limited by the presence of fine substrates; however, approximately 300 m of the channel are now vegetated.

Table 7.3-1. Trends Observed in the PDC Over 13 Years of Monitoring

Component	Trend	Additional Comments
Stream flow	No change	Stream flow has remained consistent among all years.
Water temperature	No change	PDC is slightly cooler than reference streams; however, thermal conditions are expected to improve once resloping work of canyon banks is completed.
TSS	Decrease	TSS has decreased since initial construction, with the exception of brief time periods in 2011 due to increased TSS from resloping work in the canyon area.
Nutrients (Total Nitrogen, Total Phosphorus, Total Organic Carbon)	No change	Total Nitrogen and Total Phosphorus consistently higher than in reference streams.
Culvert stability	No change	All culverts pose no potential barrier to fish passage.
Habitat structures	No change	Stable.
Riparian vegetation	Increase	Density and diversity.
Upper bank slope vegetation	Increase	Density and diversity.
Instream cover	Increase	Especially in areas with fine substrates.
Periphyton	No change	Consistently higher than reference streams.
Benthos	Increase	Benthos density has increased within enhancement structures. Biomass and community structure similar to reference sites.
Fish community richness	No change	Greater richness than reference streams.
Arctic grayling - spawners	Decrease, then increase	Initial decrease, but steady increase over past five years.
Arctic grayling – tagged fish	Cyclical	Approximate five-year cyclical pattern.
Arctic grayling – average age	No change	Average age has remained approximately seven years since 2003.
Arctic grayling – average size	Decrease	A strong older population has died off (naturally); however, several strong younger age classes have been observed consistently returning to the channel each year. Average size is expected to start increasing.
Arctic grayling – number of repeat users	Increase	Number has slowly been increasing over past four years.
Arctic grayling – residence time	No change	Also consistent with Arctic grayling in natural systems.
Arctic grayling – fry	Decrease then no change	Initial decrease and then steady density since 2004. Fry numbers are generally greater than reference sites.
Arctic grayling – fry growth	No change	Growth is slower than in reference streams; however, growth rates have remained consistent between 2003 and 2008.
Arctic grayling – fry outmigrant density	Decrease then no change	Decrease from 2003 to 2004, then consistent until 2008.

Habitat structures were generally present in their original condition, providing habitat complexity and additional cover for fish species. Structures that were slightly physically altered continue to function as intended. As such, ramp structures affected surrounding mean water velocities while weirs, vanes, and groins did not affect mean water velocities, but rather increased variability in velocity within each structure. Such changes led to the creation of microhabitats, allowing for a wider range of habitats to be exploited by rearing fish species. Benthos were more abundant within enhanced areas, while fish usage was similar within structures and near structures. It is likely that increased productivity and current heterogeneity within structures extends their effects to areas not directly within the footprint of the structure.

Recent Arctic grayling trends persisted, showing increases in the number of spawners, repeat users and tagged fish that utilized the PDC. In 2011 one clipped fish returned to spawn in the PDC, which was consistent with the expected number of returning fish (19.2%).

In combination, these results show the channel is successfully naturalizing (becoming “seasoned”) and moving towards equilibrium. The habitat structures are stable and providing enhanced fish habitat as designed. Arctic grayling continue to use the channel to successfully spawn, and juvenile grayling return annually to rear in the channel. The PDC is therefore serving its purpose as defined in the compensation agreement by continuing to provide rearing, feeding, and spawning habitat for up to seven fish species, in addition to serving as a migration corridor for lake trout and Arctic grayling between Kodiak Lake and North Panda Lake.

7.3.5 Pigeon Stream Diversion Channel

Construction and design elements for the PSD were submitted to DFO for approval along with the Pigeon Stream Fish Habitat Compensation and Monitoring Plan and Baseline Data Summary. In addition to the PSD, a water diversion berm will be constructed along the north limits of the pit. The design basis for the diversion berm is to prevent surface runoff, particularly during spring freshet, from flowing into Pigeon Pit by redirecting it back into Pigeon Stream.

The PSD will be constructed to allow flows from the headwater reaches of the Yamba/Exeter Watershed to enter Fay Bay unaltered, circumventing Pigeon Pit. The PSD will be built to mimic current hydrological conditions. That is, it will permit flooding of freshet flows into the surrounding wetlands in the vicinity of the former Pigeon Pond. BHP Billiton will utilize the experience gained from the construction and maintenance of the PDC to design, build, and monitor the planned stream diversion. Flow conditions are not expected to deviate from current conditions. The unlikely residual effect of the PSD altered hydrological regime will be local, and it will persist continuously and permanently. Once mining is complete, the PSD will remain as an independent, functional structure. The effect on water quantity from this flow diversion is expected to be negligible.

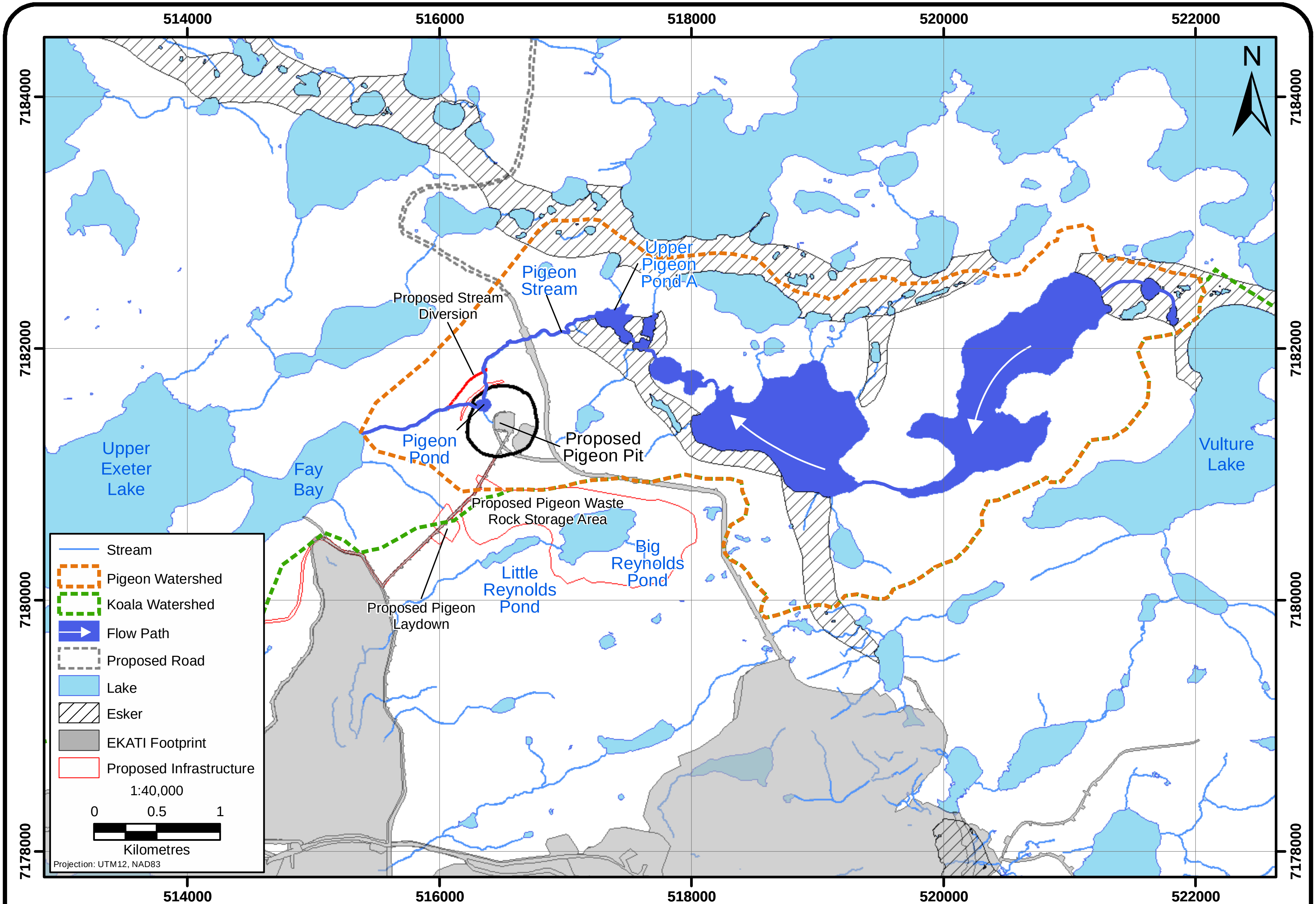
Construction of the PSD around the proposed Pigeon Pit could introduce sediments and associated parameters into downstream waterbodies, including Pigeon Stream and Fay Bay, and is not expected to be observable in Upper Exeter Lake (Figure 7.3-7). Rock used during construction of the PSD will be blasted, which will likely introduce nitrogenous compounds into surface waters. The main identifiable residual effects on water quality that may occur after mitigation measures are employed are the introduction of nitrogen and possibly sediment-associated compounds (including phosphorus) to downstream waterbodies. Phosphorus associated with sediment material could potentially be introduced into downstream waterbodies for a short period of time during the initial flushing of the channel, but is not expected to persist for more than two seasons. Upon opening the diversion channel, a brief increase in suspended sediments is anticipated due to the fine materials washed from the rock used to construct the channel.

The potential exists for primary producer biomass to be slightly enhanced by the introduction of phosphorus. The effect on primary production is expected to be temporary and localized to Fay Bay if an effect is even detected.

The frequency and duration of all the above mentioned potential effects would be continuous during the open water season and is likely to last no more than three years after construction has been completed. This effect is reversible because water quality will not be affected by the PSD after approximately three years. Federal criteria for the protection of aquatic life are not expected to be exceeded in any downstream waterbodies (Fay Bay and Upper Exeter Lake). The residual effects on water quality from the construction and operation of the PSD are expected to be minor.

◎ **Table of Contents**

gis no. EKA-01-119 Job No. 0648-121-01 July 03, 2012



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The Proposed Pigeon Stream Diversion Channel

FIGURE 7.3-7

7.3.6 Pigeon Waste Rock Storage Area and Associated Drainage

7.3.6.1 Water Quantity (Hydrology)

The WRSA for Pigeon will be located within the Koala Watershed (see Figure 7.3-7), thus it is anticipated that effects will be localized to this area and monitored as part of the existing AEMP. The hydrological effect of the proposed Pigeon WRSA will be an altered runoff pattern that will relate to a small and localized reduction in the effective drainage area in the Koala Watershed. In addition, the removal of Big Reynolds Pond (183,623 m^3) will decrease the storage capacity and flow dampening capacity of the Koala Watershed. The footprint of the area affected by the WRSA represents less than 1% of the Koala Watershed, and therefore is not expected to cause a detectable alteration in runoff patterns due to the presence of the waste rock. As well, the removal of Big Reynolds Pond will not cause a detectable change in water quantity to any waterbody other than the outflow of Big Reynolds Pond. The outflow of Big Reynolds Pond includes the connecting stream to Little Reynolds Pond and its outflow, neither of which are fish-bearing. The geographic extent of the effects on water quantity from waste rock storage is highly localized, with effects terminating in the LLCF (will not be observed further downstream).

7.3.6.2 Water Quality

The location of the proposed WRSA at Pigeon will result in the burial of Big Reynolds Pond. Runoff from the Pigeon WRSA area will remain in the Koala Watershed and drain into either Little Reynolds Pond (and ultimately Cell B of the LLCF) or indirectly into the LLCF. The runoff could contain elevated concentrations of sediment-associated parameters and nitrogenous compounds. Federal guidelines for the protection of aquatic life may be exceeded in Little Reynolds Pond for several parameters including nitrate; however, Little Reynolds Pond is a shallow slough that is not fish-bearing or connected to fish-bearing waters and therefore is not necessarily subjected to freshwater guidelines. The effect could be continuous during the open water season for as long as runoff drains into the LLCF.

It is expected that the overall residual effects of Pigeon waste rock drainage on downstream water quality will be negligible because the effects are expected to be localized and runoff will ultimately flow into the LLCF. Any residual effects will be detected as part of the existing AEMP program. The overall effect of this development activity on fish and aquatic habitat will be restricted to the loss of the small, isolated fish population in Big Reynolds Pond, which has been compensated for under Authorization SC99037 from DFO. Little Reynolds Pond does not support fish nor do the inflow and outflow streams of both Big and Little Reynolds ponds.

7.4 ENVIRONMENTAL RISKS AND MANAGEMENT

7.4.1 The Aquatic Receiving Environment Downstream of the LLCF and KPSF

Although processing kimberlite is a physical rather than a chemical process, there is some risk to aquatic receiving environments downstream of the LLCF and KPSF from the mining process. Management of the LLCF has specifically focused on the identification of long-term water quality trends and models to predict future water quality trends. In addition, BHP Billiton has focused on reducing nitrate (related to blasting) and chloride (from underground mine water) as well as management in response to observed increases in AEMP water quality variables (e.g., development of SSWQO).

<u>Nitrate</u>

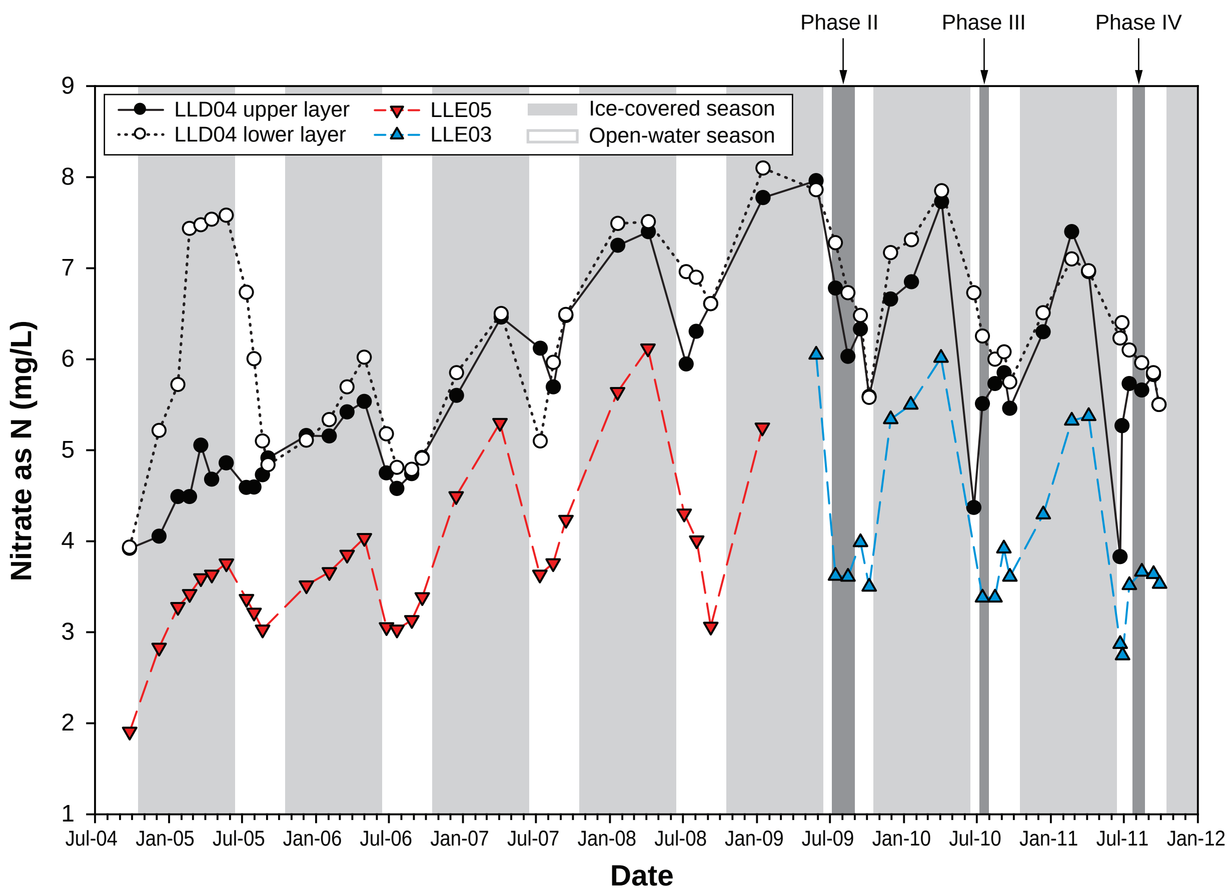
Predicted increase in nitrate concentrations in the LLCF were a concern due to the potential toxicity to aquatic life downstream of the LLCF. BHP Billiton's adaptive management approach was used to address this predicted increase. A number of actions were completed between 2009 and 2011 for the management of nitrate in the LLCF:

- New Water Quality Objective: direct communications with Environment Canada staff regarding water quality objectives for nitrate resulted in BHP Billiton adopting Environment Canada's updated Ideal Performance Standard guideline for the receiving environment. In 2011, a SSWQO for nitrate was established following a literature review and recent investigations by Nautilus Environmental on the effect of water hardness on the toxicity of nitrate (Report 53).
- Timing of Effluent Discharge: the timing of effluent discharge from the LLCF to Leslie Lake was managed to reduce the amount of nitrate released to the environment by taking advantage of summer season stratification in Cell E.
- Numerical modelling of water quality to evaluate potential effects in the receiving environment (culminating in water quality modelling issued in 2012; Report 51)
- Beartooth Pit: continue to pump water from the underground mine to the mined-out Beartooth Pit (as approval by the WLWB).

BHP Billiton also initiated an in situ experiment in Cell D of the LLCF in 2008 to stimulate the growth of phytoplankton and the biological uptake of nitrate by fertilizing the LLCF with phosphate to reduce the nitrate load in the facility (Reports 12, 36 and 49). Phase I of the water treatment test was completed in 2008 and was limited to enclosures within Cell D of the LLCF. Building on the results of the initial Phase I water treatment test, Phase II of the LLCF in situ water treatment test consisted of a larger-scale addition of phosphate to Cell D of the LLCF during the ice-free season of 2009. Sixteen tonnes of monopotassium phosphate fertilizer was added to the surface waters of Cell D between July 7 and September 2, 2009. Phytoplankton biomass increased approximately 24-fold in Cell D in response to the added fertilizer, while both total phosphate as P and phytoplankton biomass levels remained low in the adjacent containment cells. The net decrease in the nitrate load in Cell D during the 2009 open water season was 19% (Figure 7.4-1).

Phase III was undertaken during the 2010 open water season with the objective of achieving further reductions in the nitrate load of the LLCF by replicating the design of the Phase II nitrate treatment test. However, a large phytoplankton bloom was already present in the surface waters of Cell D when the first open water season samples were collected in late June 2010. This bloom was likely stimulated by residual orthophosphate from the 2009 fertilization program. By late July 2010, the phytoplankton bloom had collapsed in Cell D, nearly two months earlier than it had in 2009. The most likely explanation for the early decline of the phytoplankton bloom was efficient grazing by a large population of zooplankton. Calculated estimates of the nitrate load in the water column indicated that there was no significant drawdown of nitrate over the 2010 open water season (Figure 7.4-1). However, average late summer nitrate concentrations measured in 2010 were lower than concentrations measured in late summer 2009, suggesting that concentrations further decreased in 2010 despite continued loading of nitrate into the upstream containment cells of the LLCF.

The plan for Phase IV was to resume weekly phosphate amendments to Cell D during the 2011 open water season, with the goal of further reducing the nitrate load of the LLCF. The results of the 2011 phosphate amendment program were generally similar to the results of the 2010 Phase III program. A phytoplankton bloom was already present in the surface waters of Cell D when the first open water season samples were collected in late June 2011. This bloom was likely stimulated by residual orthophosphate from the 2009 and 2010 fertilization programs. This bloom collapsed by late July, coincident with a peak in zooplankton abundance levels. The addition of 4.3 t of phosphate fertilizer to the surface waters of Cell D between July 29 and August 20 resulted in a small but photosynthetically active bloom, as evidenced by relatively low chlorophyll *a* concentrations and elevated pH and dissolved oxygen saturation levels. Phosphate amendments were discontinued after August 20, 2011, as orthophosphate concentrations began to



Notes: Monthly averages were plotted for July, August, and September 2009; July and August 2010; and July and August 2011.
Dark grey shaded areas represent periods during which phosphate amendments were made to Cell D.
Station locations are shown in Figure 2.1-1.

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Concentration of Nitrate in Cells D and E of the Long Lake Containment Facility, 2004 to 2011

Figure 7.4-1

increase in Cell D and thermal stratification was weakening. Although a large phytoplankton bloom was apparent in the surface waters of Cell D in late June/early July 2011 and a small bloom was stimulated in response to phosphate amendments, there was no significant reduction in the calculated nitrate load of Cell D over the course of the 2011 open water season (Figure 7.4-1).

Nitrate concentrations measured throughout the 2011 open water season were similar to concentrations measured in 2010. However, nitrate concentrations also did not increase in Cell D despite continued nitrate loading to upstream containment cells. Added phosphate may have played a role in preventing any further increase to the nitrate load of Cell D.

The results of the most recent prediction models (simulating discharge of underground water to Beartooth pit in 2009 and discharge of FPK slurry to Beartooth pit starting in 2012) indicate nitrate concentrations downstream of the LLCF will not approach the hardness dependent nitrate SSWQO (see Section 7.3.2).

Snow was cleared from a large portion of the surface ice of Cell D during late winter 2012 to facilitate increased photosynthetically active radiation availability under the ice. The increased photosynthetically active radiation combined with residual phosphate in the water column of Cell D (from the 2011 phosphate additions), was completed to stimulate phytoplankton growth earlier in the winter when zooplankton populations are likely at their lowest. The increase in phytoplankton would thereby increase the potential for nitrate reduction in Cell D, which has been slowed by zooplankton grazing on phytoplankton during the last two open water seasons. LLCF waters will continue to be monitored in 2012; however, phosphate additions were not completed.

The addition of phosphate also caused notable changes to the physical, chemical, and biological composition of Cell D during the open water season. The complete results of the 2008 phosphate amendment program are presented in *EKATI Diamond Mine: 2008/2009 Long Lake Containment Facility Nitrate In Situ Treatment Test* (Report 12). As a result of these observed changes during Phase I of the nitrate treatment, the following water quality variables (in addition to nitrate, nitrite, and ammonia) were monitored weekly to bi-weekly during the phosphate amendments and resulting phytoplankton bloom in subsequent phases of the nitrate in situ tests: pH, DO, euphotic depth, turbidity, TSS, total phosphorus, orthophosphate, total organic carbon, and silicate. As a result of monitoring these variables, management of continuing fertilizer application was implemented. For example, when orthophosphate levels began to accumulate, the fertilizer applications were discontinued.

During the initial phases of the nitrate treatment, potentially toxic metals (i.e., aluminum, arsenic, cadmium, copper, lead, molybdenum, nickel, and zinc) associated with the fertilizer used for the phosphate amendments were monitored (Report 12). However, it was concluded that these metals did not increase in Cell D of the LLCF as a result of the phosphate amendment.

<u>Chloride</u>

Predicted (and observed) increases in chloride due to underground mine water mixing with the water in the LLCF have been an ongoing concern at EKATI. Chloride influences osmotic balance and ion exchange and is therefore highly regulated by aquatic organisms. At elevated concentrations, chloride can be toxic and may inhibit survival, growth, and reproduction. Elevated chloride concentrations may also reduce the diversity of organisms present in freshwater systems because organisms that are intolerant of high salinity are likely extirpated.

Mining was completed in the Beartooth Open Pit in 2009. Beginning in late 2009, underground mine water and other sources of mine water have been pumped to the mined-out Beartooth Pit as a means of

◎ Table of Contents

enhancing water quality in the LLCF, particularly with regards to chloride. In addition, FPK is planned to be deposited into the Beartooth Pit beginning in late 2012 as part of the FPK deposition plan.

Similar to the management of nitrate, a SSWQO for chloride was established following a literature review and recent investigations by Nautilus Environmental (Elphick et al. 2011). Numerical modelling of water quality to evaluate potential effects of chloride in the receiving environment was also completed (culminating in water quality modelling issued in 2012; Report 51).

Evaluated AEMP Water Quality Variables

Although concentrations of some water quality variables downstream of the LLCF have stabilized in recent years, concentrations remain elevated above baseline or reference concentrations for each of the 16 water quality variables (Figure 7.2-3). In addition, concentrations remain elevated above baseline or reference concentrations for 11 water quality variables downstream of the KPSF (Figure 7.2-4). Patterns were similar downstream of the LLCF and KPSF during the under-ice and open water seasons, though concentrations were sometimes elevated during the ice-covered season (when compared to the open water season) as a consequence of the exclusion of solutes by the ice cover. In reference lakes, concentrations have generally been low and stable through time. The evidence suggests that the observed changes in water quality in lakes and streams downstream of the LLCF or KPSF are mine effects that stem from the discharge of water from the LLCF or KPSF into the receiving environment under Water Licence WL2009L2-0001. As discussed in the 2011 AEMP, the changes in water quality are also related to the observed effects on aquatic life other than fish (Report 56).

Between 2009 and 2011 BHP Billiton activities to manage water quality risks included:

- The retention of FPK over the mine life, avoiding (if possible) the placement of material into Cell D, and having a positive impact on effluent water quality. Expertise on tailings management, water quality, and engineering design was retained to provide technical assistance in assessing the alternatives. One of the tools that BHP Billiton used was a predictive model for water quality in the LLCF. An updated model was developed to account for performance in the individual cells of the LLCF (see Section 7.3.2). This way, potential concerns could be identified and addressed before they become impacts or compliance concerns. The assessment process was designed to not only evaluate the current, accepted management plan for processed kimberlite, but also to review current performance and what preferred options are available.
- Utilization of the Beartooth Pit for mine water storage until the mine water can be managed through the LLCF again (the Beartooth system became operational in December 2009).
- Continue to assess the best timing for the discharge of water from the LLCF into Leslie Lake (spring/summer/fall) to minimize the concentration of nitrate (and other water quality variables) released to the environment.

The water quality prediction model was updated in 2011, and the results indicated that for eight water quality variables, there is a risk that concentrations in lakes lying downstream of the LLCF could exceed at least 75% of the water quality benchmark from the end of 2010 to February 2020. Of these, seven are predicted to exceed the benchmark:

- Phosphate - predictions are impacted by a recent fertilization study in the LLCF.
- Cadmium - benchmark is known to be very low (and below baseline concentrations in the lakes).

- Chloride, chromium, potassium, and selenium – predicted concentrations exceed their benchmarks only in winter months when ice exclusion processes raise concentration temporarily in the under-ice water.
- Aluminum - predicted to exceed the water quality benchmark in open water months and for multiple years during the remaining life of mine.

Aquatic Assemblages Downstream of the LLCF

Phytoplankton community composition has shifted in all lakes downstream of the LLCF as far as Nema Lake, with a decrease in the relative densities of cyanophytes (blue-green algae) and increase in the proportion of Bacillariophyceae (diatoms) through time. These shifts are likely related to the increase in nitrate concentrations following the onset and subsequent expansion of underground mining operations in 2002. More recently, phytoplankton community composition has shifted a second time in Leslie Lake. Specifically, there has been a reduction in the proportion of diatoms and increase in the relative density of chlorophytes (green algae), which are usually rare in sub-Arctic freshwater systems in the NT. This more recent shift in phytoplankton community composition in Leslie Lake is likely related to the addition of phosphorous in the LLCF, which began in 2009 and continued through 2010 and 2011 as an adaptive management response to increased nitrate concentrations.

The changes in phytoplankton composition may be associated with changes in the proportion of edible phytoplankton or the nutritional quality of phytoplankton. Diatoms generally have a higher fatty acid content than cyanophytes, which renders them a better quality food for herbivorous zooplankton (Lamberti 1996 in Wehr and Sheath 2003). This may lead to changes in the nutrient content, abundance, or taxonomic composition of zooplankton, which may, in turn, cascade upward to affect higher trophic levels from secondary consumers to top predators like fish. The second shift, from diatoms to green algae in Leslie Lake, is suggestive of a reduction in water quality in sub-Arctic lakes. The most dominant genera of green algae present in Leslie and Moose lakes, *Gloeocystis*, is relatively inedible, which may have cascading effects on zooplankton community abundance or taxonomic composition.

The changes in zooplankton community composition are likely related to two aspects of changes in water quality. First, rotifers and cladocerans are generally sensitive to changes in water quality. For example, many rotifers are intolerant of conductivity greater than 400 µs/cm, which is in the range of values observed in lakes immediately downstream of the LLCF. Cladocerans are particularly sensitive to chloride toxicity and although chloride concentrations were below the SSWQO at all sites in 2011, the SSWQO is designed to protect 95% of species against long-term exposure, and some of the more sensitive species may be affected at levels below the SSWQO (Elphick et al. 2011). Second, the observed changes in phytoplankton community composition, on which zooplankton feed, are likely related to changes in nitrate and phosphorous concentrations.

Along with analysis of the 2011 AEMP results, it is anticipated that the 2012 AEMP re-evaluation will further elucidate the relationship of water quality and aquatic assemblages at EKATI.

BHP Billiton continues to undertake a number of adaptive management actions in an effort to reduce the concentration of nitrate (and historically chloride) released into the receiving environment in order to prevent further shifts in phytoplankton community composition and declines in phytoplankton diversity. In addition BHP Billiton has recently developed SSWQO for six water quality variables known to be increasing in the receiving environment and for potential toxicity to aquatic assemblages:

- chloride (Elphick et al. 2011);
- molybdenum (Report 47);

- nitrate-N (Report 53);
- potassium (Report 52);
- sulphate (Report 54); and
- vanadium (Report 55).

7.4.2 Changes in Fish Biology

BHP Billiton has identified changes in lake trout populations as a result of the sampling programs at EKATI; it is a long-lasting effect and environmental risk that requires mitigation.

In the 2007 AEMP, sampling mortality of fish was minimized by adhering to catch limits recommended by DFO. Slimy sculpin was added as a potential indicator species for the AEMP to assess whether this species could be used as the only species for destructive sampling, thereby reducing sampling mortality of round whitefish and lake trout.

Fish population sampling in the lakes of the EKATI area will occur in the summer of 2012 as part of EKATI's AEMP. Following the re-evaluation of the AEMP that BHP Billiton issued on May 4, 2010, the WLWB required that BHP Billiton submit a work plan for the fish sampling program to the board before the end of December 2011. In this work plan, BHP Billiton evaluated four specific comments with respect to assessing the health of fish populations while minimizing sampling effects (Report 37):

1. Evaluate the continued use of index gillnets to sample fish populations:
   - evaluate the use of index gillnets to collect fish in 2012 compared to the use of less lethal types of sampling gear.
2. Evaluate non-lethal tissue sampling for measuring metal concentrations:
   - compile and evaluate the scientific literature on non-lethal methods of sampling fish tissue for the purpose of measuring metal concentrations; and
   - conduct tissue biopsy sampling of fish followed by analysis of metal concentrations to evaluate the current analytical capacity of ALS Environmental to measure metal concentrations from tissue biopsies.
3. Evaluate slimy sculpin as a sentinel species:
   - review the scientific and grey literature pertaining to the use of slimy sculpin as sentinels for tracking metal contaminants and other important biological parameters;
   - use multivariate statistical analysis to identify if parasitism presence affects slimy sculpin metal loading patterns;
   - estimate the number of samples required to detect a changes from baseline values in parameters, including body size and metals concentrations; and
   - establish sampling locations and a sampling frequency for monitoring.
4. Evaluate the need for measuring hydrocarbons in fish:
   - review data on bile hydrocarbon metabolites measured from fish sampled in 2007 and 2008;
   - review other methods as described in scientific literature that allow for hydrocarbon exposure detection in fish;
   - determine the number of fish samples required to define the spatial extent of hydrocarbon exposure;
   - integrate a hydrocarbon sampling program into the study design of the AEMP fish component.

This fourth objective addresses concerns about the previously observed presence of hydrocarbon metabolites in fish bile, indicative of hydrocarbon exposure. The 2012 AEMP field sampling plan included the following key changes:

- the addition of slimy sculpin for use as a sentinel species in all AEMP lakes for all biological parameters, metals, and PAH analyses, with a sampling frequency of every three years;
- the application of a non-lethal sampling program for lake trout using dermal punch tissue extraction methodologies required for metals analyses of muscle tissue, consequently reducing the amount of information normally obtained from lethal measures (stomach content taxonomy, liver and gonad weights, metals in liver, PAHs, sex, maturity, and egg counts);
- decreasing the sampling frequency of lake trout and round whitefish to once in every six years, unless data show need for special effects studies, on large bodied fish prior to the next scheduled sampling year, instead of the current once in every five years, to further minimize total sampling mortality and to link it with the sampling of slimy sculpin every three years; and
- an investigation into the spatial extent of hydrocarbons in EKATI area lakes.

7.4.3 Low Under-ice Dissolved Oxygen

The amount of oxygen in a lake under the winter ice decreases through the winter season because of the limited atmospheric oxygen mixing with surface waters, as well as the decomposition of plants and algae (which consumes oxygen). This cycle occurs naturally but can sometimes be amplified by mine-related effects.

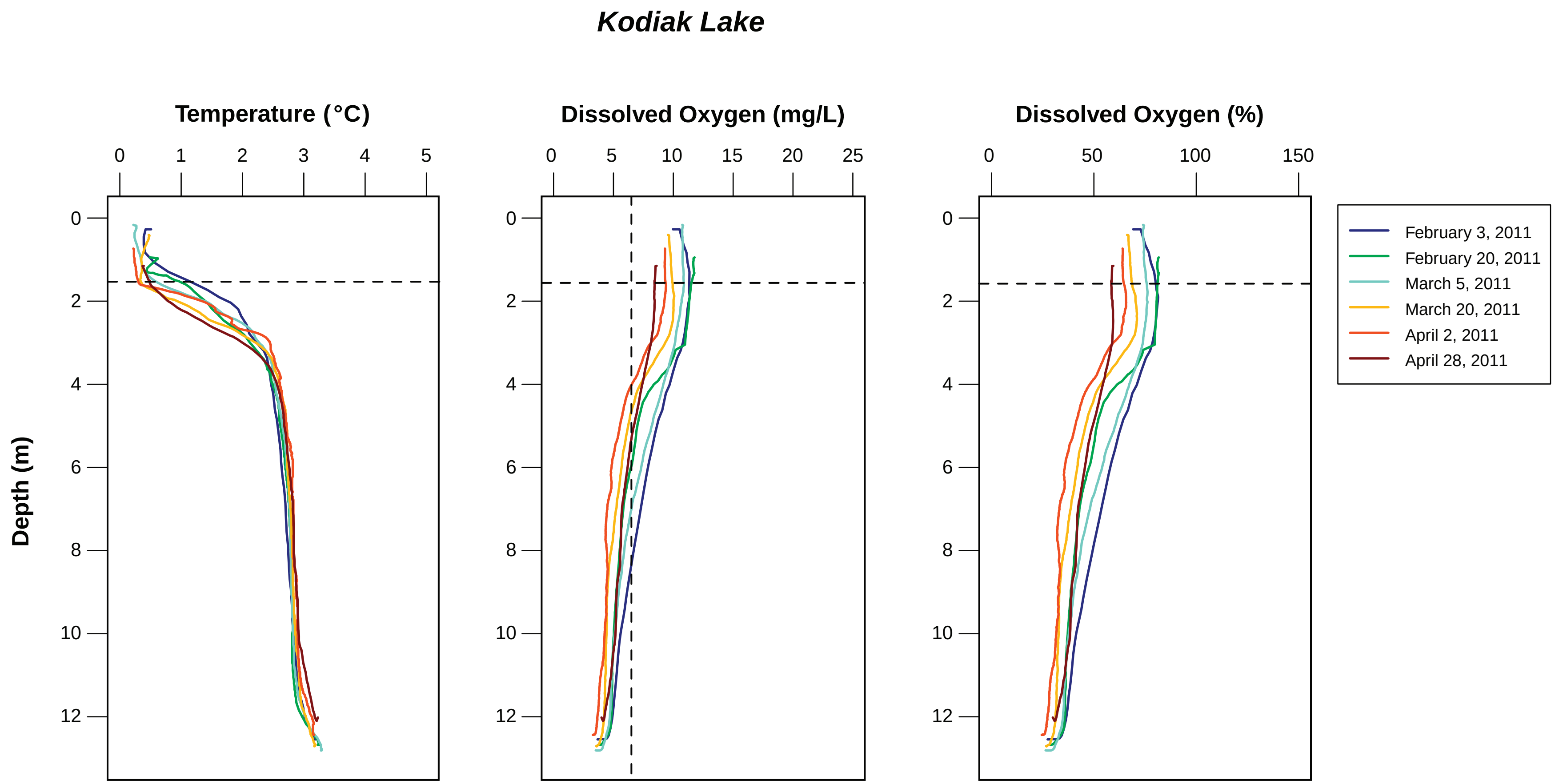
Early in the mine life, an inflow of nutrients from the sewage treatment plant at EKATI resulted in an increase in productivity in Kodiak Lake and consequently low winter oxygen levels. Reduced under-ice DO levels in Cujo Lake are also evident; however, it is not known if this is a mine effect. Although low DO in lakes can occur naturally, the effects on organisms can be lethal and result in changes in physiology or behaviour. Thus each winter since 1997, EKATI Environment Department staff have monitored under ice DO concentrations in Kodiak and Cujo lakes more regularlarly (weekly to bi-weekly; e.g., Figures 7.4-2 and 7.4-3).

Recent monitoring results indicate that changes observed in the Kodiak Lake temperature profiles likely stem from BHP Billiton's efforts to improve DO concentrations in Kodiak Lake, which have included the use of aerators (beginning in 1997). The changes in the under-ice temperature and DO profiles in Kodiak Lake correspond to the first year in which aerators were no longer used (2007). The current, stratified DO profiles likely represent undisturbed conditions in Kodiak Lake, since aerators would cause mixing of the water column, which would result in homogeneity of temperature and DO throughout the water column. Although monitoring of under-ice DO continues at Kodiak Lake as part of the AEMP sampling, aeration is no longer required.

Recent monitoring results also indicate improvements in under-ice DO concentrations in Cujo Lake, which stem from BHP Billiton's mitigation measures; these measures involved clearing snow from the lake surface to promote the production of oxygen by stimulating phytoplankton growth. BHP Billiton will continue to monitor Cujo Lake DO concentrations to ensure effects on aquatic organisms, particularly fish are limited.

Table of Contents

PROJECT # 0648-121-01 ILLUSTRATION # a35131n-EIR June 12, 2012



Notes: Data collected and supplied by BHP Billiton Environment.
Horizontal dashed line represents ice thickness; Vertical dashed line represents the CCME guideline for dissolved oxygen (6.5 mg/L).

Figure 7.4-2

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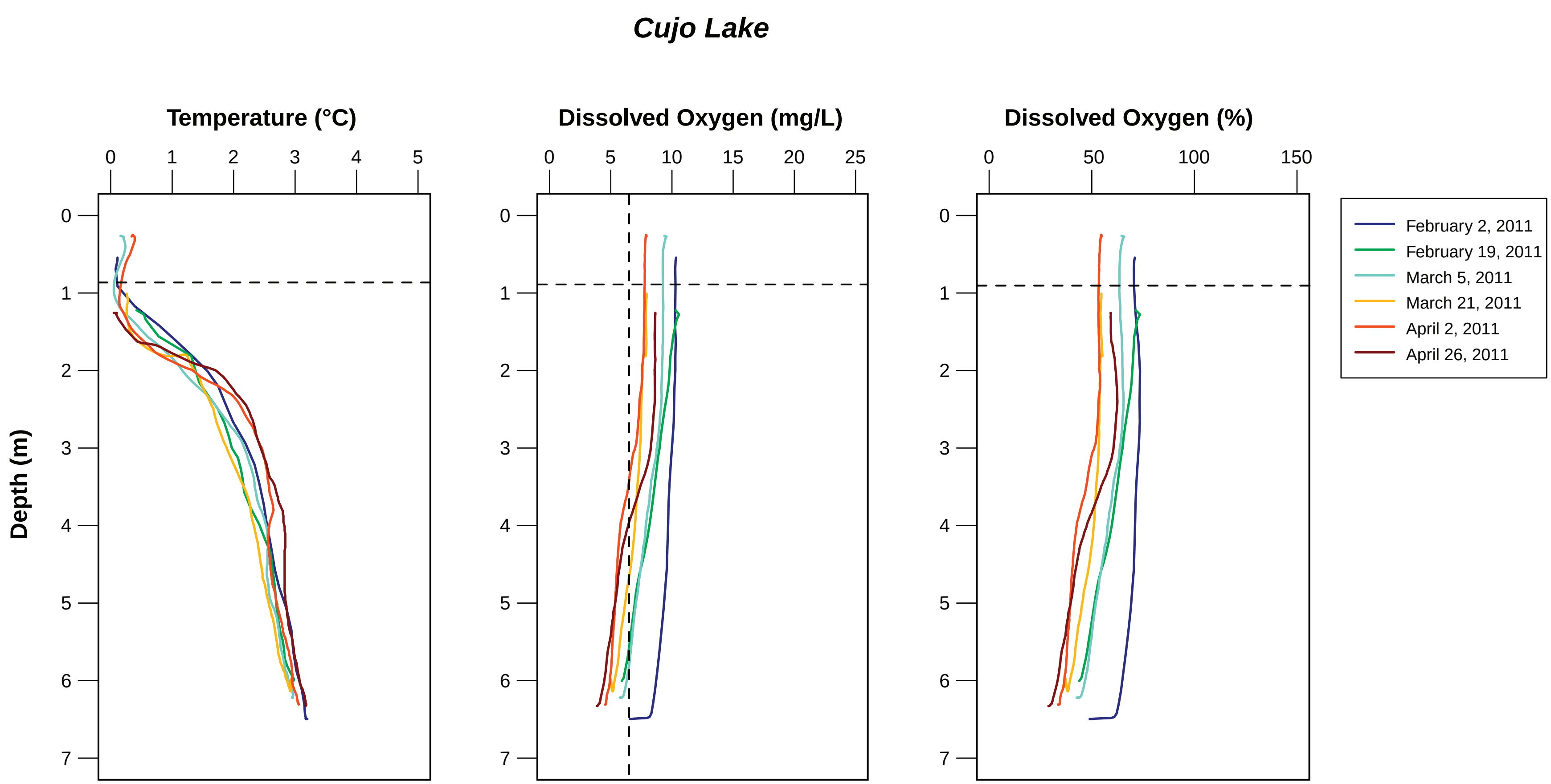
Dissolved Oxygen and Temperature Profiles for Kodiak Lake, Ice-covered Season 2011

Figure 7.4-2

PROJECT # 0648-121-01 ILLUSTRATION # a35135n-EIR June 12, 2012



Notes: Data collected and supplied by BHP Billiton Environment.
Horizontal dashed line represents ice thickness; Vertical dashed line represents the CCME guideline for dissolved oxygen (6.5 mg/L).

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Dissolved Oxygen and Temperature Profiles for Cujo Lake, Ice-covered Season 2011

Figure 7.4-3

7.4.4 Changes in Water Quality of Waste Rock Seepage

Waste rock seepage to the receiving environment represents a risk to water quality and aquatic assemblages. Construction (according to the WROMP) of the WRSAs are managed to reduce seepage into the receiving environment; management techniques including a coarse granite layer as base layer, stepped side slopes to enhance permafrost growth, encapsulation of meta-sediment within 5 m of granite waste rock, and in some cases, toe berms. For example, toe berms were built above SEEP 018/019 in 2006 to reduce seepage from waste rock piles into the receiving environment. Construction of waste rock piles are modified to encourage early permafrost development, which would reduce the volume of seepage and improve its quality. Permafrost is growing within waste rock piles and is colder than natural permafrost below it due to convective super-cooling during winter.

Seepage management continues to be addressed as described in the WROMP. The detailed seepage sampling protocol is also provided in the plan. The following tasks were outlined to address seepage management in EKATI WRSAs:

- Seepage monitoring will continue to address the requirements of Part G.4 of the current Water Licence.
- Seepage surveys will be conducted each year during freshet and fall.
- The results will be reported and interpreted in the annual Waste Rock and Waste Rock Seepage Survey reports, submitted the following March 31 to the WLWB.
- In addition, a freshet seepage report will be issued 60 days following completion of the freshet seepage survey and will compare data collected from seepage that enters the receiving environment to the Water Licence criteria.
- Where necessary, monitoring of potentially problematic seeps will continue to be conducted more frequently during the open water season (frequency is dependent on rain events). This currently includes SEEP-18B and SEEP-19 at the Panda/Koala/Beartooth WRSA, SEEP-52 at the Misery WRSA, and SEEP-360 and SEEP-362 at the Fox WRSA.

Evaluation of seepage water quality at freshet and fall allows for additional monitoring to be performed at seeps identified as areas of interest. For example SEEP-018/019, SEEP-360/362, SEEP-367, and SEEP-052 were identified as areas of interest during either the freshet or fall sampling programs between 2009 and 2011. The added monitoring did not require any additional actions. Further monitoring results' details can be found in the EKATI Environmental Agreement and Water Licence Annual Report (Report 59) or the annual WRSA Seepage Report (Report 48).

Permafrost development in the WRSAs is monitored annually. Ground temperatures in the WRSAs are typically measured a minimum of four times per year using ground temperature cables installed at various locations within the Panda/Koala/Beartooth, Fox, and Misery WRSAs, as well as the CKRSA. The results of the permafrost monitoring in WRSAs are presented in the annual WRSA Seepage Report (Report 48).

The results of the 2011 permafrost monitoring indicated that the Panda/Koala/Beartooth WRSA and toe berms remain in a permafrost condition, consistent with previous years. Observed fluctuations in ground temperatures are likely in response to removal of cover material for use as crusher feed. The time required to achieve thermal equilibrium in the Panda/Koala/Beartooth WRSA is unknown, however ground temperatures appear to be stabilizing.

Large portions of the Fox WRSA remain unfrozen, as in previous years. Similar to the Panda/Koala/Beartooth WRSA ground temperatures are equilibrating and trending towards freezing, however the time for freeze back is unknown. The Fox toe berms remain in a permafrost condition, consistent with previous years. The Misery WRSA remains in a permafrost condition, consistent with previous years. Active layer thicknesses vary significantly within the Misery WRSA as has also been observed in previous years.

The waste rock geochemistry has also been explored to gain further understanding of potential risks of seep water quality to the receiving environment. Samples are collected and analyzed according to the sampling commitments set out in the WROMP. Results are presented in the Annual Seepage Monitoring reports along with a brief discussion on neutralization and acid-generation potential of rock relative to seepage results.

7.4.5 Water Quality Associated with Misery Pit “Push-back”

The initial Misery open pit was developed between 2001 and 2005. A planned enlargement of the pit was deferred until a later time. BHP Billiton resumed mining operations at Misery Pit in 2011 through a “push-back” (enlargement) of the open pit using conventional open pit mining methods.

For the resumption of mining activities, the Misery water management system was already in place and had continued to be in use to manage runoff water and some water from the open pit sump from 2005 through 2011. The water management system comprises the Misery Pit sump, Desperation Pond, Waste Rock Dam Pond, and the KPSF. The KPSF receives inflows from the other waterbodies (including the pit sump), and excess water from the KPSF is pumped to the receiving environment, based on water quality being compliant with the site Water Licence. There have been no water quality compliance issues of note throughout the initial operation and subsequent suspension of mining at the Misery Open Pit.

At the Misery Pit, some of the waste rock to be mined is metasediment (biotite schist), which is potentially acid-generating and metal leaching; this prevents a water quality risk. The mitigation measures for metasediment were already in place and were resumed with the resumption of mining activities in 2011. The primary mitigation measures are: 1) to encapsulate metasediment waste rock within 5 m of granite waste rock (to maintain permafrost within the metasediment) and 2) to flood the Misery Open Pit with clean water when mining is complete (to submerge meta-sediment wall rock under water).

7.4.6 Water Quality and Quantity Associated with Pigeon Pit Development

BHP Billiton plans to progress with mining the Pigeon Pipe using conventional open pit mining methods. Pigeon Pipe is located to the north of the process plant and associated buildings at the EKATI. Designs of the waste rock and water management options at the Pigeon site have been completed. In support of this work, BHP Billiton has also completed studies to address risks to the aquatic receiving environment associated with Pigeon Pit development.

Pigeon Pit sump water will be pumped to the LLCF, and waste dump runoff will flow towards the LLCF, and therefore, on-going management of the LLCF is expected to reduce the risks associated with the development of Pigeon Pit to negligible. A key concern at the Pigeon Pit is that some of the waste rock to be mined from the Pigeon Pipe will be metasediment, which is potentially acid generating and metal leaching. The primary mitigation measures are the same as those in place at the Misery open pit, namely: 1) to encapsulate metasediment waste rock within 5 m of granite waste rock (to maintain permafrost within the metasediment) and 2) to flood the Pigeon Open Pit with clean water when mining is complete (to submerge metasediment wall rock under water).

7.4.7 Hydrocarbon Contamination Downstream of the LLCF and KPSF

Since evidence of hydrocarbon contamination was found in waterbodies at EKATI in 2007, BHP Billiton has continued to investigate this matter as a potential risk to fish.

Several investigations have been conducted to attempt to pinpoint the source(s) of the hydrocarbon contamination and/or to further quantify levels of contamination in the biotic (i.e., fish) or abiotic components of the environment (i.e., water and sediments) that may have led to the observed metabolites identified in fish bile in 2007. To date, these data have not shown significant hydrocarbon contamination in the abiotic environment even though the 2008 fish study supported the initial findings of bile metabolites in fish in 2007.

In the 2008 study, air emissions from diesel fuel were identified as a possible source of trace hydrocarbons entering the aquatic environment causing the detected hydrocarbon-induced metabolites in fish bile. To address this theory, a special study was conducted as part of the 2010 AEMP. Sediment samples were collected from Cell E and Leslie Lake in areas close to emission sources (Dike D and the Fox Haul Road) and analyzed for PAHs. Nanuq Lake was also sampled as a reference lake. Again, hydrocarbon contamination was not evident in sediments downstream of the LLCF in Leslie Lake or in the reference lake (Nanuq). Only small amounts of hydrocarbons were detected in Cell E sediments near the Fox Haul Road. In 2010 and 2011, additional hydrocarbon analyses were also completed for water samples collected regularly around the mine site. Additionally, the analytical laboratory was able to offer lowered detection limit (beginning in 2010) for the analysis of Total Petroleum Hydrocarbons (TPH) to increase the ability to detect trace amounts of hydrocarbon contamination in these samples. The results of this sampling did not indicate consistent or significant hydrocarbon contamination of waterbodies around the mine site, nor were they indicative of a point source for hydrocarbon release into the aquatic environment.

BHP Billiton has a number of management procedures to reduce the risk of hydrocarbon contamination in the aquatic receiving environment including:

- Fuel handling procedures.
- Internal spill reporting and clean-up.
- Fuel storage is with secondary containment.
- Drip trays under all portable light stands.
- Spill kits are available at fuel transfer areas.
- Electric pumps were installed at Cell E outlet dam.

In addition to the current management practices, an employee awareness program on storage of hydrocarbons underground is now being implemented.

To address potential hydrocarbon contamination downstream of the LLCF in 2012, liver tissues from round whitefish, slimy sculpin and lake trout will be analyzed for hydrocarbons using an enzymatic biomarker, ethoxyresorufin-O-deethylase (EROD), in the AEMP study lakes selected for each species, as well as in Cell E for slimy sculpin only. This will allow for a spatial gradient to be detected, if present, and to assist in determining the point source of hydrocarbons in the EKATI area. Given that the point source may not be the EKATI diamond mine (PAHS are being atmospherically deposited in the region from a point source elsewhere), reference sites away from camp are necessary. Because other agents may also affect EROD activity, if elevated EROD activity is observed in potentially affected lakes in comparison to reference lakes, then additional analyses for polychlorinated biphenyls and dioxins on up to three fish per lake showing elevated EROD activity will be conducted.

7.4.8 Long-term Performance of the PDC

Results of the monitoring program showed that the PDC is successfully providing fish habitat and that vegetation is establishing itself along its banks. Nonetheless, some additional habitat enhancements in the PDC still need to be conducted prior to the completion of the program. The middle reaches of the PDC are straight and consist of non-complex habitat. It is proposed that additional habitat enhancement rock structures be installed in these reaches during the winter of 2012/2013. In order to provide the necessary habitat information for the design and installation of these structures, it is proposed that a full habitat assessment of the PDC be conducted during July 2012. Although many plants have successfully re-colonized riparian and bank slope areas, results indicate that the establishment of instream vegetation is occurring at a slower rate. In order to address this issue, it is proposed that instream vegetation mats be transplanted to the PDC during the summer of 2012. Field work will be required to determine the best locations in the PDC for vegetation mat placement (conducted at the same time as the full habitat assessment), as well as to identify, cut, and remove mats from natural streams, with subsequent transplants occurring at various locations in the PDC.

Long-term stability of the PDC was identified by BHP Billiton as a risk that could influence usability and productivity by aquatic species. Annual snow clearing of the PDC is completed in the spring to avoid ice blockage during the spring melt. However, an engineering study was completed and indicated a layback of the channel walls (in the areas of identified instability) would be an effective way to provide long-term stability.

BHP Billiton recognized the importance of accelerating the slope stabilization project in 2010 to protect the PDC and initiated work to finalize the engineering design and formulate construction schedules and equipment requirements (Report 28). A comprehensive risk assessment was completed and identified the stream bed, release of sediment into Kodiak Lake and removal of the ice plug as three of the main environmental risks. The slope stabilization project was planned to be completed over two winters, reflecting the challenges associated with winter construction and risks associated with partially completed construction.

In the spring of 2011 BHP Billiton successfully completed the first phase of the PDC Slope Enhancement Project. Refinements to the engineering design resulted in several changes to help protect the environment. A snow/ice pad was constructed in the bottom of the PDC to protect the stream bed from blasting and clean-up activities and also to be more easily removed than a solid pad of ice. This technique was very successful at protecting the stream bed, and following construction, it was notched to allow water flow during spring freshet. The height of the bench in the soil section was lowered to protect the lower side slopes and minimize the potential for sediment release from these exposed slopes. An engineered berm was constructed on the bench to help filter sediment from the newly exposed walls and bench surface; the berm was envisioned to be useful during freshet and rain events

Mitigating the risk of sediment from entering the PDC involved the use of several techniques, under the expectation that some sediment would result from normal construction activities:

- enhancing silt curtains in Kodiak Lake to trap sediment;
- icing the bottom side slopes of the PDC to facilitate cleaning activities;
- air cleaning the granite wall section to collect loose sediment;
- cleaning of the ice pad following construction activities;
- procurement of silt curtains that could be placed in areas of concern once the snow and ice pad fully melted; and

- stockpiling sandbags for quick access for placement along the banks of the PDC if point sources of sedimentation to the PDC should develop.

EKATI Environment Department staff began monitoring the PDC on May 13, 2011 to assess post-construction water quality, as daily inspections indicated that water was flowing through the trench carved into the ice pad and down into Kodiak Lake.

As an example of additional mitigation techniques, EKATI Environment Department staff observed a volume of water entering the PDC that contained suspended solids. A check dam was constructed out of sandbags to trap and remove sediment. The check dam was successful in capturing sediment and has been maintained by removing accumulated sediment within the dam. Additionally, on June 19, silt curtains were installed below the check dam along the east bank of the PDC to help capture any remaining sediment entering the stream from this same area.

On July 2, 2011, following a rainfall event, a sediment flow was observed entering the PDC in the area of the check dam (northeast zone of construction activities). That evening a temporary silt curtain was installed across the width of the stream downstream of the sediment flow. The silt curtain was set up as a temporary measure to help slow the flow of sediment while allowing a small passage for fish underneath the curtain. The following day several follow up measures took place:

- a spill report was filed with the NT spill line;
- the silt curtain, installed the previous day across the width of the stream, was removed;
- a second silt curtain was installed along the east bank of the PDC to help capture any sediment not being captured by the existing silt curtain installed on June 19;
- a lined sump was created to catch sediment on the bench before it could enter the PDC; and
- two additional check dams were built in the area to help catch any residual sediments not being retained in the sump.

From July 2 to July 9, 2011 sampling was conducted in the PDC and Kodiak Lake to monitor TSS levels and the extent of the sediment release. Results show that TSS levels were elevated in the PDC from July 2 to July 5, 2011 (maximum of 84.3 mg/L) and then returned to background levels. Kodiak Lake data show that the silt curtains at the outlet of the PDC were working very efficiently as much of the sediment was retained within these curtains.

TSS concentrations remained low in the PDC with the exception of during a few isolated rainfall events that resulted in some short-term elevation of TSS downstream of the construction zone. The designated design engineering firm developed a long-term solution to this area of concern. The long-term solution involved armouring the affected area and preventing surface run-off water from contacting the exposed sediments. Construction activities for the long-term solution were conducted July 22 to August 5, 2011 and included the following:

- An access road to the erosion repair area was completed.
- All eroded channels were cleaned out of boulders and loose material to eliminate any potential voids when sealing. Channels were filled with 3/8" crush and bucket-tamped with an excavator before being overlain with geotextile and covered with 6" crush (Plate 7.4-1).
- A water control structure was built along the western edge of the original pond footprint, centred on the main erosion channel. The structure included a 1 m high berm and a 1.5 m deep key trench. The berm was built with geotextile and 3/8" crush sandwiched between two lifts of

6" material. The key trench was lined with geotextile along the bottom of the excavation, filled with 3/8" crush, and capped with 6" material.

- A weir was constructed in the water control structure to manage discharge from the pond.

The construction area has been closely monitored during rainfall events, and the results show that surface water is routed successfully over the armoured area and remains clean where it is observed to enter the PDC from the bench below.

Plate 7.4-1. Erosion control construction work near the Panda Diversion Channel, August 2011.

7.4.9 Fay Bay Water Quality and Aquatic Life

Following the monitoring in 2010, it was concluded that there were no long-term risks to water quality or aquatic life associated with the FPK release into Fay Bay in 2008. Overall, the three-year monitoring program conducted at Fay Bay and downstream environments following the unplanned FPK release has indicated some short-term effects to both the physical and chemical nature of the aquatic environment. The aquatic biology results indicate that the phytoplankton and zooplankton communities are recovering, while the benthos community remains unaffected. BHP Billiton's response to the FPK release included both immediate responses and long-term responses that have been implemented to reduce the risk of PK entering Fay Bay in the future.

<u>Immediate Responses</u>

As part of the EKATI's emergency response plan the following measures were implemented:

- reporting to the GNWT 24-hour Spill Line, First Nations leadership, regulatory agencies, and others;
- suspension of PK deposition in the upper area of Cell B;
- trenching and placement of bentonite clay inside the upper end of the Cell B “east” road to move water and PK away from the top end of Cell B;

- construction of a temporary access road to Fay Bay (inspector-authorized, geotextile underlying granite rock);
- survey of PK on the tundra and the ice;
- retrieval of PK from Fay Bay ice surface using heavy equipment, snow berms, and pumps until spring ice melt made such work unsafe;
- placement of silt fences across the tundra slope to reduce PK movement towards Fay Bay;
- collection of initial environmental samples; and
- installation of silt curtains in water near the shore area of Fay Bay and in the narrows between Fay Bay and Upper Exeter Lake (staggered to allow fish movement) as a contingency against PK migration in water.

Longer-term Responses

Following the initial responses, the following was completed to address the risk of an unplanned PK release:

- initiation of an environmental monitoring program, including both land and water;
- retrieval of PK from the tundra in a controlled manner (hand and vacuum methods) to reduce disturbance of the natural organic soil layer;
- review and enhancement of scheduled operator inspections of the LLCF to ensure deposition is according to the deposition plan;
- review and enhancement of procedure for PK deposition at the upper end of Cell A (prohibit winter deposition, mark conservative PK limit in the field);
- staged removal of the temporary access road with retrieval of underlying PK;
- installation of erosion control measures (sand bags, jute mat) in the location of the access road.
- seeding of an annual grass to accelerate re-establishment of natural vegetation;
- connection of the Cell B “east” and “west” access roads, creating a ring road around Cell B;
- installation of a plastic liner against the south bank of the Cell B road at its northern extent (i.e., internal to Cell B);
- strategic management of snow as part of freshet erosion control; and
- PK is no longer deposited in the northern portion of Cell B. Construction of an internal water channel from the uppermost end of Cell B (excavation of PK and placement of coarse, granular PK) to create an internal flowpath that directs runoff water towards the south.

7.5 SUMMARY AND CONCLUSIONS

7.5.1 Key Environmental Risks

BHP Billiton and regulators agree that water quality downstream of the LLCF is a continued key risk requiring adaptive management to avoid future negative impacts to the aquatic environment (Table 7.5-1). Management of the LLCF water quality over last three years has resulted in some improvements in water quality in downstream environments (e.g., nitrate and chloride). However, recent updates to the water quality model still indicate that, without mitigation measures, some water quality parameters will continue to increase.

Table 7.5-1. Key Environmental Risks for Water

The Aquatic Receiving Environment Downstream of the LLCF and KPSF
Management • Models predicting future water quality trends and potential contaminants of concern in the LLCF and downstream. • The AEMP is evaluated every three years to examine relationships between water quality and aquatic assemblages. • Identification of long-term water quality trends and development of site-specific water quality benchmarks as a screening tool. • Development of SSWQOs for chloride, molybdenum, nitrate, potassium, sulphate, and vanadium. • Discharge from the LLCF is scheduled to reduce contaminant loads to the receiving environment. • Underground (chloride-rich) mine water is pumped to Beartooth Pit. • Experimental testing of an in situ nitrate reduction method was conducted in the LLCF.
Residual Risk • Discharges from the LLCF and KPSF have an effect on downstream water quality. The 2011 AEMP indicated changes to phytoplankton community composition and zooplankton community composition related to changes in water quality in lakes downstream of the LLCF. These effects are expected to be short-term (with management of water quality); however, risks to aquatic ecosystem (i.e., food web dynamics) exist. • The 2011 AEMP identified 16 water quality variables that have increased downstream of the LLCF and 11 water quality variables that have increased downstream of the KPSF due to mine activities. Out of these variables, nitrate downstream of the LLCF has been identified as the highest risk.
Future Actions • Implementation of a FPK deposition plan that retains the use of Cell D as a mine water management pond by optimizing the use of Cells A and C as well as Beartooth Pit. • BHP Billiton has developed a Response Framework that provides a structured early warning system for the receiving environment. This framework will be reviewed during the Water Licence renewal process.
Fish Biology
Management • During the 2007 AEMP, the sampling mortality of fish was reduced by adhering to catch limits recommended by DFO (this is in addition to sampling every five years).
Residual Risk • The sampling programs at EKATI have affected fish populations. Without changes to the monitoring program this effect could be long-lasting.
Future Actions • Changes to the fish monitoring program in the summer of 2012 will include the following components to address the potential impacts to fish populations: - the addition of slimy sculpin for use as a sentinel species in all AEMP lakes for all biological parameters, metals analyses, and PAHs , with a sampling frequency of every three years; - the application of a non-lethal sampling program for lake trout using dermal punch tissue extraction methodologies; - decreasing the sampling frequency of lake trout and round whitefish to every once in every six years unless data show a need for special effects studies on large-bodied fish prior to the next scheduled sampling year, instead of the current once in every five years, to further minimize total sampling mortality and to link it with the sampling of slimy sculpin every three years; and - inviting community members to participate in the fish monitoring program and share local knowledge.

(continued)

◎ Table of Contents

Table 7.5-1. Key Environmental Risks for Water (continued)

Low Under-ice Dissolved Oxygen
Management • Under-ice DO was monitored in Kodiak and Cujo lakes bi-weekly each winter. • Adaptive management to address low under-ice DO (e.g., snow clearing to promote the production of oxygen by stimulating phytoplankton growth and aeration to introduce DO).
Residual Risk • Low DO in lakes can occur naturally and its effects on aquatic organisms can be lethal and/or result in changes in physiology or behaviour. Sampling in Cujo Lake has shown low DO levels in the winter however there is no indication of effects on fish populations. However there remains a risk of low DO and its potential effects to fish in Cujo Lake.
Future Actions • Management and bi-weekly monitoring of Kodiak Lake for low under-ice DO is no longer required except for the AEMP late winter sampling. • Cujo Lake will be continued to be monitored bi-weekly for under-ice DO during the winter. • Continue with adaptive management actions at Cujo Lake based on monitoring results.
Water Quality of Waste Rock Seepage
Management • WRSAs are being constructed according the WROMP: coarse granite layer as base layer, stepped side slopes to enhance permafrost growth, encapsulation of metasediment within 5 m of granite waste rock, and in some cases toe berms. • The WROMP provides for specific management actions in response to monitoring results (e.g., movement of metasediment from Misery WRSA in response to monitoring results at SEEP 052). • WRSAs have a minimum setback of 30 m from waterbodies. • Increased sampling frequency at seeps identified as areas of interest.
Residual Risk • Waste rock seepage flowing into the receiving environment can pose a risk to water quality and aquatic assemblages. At EKATI, seepage is managed and risks to the receiving environment are low.
Future Actions • Maintain current management practices.
Water Quality Associated with Misery Pit "Push-Back"
Management • The Misery water management system consists of the Misery Pit sump, Desperation Pond, Waste Rock Dam Pond, and the KPSF. The KPSF receives inflows from the other water bodies (including the pit sump), and excess water from the KPSF is pumped to the receiving environment, when water quality complies with the site Water Licence. • Predicted flow volume, waste dump runoff and pit wall runoff water quality, waste rock runoff water quality, and anticipated water quality in the KPSF were assessed. • An assessment of waste rock management options was completed and resulted in the modification of the design of the WRSA to address risks to the aquatic receiving environment.
Residual Risk • Some of the waste rock to be mined at Misery Pit is metasediment (biotite schist), which is potentially acid-generating and metal leaching. There is a risk that contaminants released from this material require additional management responses to comply with the site Water Licence.
Future Actions • Encapsulate metasediment waste rock within 5 m of granite waste rock (to maintain permafrost within the metasediment). • Flood the Misery Open Pit with clean water when mining is complete (to submerge metasediment wall rock under water).

(continued)

Table 7.5-1. Key Environmental Risks for Water (continued)

Water Quality and Quantity Associated with Pigeon Pit Development
Management • Development of models and predictions of water quality, flow, and runoff related to Pigeon Pit. • Pigeon Pit sump water will be pumped to the LLCF, and runoff from the WRSA will flow to and be managed in the LLCF.
Residual Risk • Some of the waste rock to be mined at Pigeon Pit is metasediment (biotite schist), which is potentially acid generating and metal leaching. There is a risk that contaminants released from this material require additional management response to comply with the site Water Licence.
Future Actions • Encapsulate metasediment waste rock within 5 m of granite waste rock (to maintain permafrost within the metasediment). • Flood the Pigeon Open Pit with clean water when mining is complete (to submerge metasediment wall rock under water). • Implementation of the Pigeon AEMP.
Hydrocarbon Contamination Downstream of the LLCF and KPSF
Management • Fuel handling procedures. • Internal spill reporting and clean-up. • Fuel storage is with secondary containment. • Drip trays under all portable light stands. • Spill kits are available at fuel transfer areas. • Electric pumps were installed at the Cell E outlet dam.
Residual Risk • The 2007 AEMP indicated that fish in EKATI lakes downstream of the LLCF were exposed to hydrocarbons; however, there was no evidence that the hydrocarbon exposure influenced fish health. Water and sediment in the LLCF and its downstream lakes were sampled for the presence of hydrocarbons in 2008, 2010, and 2011. The sampling did not detect hydrocarbons in these lakes. Therefore, hydrocarbons represent a low risk to the aquatic environment.
Future Actions • The 2012 AEMP will integrate a hydrocarbon sampling program into the study design of the fish component to further evaluate the risk of hydrocarbons in the aquatic environment and potential effects on fish. • Employee awareness program on hydrocarbon storage underground.
Long-term Performance of the PDC
Management • Clearing the PDC of snow in the spring. • A layback of the channel walls was necessary, and the first phase of the slope stabilization was completed in the winter of 2010/2011.
Residual Risk • Constructed fish habitat channels have a risk of not performing as intended; however, 14 years of PDC monitoring has shown that the PDC is successfully providing self-sustaining fish habitat. • In some areas of the PDC, there is a risk that wall stability will impact the performance of the channel and its fish habitat.
Future Actions • Installation of additional rock structures to further enhance fish habitat in middle reaches. • Transplantation of instream vegetation mats to the PDC in the summer of 2012. • Continued slope stabilization work.

(continued)

Table 7.5-1. Key Environmental Risks for Water (completed)

Fay Bay Water Quality and Aquatic Life
Management • Emergency response plan (e.g., initial response to unplanned release of FPK included clean-up and installation of silt curtains in Fay Bay). • A monitoring program was implemented and completed to assess both short and long-term effects of the PK release. • Construction work was completed at Cell B to minimize future risks of PK release. • Enhancement of procedures for PK deposition at the upper end of Cell A. • Additional regular inspections of LLCF to verify deposition is according to the deposition plan. • PK is no longer deposited in the northern portion of Cell B. • Strategic management of snow as part of freshet erosion control.
Residual Risk • Following monitoring in 2010, it was concluded that there were no long-term risks to water quality or aquatic life associated with the unplanned release of FPK into Fay Bay in 2008.
Future Actions • Maintain current management practices.

Changes in aquatic assemblages (i.e., phytoplankton and zooplankton) were detected in lakes downstream of the LLCF as part of the AEMP monitoring at EKATI. The changes have been linked to the observed changes in water quality (e.g., nitrate and chloride), thus it is anticipated that further risks to the aquatic assemblages can be addressed with management of water quality (Table 7.5-1). In addition, BHP Billiton has recently developed a SSWQO for six water quality variables known to be increasing in the receiving environment and for potential toxicity to aquatic assemblages.

The previous edition of the EIR identified changes in lake trout populations due to the sampling programs as a key risk for which mitigation should be investigated. A recent work plan for fish sampling in 2012 addressing this key risk was developed following discussion with DFO, the WLWB, and communities. The results of the 2012 AEMP fish sampling program will be discussed in the next edition of the EIR.

7.5.2 Looking Forwards

There are several initiatives underway in addition to the routine programs for monitoring water and fish to address the effects to the water VECs. The development of Pigeon Pit and the Misery Pit “push-back” will use BHP Billiton’s experience with earlier pit development as well as improvements to engineer designs to minimize risks to the aquatic environment.

Further improvements to water quality downstream of the LLCF will continue with the implementation of a FPK deposition plan that retains the use of Cell D as a mine water management pond by optimizing the use of Cells A and C as well as Beartooth pit. The use of Beartooth Pit for underground mine water storage will continue, and FPK slurry storage will be added beginning in September 2012.

BHP Billiton recently submitted its renewal of the existing Water Licence (expiring in August 2013), which included a 15-year environmental record of environmental monitoring data, as well as a review of aquatic protection measures. This supporting information and the depth of understanding of the aquatic environment is expected to facilitate the WLWB’s review process in addition to providing information to others in or associated with the Canadian diamond mining industry. As a result of this process, BHP Billiton has now identified the water quality parameters that may be of potential concern and has proposed effluent quality criteria and special studies appropriate to those parameters. BHP Billiton has also designed a broadly inclusive response framework that provides a structured early warning system for the receiving environment.

8. Wildlife

8. Wildlife

8.1 SUMMARY OF MONITORING PROGRAMS

The 1995 EIS identified caribou, grizzly bears, wolves, wolverines, upland breeding birds, raptors, and breeding and migratory water birds as important wildlife species. Wildlife VECs considered in this report include caribou/habitat, carnivores/habitat, and breeding birds/habitat.

8.1.1 Wildlife Effects Monitoring Program

The WEMP encompasses all of the wildlife VECs and is a requirement of BHP Billiton's Environmental Agreement. The WEMP has been conducted since 1997, and the 2011 WEMP marks the fifteenth annual program and report to be completed. The annual WEMP report presents the results of wildlife monitoring activities at EKATI from October 1 to September 30 (2009 and 2010) or December 31 (2011; Reports 20, 38, and 57). The report also includes analyses of data from prior years, combined with the new data from the current monitoring year.

The WEMP uses scientific methodology and incorporates TK as a source of information regarding wildlife and local ecology. Aboriginal people are invited to participate in the WEMP to gather field data and assist in minimizing effects on wildlife.

The WEMP was developed through extensive consultation with stakeholders, including regulators, scientists, and Aboriginal people. The WEMP focuses on wildlife species and habitats that were identified during the Environmental Assessment Review Process (the regulatory regime that preceded the Mackenzie Valley Resource Management Act of 1998) as being of social or economic importance or of particular ecological or conservation concern (i.e., VECs). Wildlife effects are defined as changes to a VEC due to human activities (BHP Billiton 2003). A wildlife effect is not necessarily a negative impact; an effect may also be neutral or positive.

Focal species for the monitoring program include caribou, grizzly bears, wolves, wolverines, breeding birds, and falcons. Since 1998, BHP Billiton and Diavik have worked cooperatively on some of the monitoring programs, including the falcon nest survey, the wolverine DNA study, and the caribou aerial survey. Caribou aerial surveys were not conducted in 2010 or 2011.

Objectives of the 2009, 2010, and 2011 WEMPs included:

- assessing potential changes in wildlife habitat availability;
- assessing general changes in the biophysical environment (i.e., weather, snowmelt, and insect activity; 2009);
- monitoring interactions between wildlife and traffic, and assessing success of mitigation efforts;
- monitoring wildlife mortalities and incidents and assessing the effectiveness of mitigation efforts;
- monitoring potential wildlife attractants and assessing the effectiveness of waste management efforts;
- inspecting buildings (i.e., accommodation skirting) and fencing structures at the EKATI and Misery camps for evidence of interaction with or disturbance by wildlife;

- documenting incidental caribou and caribou herd observations;
- assessing caribou behaviour (activity budgets and responses to stressors);
- assessing caribou distribution relative to EKATI roads (2009 and 2010);
- assessing permeability of EKATI roads to caribou (2009 and 2010);
- monitoring wildlife interactions with the LLCF;
- documenting incidental carnivore observations, including grizzly bears, wolves, wolverine, and foxes;
- assessing wolf breeding success and occupancy of natal dens;
- assessing density and diversity of breeding birds (2009);
- participating in the North American Breeding Bird Survey;
- assessing nesting occupancy and productivity of raptors on pit walls; and
- assessing regional falcon nesting and reproductive activity (2009 and 2010).

8.1.2 Community Involvement and Traditional Knowledge

Throughout 2010 and 2011 there were several community based workshops and site visits to enable involvement of community members in the development of the WEMP and discussion on how TK can be incorporated into the wildlife monitoring programs:

- In June 2010, a Mines, Regulators, and Scientists Technical Workshop was conducted to obtain recommendations on how to better monitor wildlife, examine opportunities to synchronize and align the various diamond mine environmental monitoring programs, and review how the mines can enhance the involvement of TK holders in these programs.
- In September 2010, a site visit to the EKATI and Diavik mines was held to allow community representatives to see and learn about the environmental and wildlife monitoring programs at the mine sites. Presentations, discussions, and monitoring demonstrations were held in preparation for the Diamond Mines Wildlife Monitoring Programs - Community Workshop.
- In October 2010, the Diamond Mines Wildlife Monitoring Programs - Community Workshop was held at the Tree of Peace in Yellowknife. The objectives for the workshop were (1) to discuss the use of TK in monitoring wildlife and determine how it can be incorporated and (2) to get ideas on how the mines can conduct and improve their wildlife monitoring programs using input from TK holders to incorporate community perspectives. The workshop provided the community representatives and TK holders a forum to voice recommendations on proposed changes before the mines prepare their 2011 Wildlife Monitoring Permit applications.
- In 2011, Community Engagement programs were initiated for Kugluktuk (June), Luksel K'e Dene First Nation (August), North Slave Metis Alliance (September), and Yellowknives Dene First Nation (September) to demonstrate and provide a hands-on-experience on how the EKATI Environment Department conducts its day-to-day site-based environmental monitoring programs. Over a four-to seven-day period, the community representatives (Elders and/or youths) participated with wildlife observations and behavioural scans, site management surveys, and other environment site activities that are based on programs designed to determine whether mine activities have effects on wildlife and their habitat. In addition BHP Billiton invited community members to assist with identification of grizzly bear DNA plots (see Section 8.4.3 for study details). Community members were asked to locate suitable grizzly bear habitats based on what the community members consider to be potential areas that grizzly bears may frequent based on their TK and experience.

Table of Contents

- In October 2010, the Thirteenth North American Caribou Workshop was held in Yellowknife, NT. The workshop theme, Sustaining Caribou and their Landscapes – Knowledge to Action, provided participants with the opportunity to share both scientific and TK for sustaining caribou populations. The workshop was attended by EKATI Environment Department staff to gain a broader understanding and focus on local and regional TK about caribou and how Aboriginal harvesting and stewardship practices relate to science-based research and management regimes.

8.2 PREDICTED AND OBSERVED EFFECTS

8.2.1 Caribou/Habitat

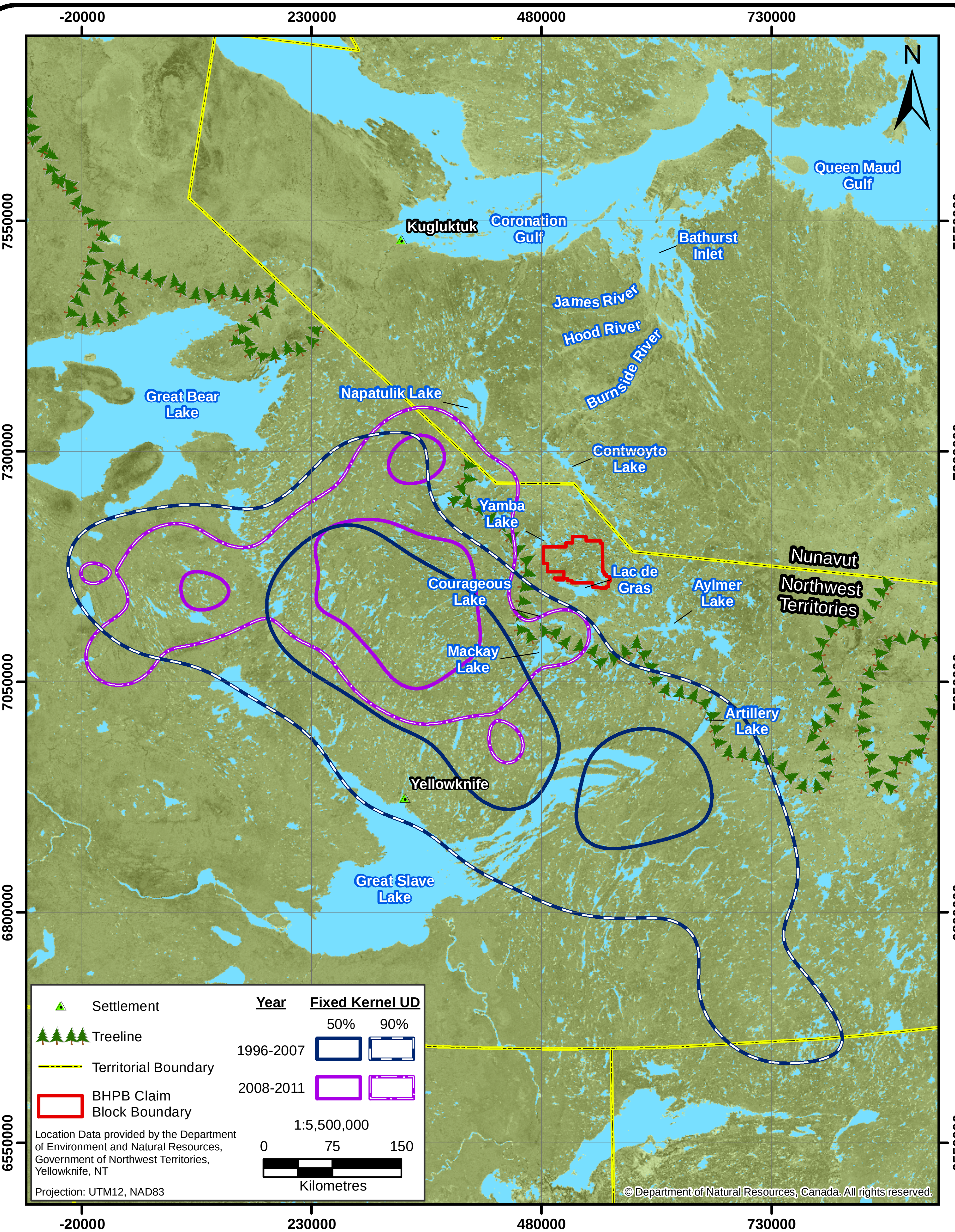
The 1995 EIS predicted several possible effects of mine activities on caribou, including possible impediments to caribou movements and migrations, increased hunting mortality related to the winter road, collisions with vehicles, loss of foraging habitat, disturbance or displacement as a result of intense noise, and reduced drinking water quality (primarily within the LLCF).

Information from satellite collared cows collected by the GNWT ENR indicates that both the Bathurst herd, and to a lesser extent the Ahiak herd, have seasonal home ranges that overlap with the EKATI study area. The most recent survey results, conducted in June 2009, estimated the Bathurst herd to be 31,900 ± 11,000 individuals (Adamczewski et al. 2009). A more recent survey for the Bathurst caribou herd was planned for June 2012; however, the results of the survey were not available at the time of this report. The last census for the Ahiak herd was in 1996 and estimated 200,000 individuals (GNWT ENR 2006). A census was planned in 2010, but was subsequently cancelled. Both traditional and scientific knowledge indicate that caribou herd size cycles relatively regularly with climate patterns (GNWT ENR 2005, 2006). Caribou herds also exhibit periodic changes in seasonal migration routes and in calving and winter ranges (Gunn et al. 1997; Gunn et al. 2002; Bathurst Caribou Management Planning Committee 2004; Boulanger et al. 2004). For the Bathurst herd, seasonal ranges have shifted slightly when comparing historical collar data to more recent satellite data. These shifts are suggested by both the 90% fixed kernel utilization distributions, which represent general range extents, and the 50% fixed kernel utilization distributions, which represent core range areas (Figures 8.2-1 and 8.2-5). Spring migration paths have also been variable (Figures 8.2-2 to 8.2-5). Data during fall are sporadic and are presented as ranges rather than movement paths (Figures 8.2-6 to 8.2-9).

Johnson et al. (2005) estimated that 37% of high-quality post-calving caribou habitat was lost because of human disturbance in a portion of the NT (190,000 km^2, encompassing the EKATI study area); therefore, it is important to continue to monitor caribou distribution and behaviour in the region. Monitoring caribou is a priority at EKATI, and there are several programs in place to ensure that impacts to caribou are monitored and mitigated. These include recording incidental observations of caribou passing through the mine site, collecting information on abundance and group composition, behavioural surveys to determine activity budgets and responses to stressors, surveys in the LLCF to ensure animals are not getting trapped in the fine kimberlite, and a new camera monitoring program initiated in 2011 to monitor caribou interactions with roads and other infrastructure.

8.2.1.1 Injured Caribou: Possible Collisions with Vehicle Traffic

During life of mine to date, there have been no vehicle or aircraft-related caribou deaths as a result of collisions.



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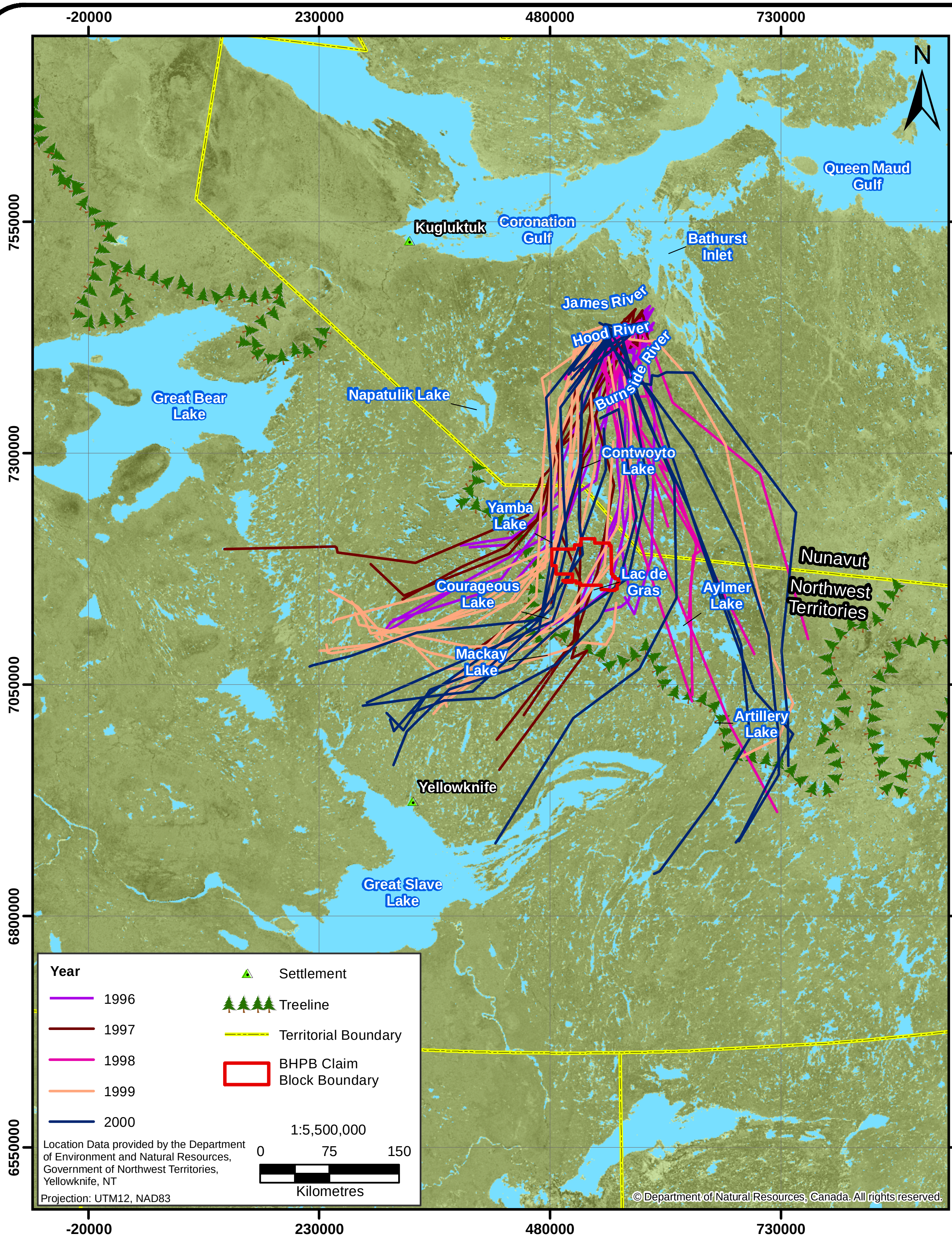
Distribution of Collared Bathurst Caribou during Winter, 1996 - 2011

FIGURE 8.2-1

gis no. EKA-23-144 Job No. 0648-121-01 July 03, 2012



bhpbilliton
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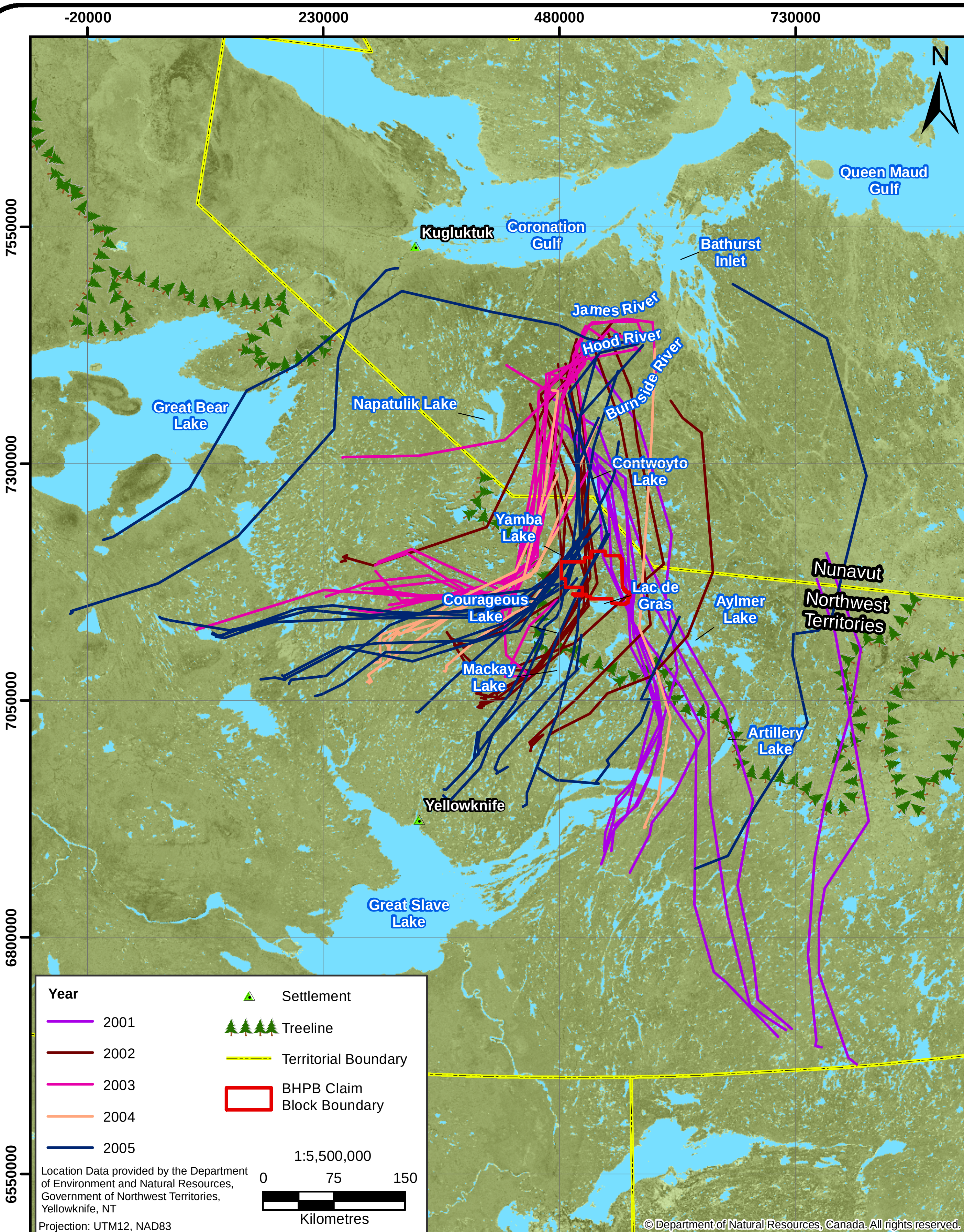
Spring Migration Routes of Collared Bathurst Caribou, 1996 - 2000

FIGURE 8.2-2



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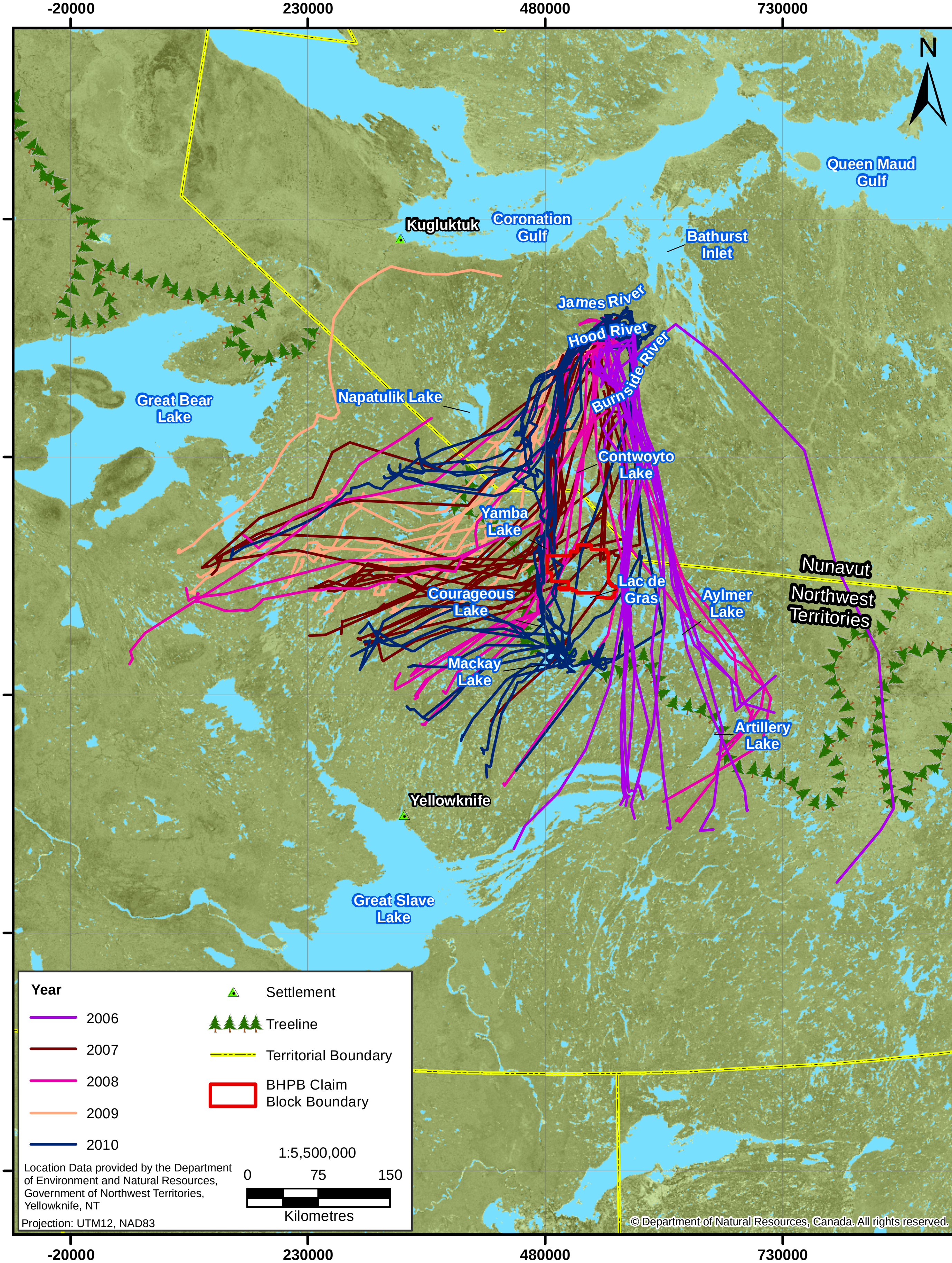
Spring Migration Routes of Collared Bathurst Caribou, 2001 - 2005

FIGURE 8.2-3



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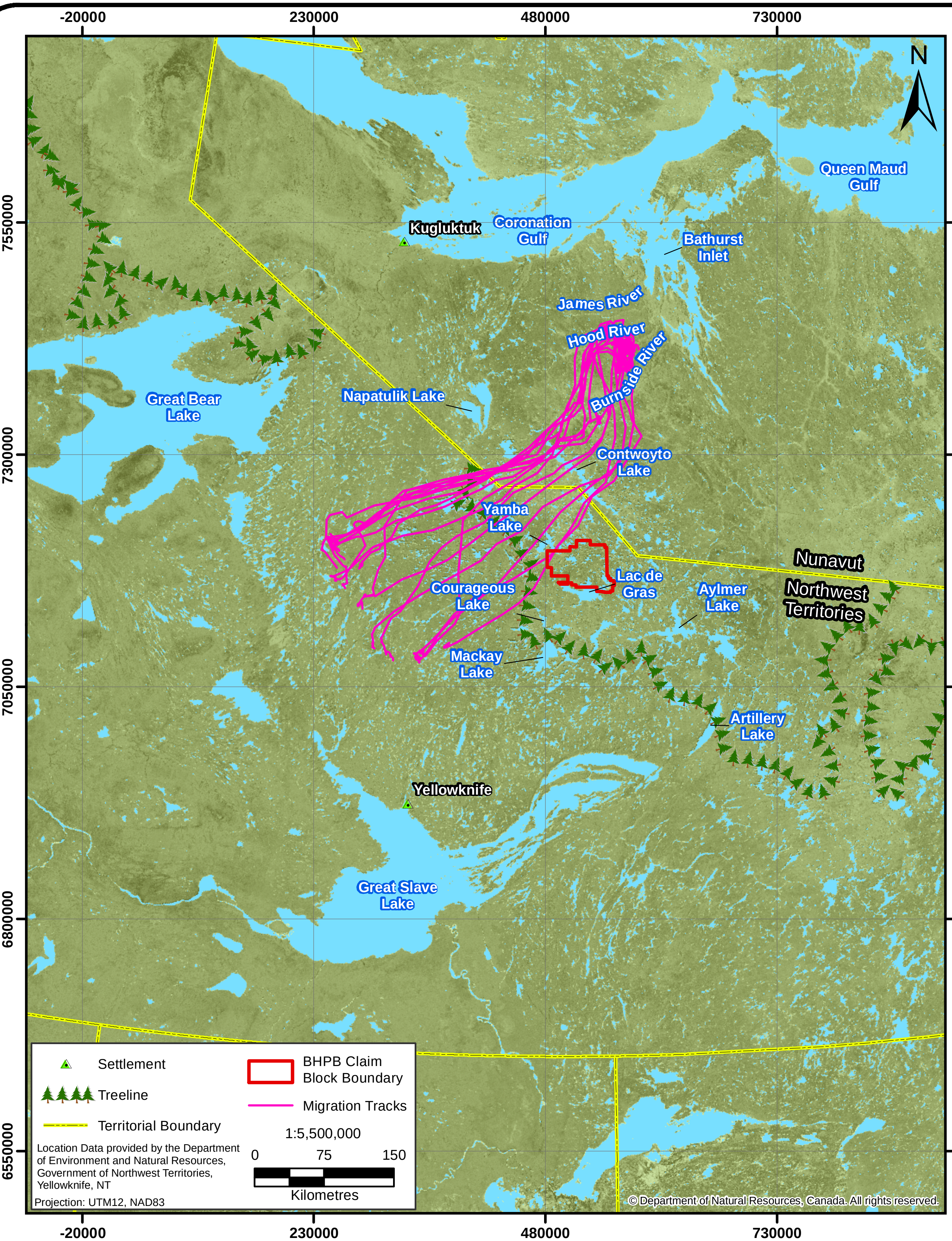
Spring Migration Routes of Collared Bathurst Caribou, 2006 - 2010

FIGURE 8.2-4



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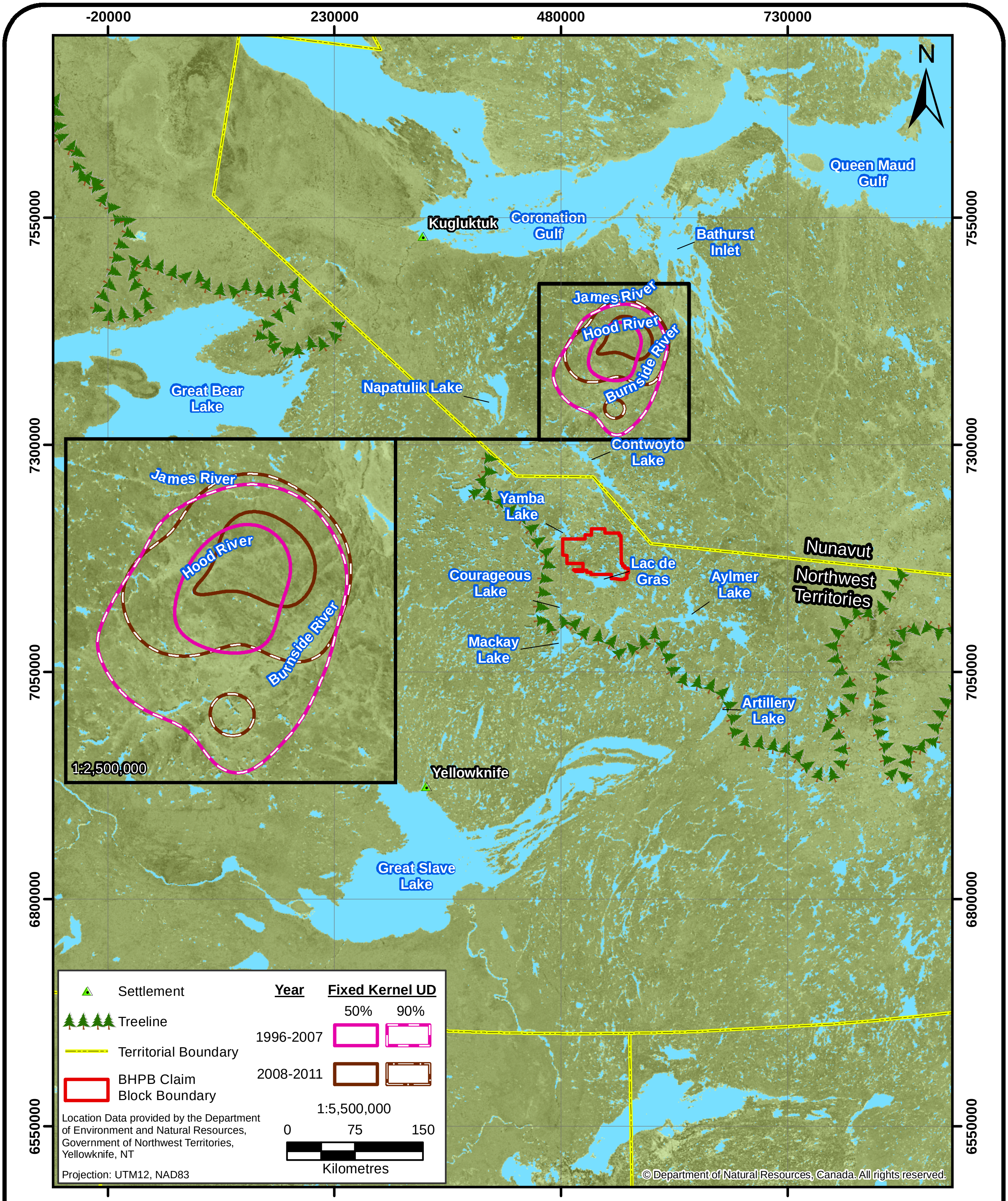
Spring Migration Routes of Collared Bathurst Caribou, 2011

FIGURE 8.2-5

gis no. EKA-23-148 Job No. 0648-121-01 July 03, 2012



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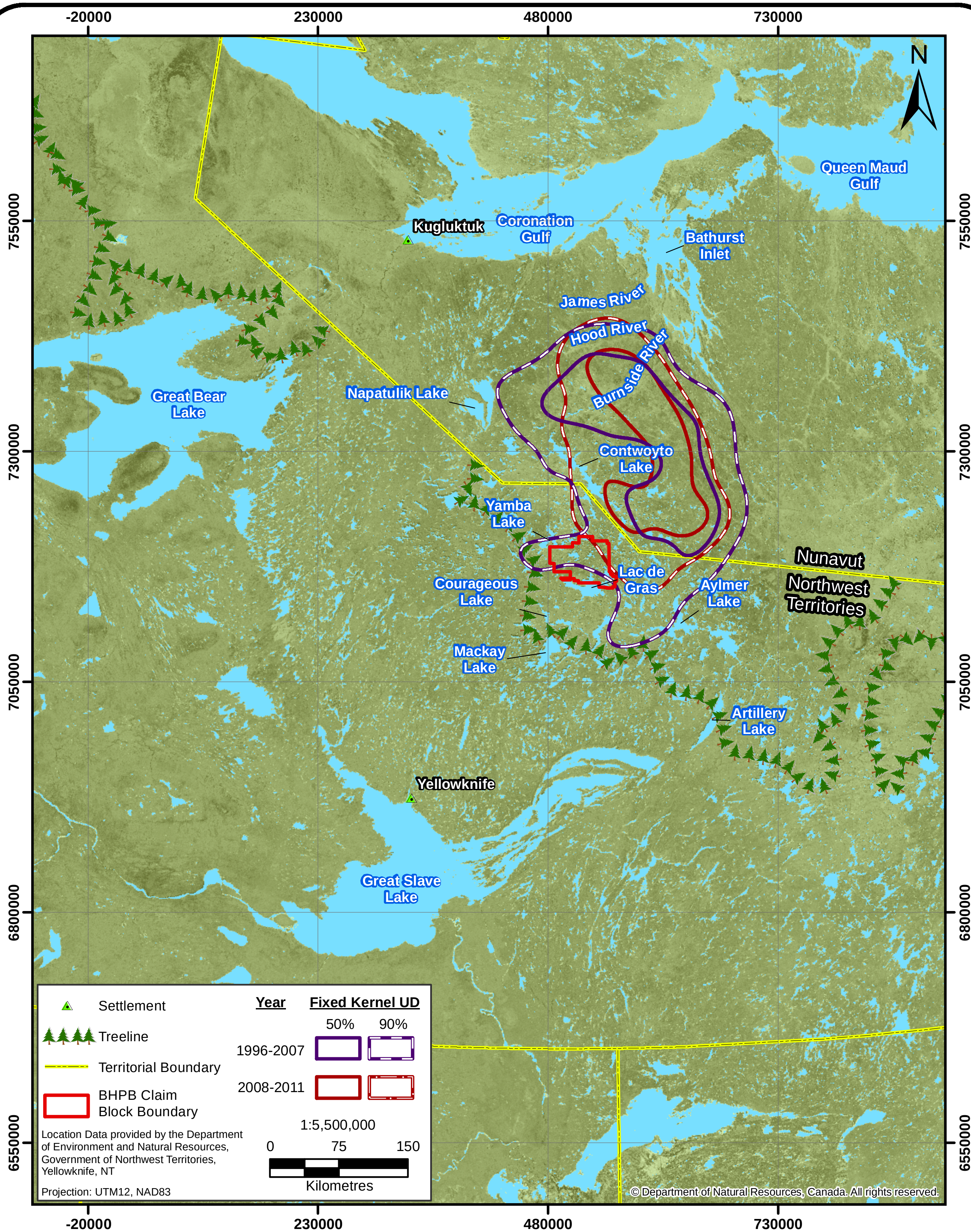
Distribution of Collared Bathurst Caribou during Calving, 1996 - 2011

FIGURE 8.2-6

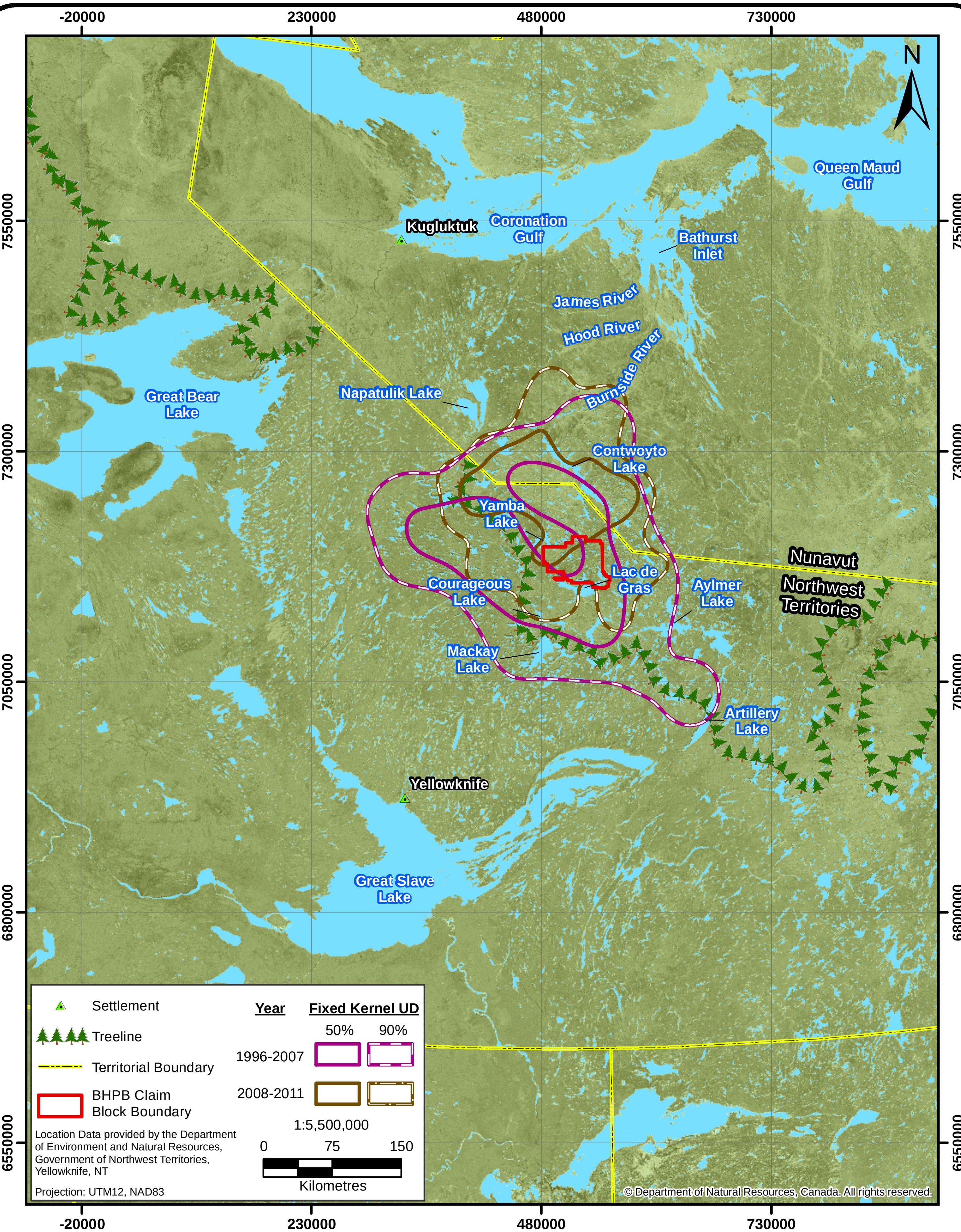
Table of Contents



Distribution of Collared Bathurst Caribou during Post-Calving, 1996 - 2011

FIGURE 8.2-7

Table of Contents



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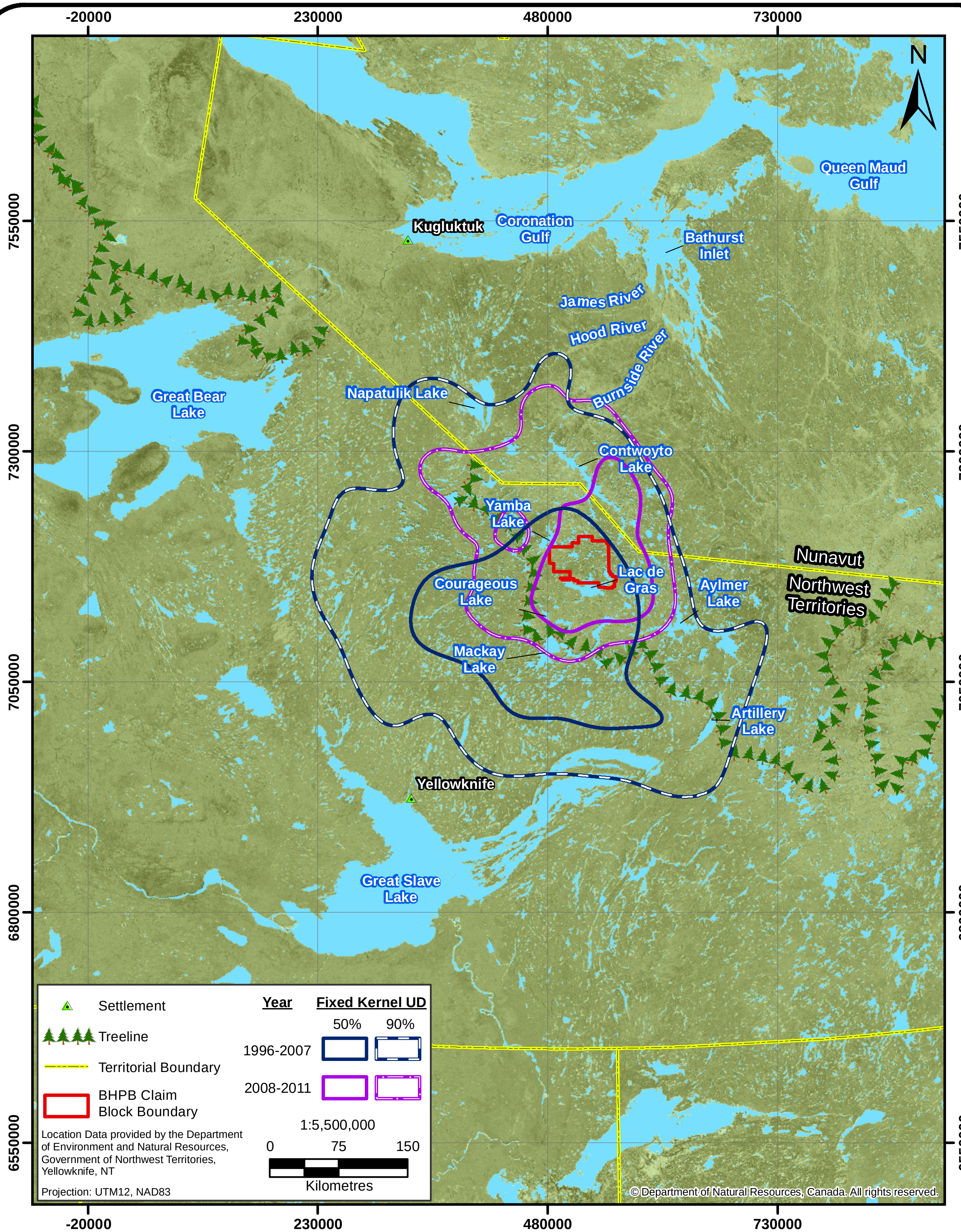
Distribution of Collared Bathurst Caribou during Summer, 1996 - 2011

FIGURE 8.2-8



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Distribution of Collared Bathurst Caribou during Fall, 1996 - 2011

FIGURE 8.2-9

8.2.1.2 Injured Caribou: Possible Injury to Caribou While Travelling through the Mine Site

Injury to caribou as a result of travelling through the mine site was not predicted in the 1995 EIS. However, historically there have been several incidents reported.

- Three caribou died after getting stuck in King Pond sediments during dewatering.
- One deceased caribou was found caught in the electric fence surrounding the airstrip in 2004. The exact cause of death is unclear as there was also evidence of wolf predation that occurred either before, after, or during the encounter with the fence.
- In 2005, a caribou became entangled in support guy wires of a tower. The caribou was successfully freed after some of its antlers were cut off.

Eight caribou mortalities at EKATI were reported in the 2009 WEMP. Four of the caribou mortalities appeared to be due to natural causes, such as predation, while the other four involved entanglement with the airport fence. Three caribou mortalities were related to the electric fence surrounding the airport, and the other was trapped in the rope fence on the east side of the airport. One caribou yearling was observed inside the perimeter of the electric fence surrounding the airstrip. The caribou was monitored visually until, within a few minutes, it safely went back through the fence to join a group of 10 caribou on the other side. In response to these incidents, EKATI environment staff developed new strategies to keep caribou off the airstrip while minimizing impacts to caribou (see Section 8.4.4).

Seven caribou mortalities at EKATI were reported in the 2010 WEMP. Five of the caribou mortalities appeared to be due to predation, and one died of unknown causes. One caribou mortality involved entanglement with the airport fencing that had been improved the previous year. In order to avoid further fence-related mortalities at the airport, BHP Billiton replaced the fence in August 2010 with a Construction and Safety Barrier Fence (see Section 8.4.4).

Five caribou mortalities at EKATI were reported in the 2011 WEMP. There were four observations of caribou carcasses near Misery Road (km 10, 20, and 22) and one near Larry Lake between October 17 and November 2, 2010. Three of these caribou appeared to have been killed by wolves; the cause of death of the fourth is unknown. All four cases were reported to NWT ENR. The fifth mortality was a young female caribou observed near the airstrip that would not leave after repeated attempts to deter her from the area. After it became apparent she might pose a significant threat to aircraft and human safety, and after consultation with ENR, the animal was dispatched. The meat was distributed to the communities.

There were approximately seven to nine injured caribou observed along Misery Road during fall migration in 2010. The exact number is uncertain due to the possibility of the same animals being observed. 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. Both groups moved through within a few days. It is common to observe some injured animals travelling with such large groups. None of these injuries are believed to be the result of vehicle collisions or interactions with other mine infrastructure. 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 the groups were in the vicinity of the road. Sable Road was also closed from October 13 to 18.

8.2.1.3 Movement Alterations

The 1995 EIS predicted that there would be alterations to caribou movement and avoidance of mine site infrastructure and road system. Studies conducted prior to 2005 indicated that caribou abundance and behaviour were not negatively altered or affected by the physical presence of the mine site or roads. In 2002, the probability of observing a nursery group increased with distance from the core mine area. Historical effects also included negligible loss of feeding habitat due to the construction of mine infrastructure. In 2005, reanalysis of data combined across all survey years found that the probability of encountering caribou increased significantly with distance from mine development. This was reiterated in the 2009 EIR. There was no relationship between the presence of caribou groups with calves and distance from the mine.

At EKATI, aerial surveys have been the primary means to determine relative abundance and distribution of caribou around the mine site. An 11 to 14 km zone of influence has been identified for caribou around the EKATI – Diavik Mine complex (Boulanger et al. 2012). The mechanism underlying the zone of influence is still unclear. Nevertheless, thousands of Bathurst caribou are observed to pass through the site every year during both the northern and southern migrations and during the post-calving period. To address causal mechanisms underlying a zone of influence would require extensive research using collar data, habitat mapping, and the development of regional partnerships. BHP Billiton has instead focused its efforts on assessing potential direct effects of mine activities and infrastructure on caribou as they move through the EKATI study area. In addition, workshops held in 2010 with the other diamond mines (Diavik and Snap Lake) and regulators addressed the need to coordinate objectives and methodologies for the respective monitoring programs. As a result, caribou scan surveys and aerial surveys continue to be conducted in collaboration with Diavik. Further, BHP Billiton is committed to incorporating available TK in its environmental monitoring programs. For example, in the fall of 2012, community members will be invited to site to conduct caribou observations during fall migration (e.g., behaviour and body condition) and to provide additional insights to EKATI's caribou monitoring program.

During the 2009 to 2011 EIR reporting period, aerial surveys were conducted only in 2009. Surveys were subsequently discontinued in response to technical sessions held in September 2009 and June 2010 that recommended a hiatus to aerial surveys until there was a significant change in mining activities. Aerial surveys were resumed in 2012 by Diavik, in collaboration with EKATI. Incidental caribou observations continued to be monitored and recorded to address potential risks associated with human and wildlife interactions and to identify mine structures that are acting as potential barriers to caribou movement. Prior to 2006, aerial surveys were the only method used to record caribou sightings within the study area. In 2006, it was recognized that information regarding caribou presence and herd size should be recorded on an ongoing basis at EKATI in order to better assess caribou habitat use in and around the mine site. Furthermore, recording incidental caribou observations helps determine the composition (i.e., age and sex) of caribou herds moving through the study area. Discussions are ongoing regarding the utility and schedule for future aerial surveys.

Aerial Surveys

Aerial surveys have been conducted from 1997 to 2009. During this period, the survey methodology has undergone some changes in timing and coverage. From 1997 through 2001, surveys were flown once per week (or twice per week when over 1,000 caribou were counted during a survey) from mid-April through mid-October. From 2002 to 2004, surveys were typically flown once per week from mid-April to late September.

Beginning in 2003, every second transect was flown between early June and early July in order to reduce survey effort when caribou were primarily at the calving grounds and generally absent from the study area. These transects were flown between June 5 and July 10, depending on predominant herd location gathered from satellite-collared caribou location data.

Transect widths were reduced from unbounded (1 km on each helicopter side) to 600 m on each helicopter side in the fall of 2000. There were also some reductions made in the length of the northern portion of the most easterly transects after 2002. Starting in 2004, the distance of caribou observations from the transect line were recorded.

In 2006, the caribou aerial study area was expanded beyond the original study area after consultation with stakeholders and permission from the GNWT ENR. The study area boundary was expanded based on findings that suggested a broader scale investigation was needed to enable an accurate assessment of caribou distribution relative to mine development. The new study area included the area within a 30 km buffer around the mine site. The spacing between the transect lines was changed from 4 km to 8 km. The resulting study area was more than twice as large as the previous study area (6,300 km^2 vs. 2,800 km^2), although the area actually covered by the survey (i.e., within transect boundaries) was only slightly larger (960 km^2 vs. 810 km^2).

The timing of the surveys was also modified, with the first survey conducted in early July and the last survey in mid-October. The surveys conducted during the northern migration period for 2006 (mid-May to early June) used the old survey transects. The northern migration period has not been surveyed since 2006.

In August 2009, EKATI and Diavik mines have collaboratively expanded the aerial survey study area after consultation with regulators and permission from GNWT ENR (Figure 8.2-10). The study area was expanded south to ensure that an effective buffer around Diavik was surveyed to accurately assess caribou distribution relative to mine development. The existing transect lines were extended to cover the new area. In addition, new safety regulations by BHP Billiton required two pilots to be in the helicopter during surveys in 2009.

Portions of the Bathurst caribou herd pass near or through the EKATI study area during their northern and southern migrations. In 2009, observers counted 9,979 caribou within the EKATI study area between July 18 and October 18, with the majority of caribou (89%) observed during the six surveys conducted in the fall (September and October). The largest number of caribou (2,495) was counted on September 26. Overall, caribou abundance and timing of migrations through the EKATI study area in 2009 were relatively consistent with patterns recorded over the previous 11 years (Figure 8.2-11).

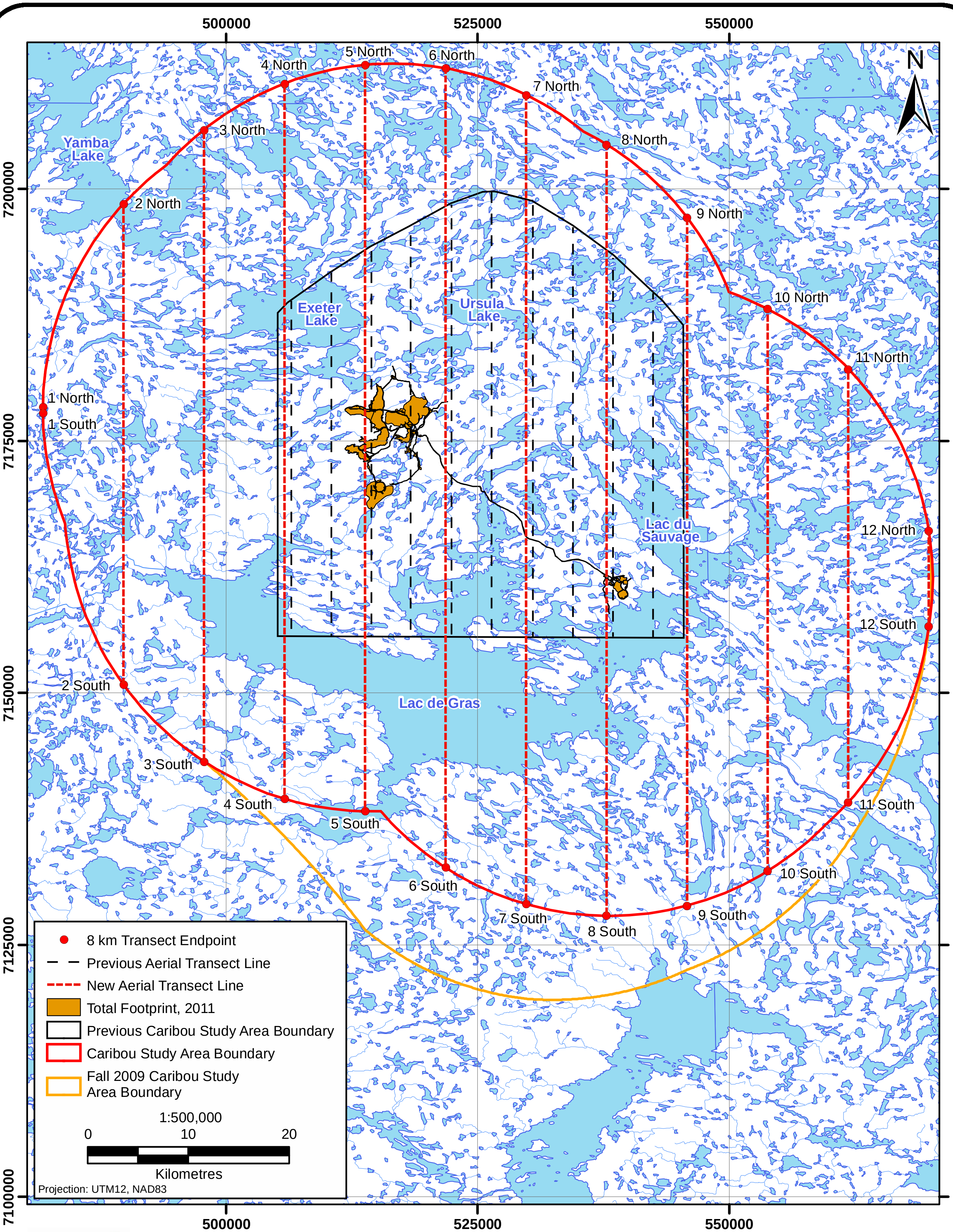
Incidental Observations: 2009 to 2011

Incidental caribou observations in and near the EKATI study area can be reported by all BHP Billiton staff. Helicopter operators, ground-based field workers, and other mine personnel on all working shifts recorded caribou sightings. Caribou observations reported on the mine site in close proximity to roads, personnel, or mine structures are investigated and the caribou are visually monitored by WEMP Wildlife Technicians.

BHP Billiton staff observed caribou on 106 occasions during work activities at EKATI during the 2009 WEMP reporting period. In 2009, several large herds were observed, including eight observations of herds with 100 to 1,000 animals and five observations of herds with more than 1,000 animals (Table 8.2-1). Incidental sightings of caribou peaked on September 17, 2009, when approximately 7,500 caribou were sighted near the mine. During the southern migration, 19,063 caribou were sighted (97% of all caribou counted) between September 1 and September 30, 2009.

There were 87 incidental observations of caribou reported on 56 separate days during the 2010 WEMP reporting period. An estimated 11,571 caribou were counted, of which 8,471 were seen between October 1 and November 2, 2009 (73% of all caribou counted). There were two peaks during this period; over 4,500 animals passed through site between October 5 and October 21, and then over 3,700 animals passed through site between October 29 and November 2. It was a relatively mild fall in 2009, which may account for the delay in the southward migration by some caribou. During the remainder of the winter through April 2010, an additional 44 caribou were observed.

gis no. EKA-23-152 Job No. 0648-121-01 September 25, 2012



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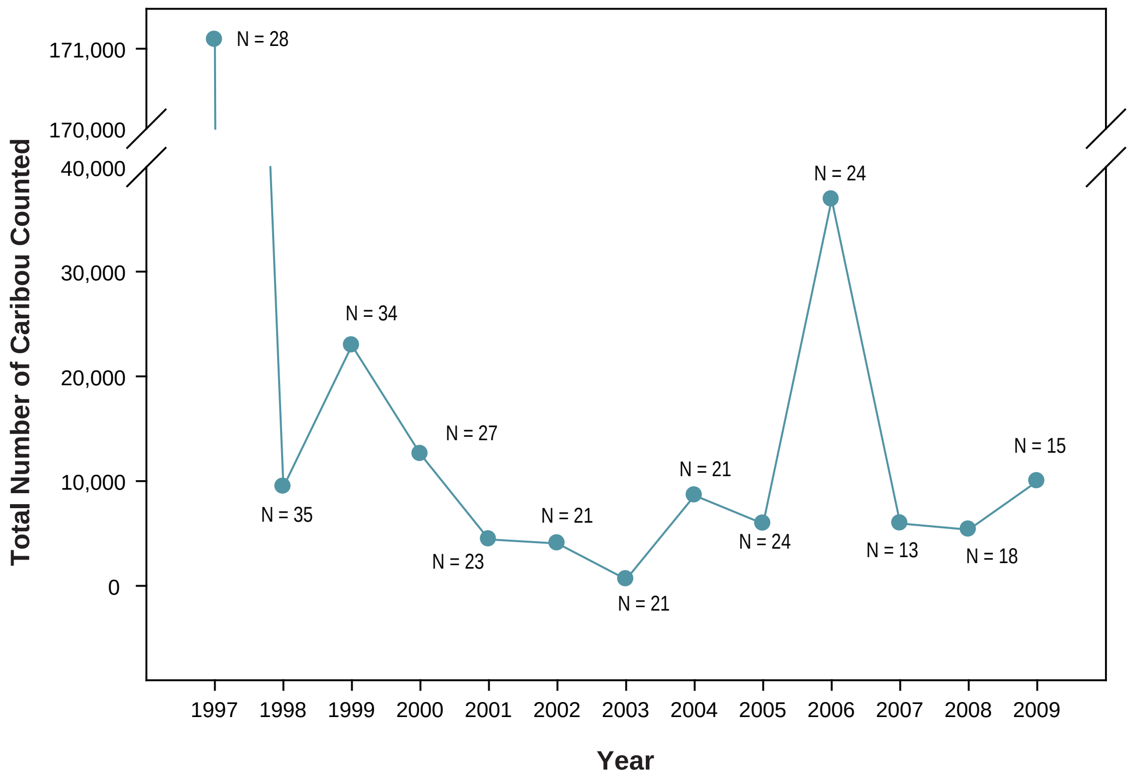
Caribou Aerial Survey Transect Lines in the EKATI Study Area

FIGURE 8.2-10

◎ Table of Contents



Notes: N = Number of surveys conducted.
Survey area (route) expanded in 2006.
Numbers shown are unadjusted counts.

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Figure 8.2-11

Total Counts of Caribou during Aerial Surveys of the EKATI Study Area from 1997 to 2009

Table 8.2-1. Incidental Caribou Observations by Herd Size

Herd size	Number of Observations		
	2009	2010	2011
< 5	72	42	129
5-50	17	22	49
51-100	4	6	2
101-1,000	8	15	9
1,000+	5	2	3

Overall in 2010, the 42 caribou observations were of groups with less than five individuals (Table 8.2-1). Group size ranged from one to greater than 3,000 individuals, with the majority of herd observations containing less than 50 individuals. The first group of caribou (more than one animal) in the spring (165 animals) was observed on May 6, 2010, and the last group (two animals) was observed July 31, 2010. Although there were no groups of caribou observed in the study area after July 31, there were several observations of solitary animals until August 25, 2010. Over 1,700 caribou in large mixed groups (bulls, cows, yearlings, and calves) were observed passing through site between July 20 and 21. Peak calving is typically during early June, and for the Bathurst herd, occurs north of EKATI and southwest of Bathurst Inlet. As the weather warms and biting and parasitic insects emerge, caribou form large aggregations during the post-calving period (by late July) and can move continually during periods of high insect harassment, seeking sites that might offer some relief. The first calf observation was on July 20, 2010, seen within a herd of approximately 200 individuals near km 20 of Misery Road. Forty-eight caribou observations (55%) were relatively close (< 50 m) to the mine site. From October 4 to 12, 2010, 13,011 caribou were sighted (88% of all caribou counted), representing the tail end of their southward migration to the wintering grounds.

BHP Billiton staff observed caribou on 191 occasions at EKATI during the 2011 reporting period, the sixth year that incidental observations were formally reported for caribou. The total number of observations was higher than in 2009, 2008, and 2006 (106, 66, and 57 observations, respectively), but lower than in 2007 (193). In 2011, several larger groups were observed, including nine groups with 100 to 1,000 animals and three groups with more than 1,000 animals (Table 8.2-1). Over 500 caribou (bulls, cows, yearlings, and calves) were observed passing through the mine site between June 3 and July 31. This is lower than the 1,700 that passed through the site during the same period in 2010. Only 628 caribou were observed passing near the EKATI mine site during the fall of 2011, demonstrating the highly variable presence of caribou during their annual migration.

Overall, the number of caribou observed between 2009 and 2011 indicates that caribou are continuing to use the area around EKATI.

8.2.1.4 Behavioural Disturbance

The 1995 EIS predicted there would be disturbance to caribou behaviours as a result of mine-related activities. Previous versions of the EIR have noted that noise from mine-related activities (i.e. blasting, sirens, haul trucks, etc.) has had a minor effect on caribou behaviour. Caribou were found to respond to a variety of stressors with blasts and traffic evoking the greatest response. As the distance to the disturbance increased, or if a group did not have calves, there was a reduced likelihood of a 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. Caribou feeding appeared to increase with increasing distance from the mine. 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.

Monitoring caribou behaviour enables a more direct assessment of mine-related activities on caribou activity budgets (e.g., time spent feeding, resting, walking, running, etc.), and to quantify the relative degree of responses to specific stressors (e.g., aircraft, vehicles, blasts). A scan survey method was the primary means to record caribou behaviour at EKATI; however, scan surveys only provide a portion of the behavioural information. As a result, in 2010, EKATI incorporated focal sampling (in addition to scan surveys) where a single animal is observed for a minimum period of time, and changes in behaviour over that time period are time stamped. Scan sampling is ideal for identifying the frequency of dominant behaviours in a group over a period of time. Focal observations, on the other hand, are more useful for determining activity budgets (Altmann 1974; Martin and Bateson 1993) or the proportion of time an animal is engaged in a particular behaviour and the length of time it takes an animal to return to a non-alert state following a stressor event. Focal surveys are an excellent means to examine caribou behaviours in response to mine activity; however, larger sample sizes across sex and age classes are required for the technique to provide adequate information.

Sample sizes for the 2010 and 2011 focal surveys were too small to make any definitive conclusions regarding caribou activity budgets and responses to stressors (see below for trends). Larger sample sizes will enable BHP Billiton to explore the relationship between caribou behaviour and mine activities. Currently the focal and scan surveys are opportunistic and the number of surveys completed each year is variable. With additional effort by trained wildlife technicians in 2012 and 2013 (and subsequent years), it is expected that a sufficient number of observations will be obtained to make statements about caribou behaviour in relation to mine activities. Diavik is also completing the scan surveys (using the same methods at sites greater than 14 km from EKATI) with the intention of sharing the data for the 2012 reporting period. As a result, a more complete and detailed data set will be provided by the combination of focal (activity budgets) and scan (frequency distributions) surveys.

During 2009, scan surveys were conducted on eight nursery groups and five non-nursery groups at EKATI. Three of the nursery groups and three of the non-nursery groups were not exposed to a stressor. The effect of distance from the mine on the proportion of caribou bedding or conducting alert/moving behaviours was statistically significant for nursery groups but not significant for non-nursery groups. This result might indicate that distance from the mine affects bedding and alert/moving behaviours differently for nursery and non-nursery groups. For nursery groups, the proportion of caribou in nursery groups conducting alert/moving behaviours was higher closer to the mine, while bedding behaviour in nursery groups was lower closer to the mine. This indicates that the mine or mine-related activities (e.g., noise, human presence) may have an influence on bedding and alert/moving behaviour for caribou nursery groups. Other factors, such as insects, can also influence caribou bedding and moving behaviours.

Feeding behaviour was not affected by distance to mine infrastructure for both nursery and non-nursery groups. This result suggests that mine and mine-related activities may not have inhibited caribou feeding behaviour in 2009, as the proportion of feeding caribou did not vary with distance from the mine.

Group composition, distance to the stressor, and type of stressor affected the behavioural responses of caribou differently. Nursery groups responded more strongly to nearby disturbances, while the responses of non-nursery groups were not related to distance to disturbance. Nursery groups were more likely to respond to certain stressors (e.g., light trucks, heavy trucks, and blasts) than non-nursery groups, which showed no variation in responses to different stressors. These results are not consistent with results from previous reports (e.g., BHP Billiton 2004, 2005, 2006a). The observed behavioural response to vehicles is consistent with other studies that suggest caribou increase vigilance in response to traffic (Wolfe et al. 2000; Dyer et al. 2001).

In 2010, of nine animals for which observation data were available, five were exposed to at least one stressor event. Twelve stressor events were recorded: ten light vehicles, one medium vehicle, and one heavy vehicle. Eleven of the stressor events elicited a response from the caribou. The majority of responses (n = 9) involved caribou looking up and alert, two involved the animal walking away, and one involved no response (a cow remained bedded with the passing of a light vehicle). Where a response was observed, it took an average of 1 minute and 58 seconds (range 15 seconds to 3 minutes and 58 seconds) to return to either bedding or feeding behaviour.

Results from focal surveys in 2011 indicated that caribou seemed to spend most of their time (> 62% for males or 68% for females) either feeding or bedded, which may suggest some tolerance for areas in the vicinity of the mine. Nearly a quarter of their time was spent either vigilant or walking through the area. Activity budgets need to be developed for animals at varying distances from the mine and across sex and age classes before the impacts of mine activity on caribou behaviour can be interpreted. Passing vehicles did appear to illicit some level of response that at minimum involved looking up and being alert. The observed behavioural response to vehicles is consistent with other studies that suggest caribou increase vigilance in response to traffic (Wolfe et al. 2000; Dyer et al. 2001).

8.2.1.5 Roads Acting as Barriers to Caribou

Roads may act as a potential deterrence or attractant for wildlife (Forman and Alexander 1998; Trombulak and Frissell 2000). Road avoidance or attractant behaviour varies between species and within species such that certain populations, age groups, genders, or individuals react either positively or negatively to roads. The list of positive and negative effects of roads on wildlife is extensive, but some of the major effects involve a change in wildlife movement patterns. 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; Plate 8.2-1).


Plate 8.2-1. Caribou observed at Misery Road Km 20, 2010.

The 1995 EIS predicted that there would be alterations to caribou movement and avoidance of mine site infrastructure and road system. Prior to 2010, concerns regarding caribou interactions with roads and their potential as barriers were addressed by two monitoring programs: 1) caribou snow track surveys and 2) caribou on roads surveys. Snow track surveys were conducted between 2002 and 2009 to determine if Misery Road was acting as a potential barrier to caribou movement. The results indicated that Misery Road may be acting as a semi-permeable barrier to caribou movement during periods of snow cover (April and May). Characteristics that influence permeability included snow bank height (> 1 m), length of time the road was in existence, the size of the caribou group crossing the road, and the extent of haul truck activity. Larger caribou groups were more likely to cross roads, and analyses suggest that caribou are unable to distinguish between light, medium, and heavy traffic when crossing roads.

Caribou on roads surveys in 2009 indicated that caribou were relatively more abundant on roads compared to surrounding landscape features. Caribou exhibited more active behaviours near roads, yet were found to feed more frequently away from roads. This may be attributed to study design limitations rather than a behavioural response (i.e., vehicles used in the survey could be disturbing caribou near roads or surveyors may be more likely to detect caribou that are closer to the roads).

During the 2010 study period, there were eight observations of caribou or caribou groups within 200 m of the road during vehicle encounter surveys, and one caribou observation was outside the 200 m study area. One of the eight groups observed within 200 m of the road had calves. Over the 10 years of the caribou on roads survey (2001 to 2010), 486 caribou observations have been recorded within 200 m of the road: 121 nursery groups, 153 non-nursery groups, 208 single animals, and 4 single calves. An additional 11 groups of caribou have also been recorded during these surveys farther than 200 m from the road.

The caribou on roads and snow track surveys contributed some understanding about caribou interactions with roads at EKATI, but they are highly dependent on survey effort and subject to observer bias in terms of missed observations. Potential changes to the caribou program were discussed at technical and community workshops held in September 2009, June 2010, and October 2010. As a result of these discussions that were intended to improve the WEMP with current information and techniques, the caribou on roads and snow track surveys were discontinued from the caribou monitoring program and replaced with a camera monitoring program in 2011. During this first year, the camera monitoring program was intended to test the potential use of wildlife cameras as an effective alternative to monitoring caribou (and other wildlife) activity near roads and mine infrastructure to address the concern that Misery Road may be acting as a barrier to movement or source of injury for wildlife. Cameras have the distinct advantage of eliminating observer bias by providing data 24 hours a day across seasons and a range of weather conditions, as well as providing greater coverage of the mine site. Over time, with enough cameras and increasing coverage, the intent is to identify specific road characteristics (e.g., berm height, boulder composition) that may prevent wildlife from crossing and identify those areas that may require further mitigation (see Section 8.4-2).

8.2.1.6 The Long Lake Containment Facility as Potential Physical Hazard to Caribou

Although not predicted in the 1995 EIS, recent concern has been expressed that caribou may become trapped in the PK, which could potentially lead to injury or death. Ingestion of PK within the LLCF is of further potential concern.

One dead caribou was found within the LLCF in 2005. The cause of death was determined to have been predation. Prior to this, caribou were observed to pass through the LLCF without incident. Between 2006 and 2008, caribou were observed in the vicinity of the LLCF. Evidence from track and observed caribou behaviour does not suggest the PK inhibits caribou movement.

During the 2009 to 2011 WEMP reporting periods, 103 surveys of the LLCF were completed (Table 8.2-2). Caribou or caribou tracks were sighted during a majority of surveys. Over the years, groups of up to 20 caribou have been incidentally observed bedded down on the ice on Cell D during spring migration. Overall, 487 formal surveys of the LLCF have been conducted from 1999 to 2011 (Table 8.2-2). Caribou were reported within the vicinity during 91 (19%) of these surveys. From 2000 to 2011, a 622 caribou have been observed within the LLCF area during formal surveys.

To date, no caribou injuries or deaths have been directly attributed to the LLCF. In 2006, a caribou with a broken hind leg was observed in the LLCF but it is unknown whether the injury resulted from an interaction with the LLCF or was incurred prior to the animal entering the LLCF. Observations of caribou and caribou tracks crossing Cell B and other areas of the LLCF suggest that the PK does not block caribou movement.

Table 8.2-2. Summary of Caribou Frequency within the Long Lake Containment Facility, 1999 to 2011

	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	Total
Surveys (#)	64	27	22	10	60	25	43	17	18	58	22	16	65	487
# Surveys Caribou Observed	27	3	15	6	2	8	14	3	0	3	1	4	5	91
% of Surveys Caribou Observed	42	27	68	60	3	32	33	18	0	5	5	25	8	19
Total Caribou Observed in LLCF (#)	-	3	48	7	3	40	66	402	0	16	2	30	5	622

The LLCF may provide refuge habitat from insect harassment during summer months. The LLCF basin is a large, flat, largely non-vegetated and wind-exposed habitat not associated with mosquito and oestrid fly activity. Industrial structures, such as roads and oil fields, have been found to provide insect-relief habitat for caribou (Cronin et al. 1998). However, the majority of caribou groups observed were travelling through the LLCF area, which may indicate that it is not being used as refuge habitat from insects.

Currently, there is almost no vegetation cover on the LLCF. As a result, observed feeding behaviour has been relatively limited within the LLCF basin from 2000 to 2011. Vegetation cover, however, is increasing in the LLCF basin, and subsequently will pose an exposure pathway to wildlife. To address this potential risk to wildlife, a focus on intensive behavioural surveys within LLCF basin will provide more information on feeding in these areas as re-vegetation progresses (see Section 8.4.4).

8.2.2 Carnivores and Habitat

The VEC carnivores include grizzly bear, wolf, and wolverine. Grizzly bears are assigned special importance because of their cultural value, conservation status, and role as an “umbrella species.” Grizzly bears are considered a species of Special Concern by the Committee on the Status of Endangered Wildlife in Canada (COSEWIC) because of their low population density, low reproductive capacity, and sensitivity to disturbance. Grizzly bears are called an umbrella species because they have large home ranges and their minimum area and habitat requirements encompass those of many smaller species. Therefore, protecting habitat for umbrella species like grizzly bears ensures the protection of adequate habitat for the many associated species and ecological communities.

Wolves are listed as secure in the NT (GNWT ENR 2008a) and considered not at risk by the COSEWIC (2005). Wolves in the EKATI area depend on the Bathurst caribou herd as their main source of prey, particularly during the winter (Kuyt 1972; Walton et al. 2001). During the spring, wolves follow the Bathurst caribou herd north of the tree line and choose den sites south of the Bathurst calving grounds. This strategy likely optimizes the availability of food resources for rearing pups (Heard and Williams 1992). Wolf pups usually leave the natal den in early August, but do not leave the summer range until October. As predators of migratory caribou, wolves within the EKATI study area have larger home ranges and exhibit less territorial behaviour than wolves in other parts of North America (Walton et al. 2001).

However, potential risks for the local population may arise from habitat removal and human disturbance (Clarke et al. 1996). Human development can result in wolves avoiding certain areas (Johnson et al. 2005). Conversely, certain features of human developments (such as landfills and infrastructure) can act as wildlife attractants, increasing the likeliness of wildlife habituation.

Wolves have cultural and commercial value, and they are ecologically important because they are the main predator of caribou. Wolves are less sensitive to disturbance than bears or wolverines because they have a greater reproductive capacity and dispersal ability than bears or wolverines. Because of this resilience, they may be a less effective indicator of environmental stress than other carnivores.

Wolverine, the largest member of the weasel family, has a circumpolar distribution in the tundra, taiga plains, and boreal forests of North America (Weir 2004). The western population of wolverine, including those in the NT, is considered a Species of Special Concern by the COSEWIC (COSEWIC 2003). The status of wolverine in the NT is sensitive (GNWT ENR 2008a).

Wolverines are highly adaptable, often changing their location and distribution over time. Wolverine home ranges are typically up to 1,000 km^2 (COSEWIC 2003; Rowland et al. 2003). They opportunistically travel on snowmobile trails and scavenge along trap lines and at hunter kills (COSEWIC 2003). Wolverines moving through human-occupied areas are a potential cause for concern with regards to wildlife and human safety. Food and food waste may potentially act as wildlife attractants, increasing the possibility of wildlife habituation. In response to these concerns, BHP Billiton monitors wolverines as part of the WEMP.

The 1995 EIS noted that grizzly bear are the carnivore species most sensitive to disturbance in the EKATI claim block and predicted several potential effects of mine development, including:

- habitat loss or modification due to mine infrastructure;
- disturbance and displacement from aircraft and vehicles; and
- negative interactions with humans as a result of bear attraction to the mine’s landfills.

The 1995 EIS predictions for wolves and wolverine were similar as those for grizzly bear, with an additional prediction of collisions with vehicles. Wolverines were not predicted to be attracted to landfills, per se, but they would be attracted to camps and human activity.

Arctic fox and red fox were not identified as VECs during the Environmental Assessment Review Process. However, fox occurrence at EKATI is an ongoing concern, and a decision was made to monitor foxes (at least informally) in 1997. Monitoring and recording incidental fox observations in the study area may help minimize risks associated with human and wildlife interactions. Once a fox is sighted within the mine site area, BHP Billiton staff that is at risk of encountering the fox are notified, and work activities are adjusted accordingly.

Two species of fox inhabit the Slave Geological Province of the NT: the red (or “coloured”) fox (*Vulpes vulpes*) and the Arctic fox (*Alopex lagopus*). Foxes (especially Arctic fox) are considered important furbearers in the north. The population sizes of Arctic and red foxes for the region are unknown, but current estimates are greater than 10,000 for both species (GNWT ENR 2007). Foxes are opportunistic foragers. As human activities in the Arctic increase, fox populations occasionally thrive near landfills and other artificial food sources. Along with increased fox populations near mining camps and areas with other human activities, the risk of disease transmission also increases. Of particular concern is the transmission of rabies to humans. Foxes are the primary animal vector of rabies in the NT (Walker and Elkin 2005).

8.2.2.1 Habitat Loss or Modification

The 1995 EIS predicted minor mine-related effects on wolves, wolverines, and grizzly bears including possible loss of denning habitat and physical disturbance due to intensive activity from the ground and air. Previous editions of the EIR indicated that there appears to be minimal interaction between carnivores and the mine or its personnel. Between 2003 and 2005, bear sign surveys indicated that bears continued to use critical habitat in the study area. This was confirmed in surveys conducted between 2006 and 2008. Track surveys indicated continued wolverine presence and wolves continued to occupy dens in the study area, and there was no detectable relationship between distance to the mine site and wolf den occupancy or productivity. Between 2006 and 2008, wolf productivity in the area was relatively lower than in previous years; however, without regional data it was difficult to determine if this trend was specific to the EKATI area.

Grizzly Bears

The recording of incidental grizzly bear observations in the study area allows bear activity to be identified and monitored, which can help locate and eliminate bear attractants and minimize human/bear interactions. Once a bear is sighted within the mine site, BHP Billiton personnel are notified and work activities are adjusted to avoid encounters.

From October 1, 2008, to September 30, 2009, there were 69 incidental sightings of grizzly bears (Table 8.2-3). From October 1, 2009, to September 30, 2010, there were 46 incidental grizzly bear observations recorded during 36 separate days near EKATI, the lowest since 2003 (42 sightings; Table 8.2-3). From October 1, 2010, to December 31, 2011, there were 70 incidental observations out of 117 total bears recorded during 45 separate days near EKATI (Table 8.2-3).

Table 8.2-3. Summary of Incidental Grizzly Bear Observations at EKATI, 2001 to 2011

	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011
Incidental Observations (over separate days)	36 (18)	37 (30)	42 (unknown)	60 (42)	76 (55)	63 (48)	48 (36)	62 (45)	69 (48)	46 (36)	70 (45)
Family Group Observations	11	13	15	9	9	4	8	10	24	13	32

Note: Family groups include all sightings of multiple bears.

The number of family groups (multiple bears) observed each year from 2001 has remained relatively consistent, with the exception of 2011, when the highest number of family groups (33) was reported since 2009 (24) and 2006 when the lowest number (4) was reported.

In previous EIR reports, results of a grizzly bear sign survey were presented. By looking at habitat use, this survey attempted to address the possibility that bears were spending less time near the mine. The results of the surveys showed that there has been variability in habitat use among years, which may represent varying habitat preferences or may correspond to a change in the number of bears moving through and using the study area during each season. The sign survey design does not distinguish between these two possibilities. After consultation and approval from ENR and other stakeholders, the grizzly bear sign survey was discontinued in 2009 and was replaced with a DNA hair snagging study in 2012, in collaboration with other diamond mines in the region.

Wolves

Monitoring and recording incidental wolf observations in the study area may minimize potential risks associated with human and wildlife interactions. Once a wolf is sighted within the mine site, BHP Billiton staff members at risk of encountering the wolf are notified and work actions are adjusted accordingly. Recording incidental wolf observations helps determine the presence, timing, and family composition of wolf packs moving through the study area.

Overall, wolf presence within the EKATI area has been relatively consistent over the last 11 years (Table 8.2-4). 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.

Table 8.2-4. Summary of Incidental Wolf Observations near EKATI, 2001 to 2011

	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011
Incidental Observations (over separate days)	38 (-)	59 (42)	54 (27)	58 (46)	58 (40)	47 (43)	34 (30)	55 (45)	58 (45)	25 (23)	41 (36)
Family Group Observations	-	-	-	22	20	13	21	16	20	10	14

Note: Family groups include all sightings of multiple wolves.

Active wolf den sites have been established in the EKATI study area over the last 16 years, although some sites appear to have been abandoned, while other new sites have been discovered. Walton et al. (2001) found that although wolves show den site fidelity, they will establish new den sites within 25 km of previous dens. However, since only the locations of dens are monitored, it is difficult to determine if the wolf pack observed is a previously observed pack that has relocated within the area or if it is a new wolf pack that has moved into the area.

Recent wolf productivity in the area has been relatively low compared to previous years. Since 2003 (excluding 2006), wolf productivity has been lower (from 0 to 1.7 pups per year) than the average of two pups per year over all years. However, these results may be skewed because some den sites were not surveyed between 2006 and 2008, potentially missing active wolf dens in the area. Additionally, without regional data, it is difficult to determine if this trend is specific to the EKATI area or observed throughout other areas in the NT.

Monitoring of wolf breeding has been conducted in conjunction with the GNWT ENR since 1995 to assess the potential for mine development to affect wolf den site distribution and breeding success. Areas of known wolf activity in the EKATI study area were surveyed by the ENR during late May to early June to determine den occupancy. Active dens were subsequently re-surveyed by the ENR in August to determine the presence of pups. In 2011, ENR conducted surveys for wolf dens throughout a large portion of the Slave Geological Province of the NT. Twenty-two sites were active during occupancy surveys in May/June with a total of 37 wolves; however, pups were confirmed at only two of these dens during productivity surveys in August. Coincidentally, few (46) caribou (a major prey for wolves during denning) were observed during these surveys (D. Cluff, pers. comm.). Similarly in 2010, two active dens were observed during productivity surveys in August, and no pups were observed. In 2009, four dens were active during productivity surveys in August; however, pups were confirmed at only one of these dens. Therefore, it appears as though den productivity was low over a large area between 2009 and 2011. Overall, the mean pup production for the EKATI area since 1995 is 5.3 pups per year and 2 pups per occupied den.

<u>Wolverines</u>

The number of incidental wolverine observations reported has varied between years (Table 8.2-5). It is important to acknowledge that disproportionate effort over the years could skew the number of wolverine observations so that the data are not comparable from year to year. For example, there were fewer people at Misery Camp between 2007 and 2010 to report sightings. More importantly, the high number of incidental wolverine observations reported during 2005 has not re-occurred in subsequent years. During 2005, five wolverines were removed (one mortality and four were relocated 200 km away) from the area (BHP Billiton 2006a).

Table 8.2-5. Summary of Incidental Wolverine Observations near EKATI, 2003 to 2011

	2003	2004	2005	2006	2007	2008	2009	2010	2011
Incidental Observations (over separate days)	14 (12)	32 (25)	128 (86)	23 (23)	9 (8)	40 (35)	12 (11)	18 (18)	12 (11)

The use of genetic markers to study wolverine populations in the NT has provided insight into the distribution and connectivity of these populations (G. M. Wilson et al. 2000; Kyle and Strobeck 2002). To obtain reliable information on wolverine population size and distribution at EKATI, a DNA-based population assessment was conducted in 2005 and 2006 and again in 2010 and 2011 by BHP Billiton in conjunction with the GNWT ENR and Diavik (Figure 8.2-12). The regional DNA-based study replaced the wolverine snow track survey that was conducted at EKATI from 1997 to 2004. The four-year wolverine DNA-based study within the EKATI area was carried out to obtain reliable population and range estimates, so that wolverine density and activity relative to mines could be tracked. Boulanger and Mulders (2008) published a summary report detailing the DNA mark recapture results for wolverines at Daring Lake, EKATI, Diavik, and Kennady Lake in 2005 and 2006. The final report is pending.

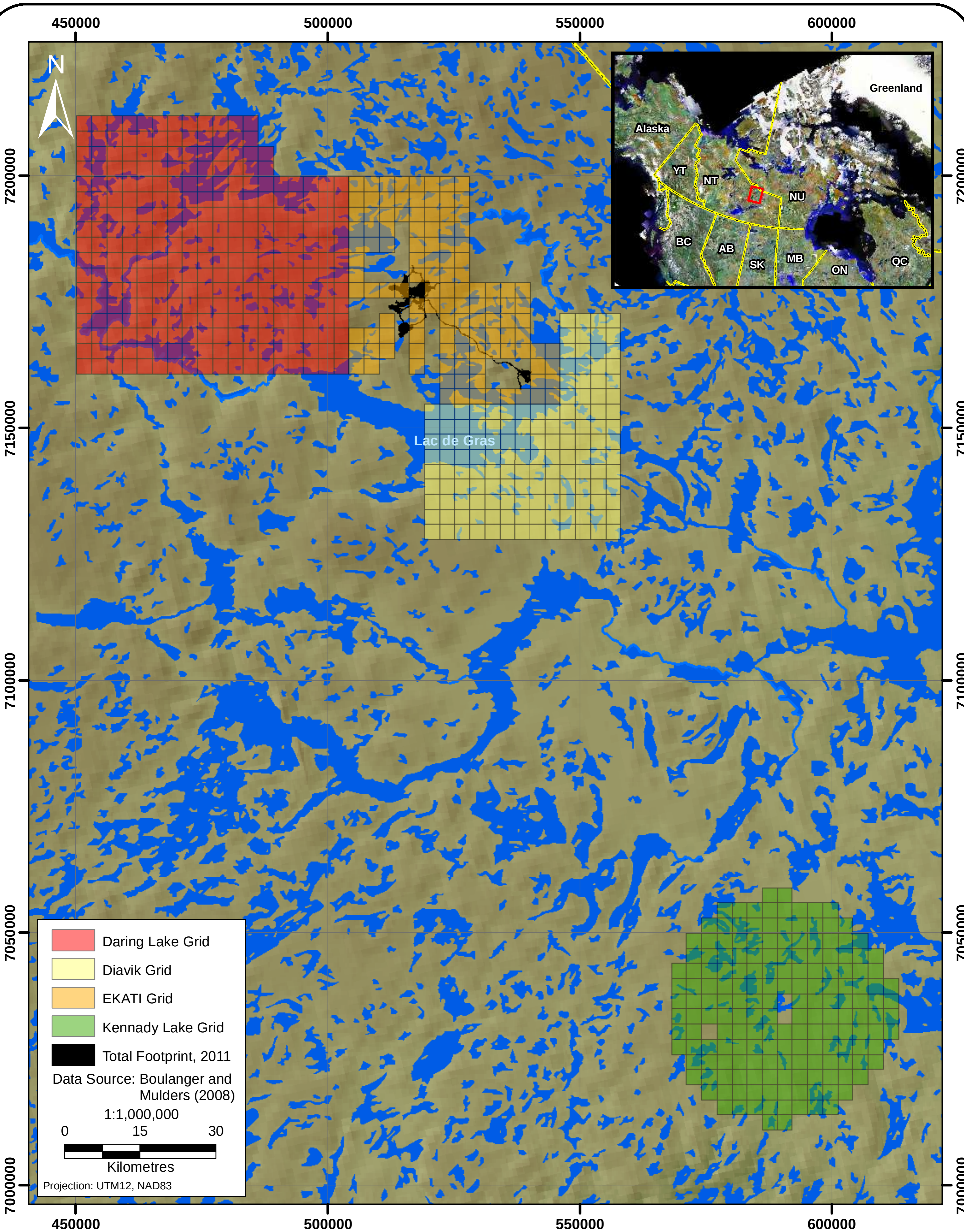
Boulanger and Mulders (2008) found that DNA sampling was successful in estimating population size, trend, and demographic parameters of wolverine populations. The initial two-year study in 2005 and 2006 found that male wolverines exhibited larger movements, lower apparent survival, and lower fidelity. Generally, female populations appeared to be more stable (i.e., little change in density between 2005 and 2006) compared to male populations. This trend was found within all sampling grids studied, including the Daring Lake study area, a control site with no mining activity. This suggests that the large-scale trend of lower numbers of males may be due to harvest or other natural factors, and not mining activities. Boulanger and Mulders (2008) recommended the continuation of DNA-based methodologies to accurately monitor changes in wolverine populations in the surrounding EKATI area.

The EKATI study area contains 184 barbed-wire posts. In 2010, BHP Billiton submitted 298 samples for DNA analysis, yielding 117 good samples that could be used for DNA extraction. In the 2010 study, 13 males and 11 females were identified, including six that matched animals sampled in the Diavik study area, seven recaptures from previous work in the EKATI study area, and five recaptures from Daring Lake. In 2011, BHP submitted 498 samples for DNA analysis, yielding 98 good samples that could be used for DNA extraction. During the 2011 field season, 13 males and 12 females were identified, including 13 recaptures from previous work in the BHP study area, nine that matched animals sampled in the Diavik study area, and seven recaptures from Daring Lake. Altogether, 63 individuals (35 males and 28 females) have been identified in the EKATI study area over four years of sample collection. Final results from the 2010 and 2011 program are pending.

<u>Foxes</u>

From October 1, 2008, to September 30, 2009, there were 126 incidental observations of 166 individual foxes, recorded on 90 separate days near EKATI. From October 1, 2009, to September 30, 2010, there were 174 incidental sightings of 200 individual foxes over 120 separate days near EKATI, an increase from 2009 (126) but comparable to 2008 (174) and 2007 (162). From October 1, 2010, to December 31, 2011, there were 61 incidental sightings of 66 individual foxes over 55 separate days near EKATI. However, observations could have been the same fox recorded on multiple occasions.

On June 12, one fox den was observed adjacent to Misery Road near km 21. This den was also active in 2009. Up to five kits were observed around the den site. Wildlife signs were placed at either side of the den to warn traffic of wildlife presence and ensure vehicle speeds were reduced through the area. On July 3, a gis no. EKA-23-153 Job No. 0648-121-01 September 25, 2012



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Distribution of the Four Sampling Grids for Monitoring Wolverines in the Slave Geological Province, 2005 to 2006 and 2010 to 2011

FIGURE 8.2-12

second den was discovered near the Misery Pit Laydown, and at least five kits were observed by drilling crews. The den was monitored while a drilling crew completed their activities in the area over a span of two days. Active dens have been established adjacent to the EKATI airstrip yearly since at least 1994, but none were observed in 2010 or 2011. Foxes are relatively tolerant of disturbance; for example, in 1997 the probability of a fox den being occupied increased with proximity to the mine site (BHP Billiton 1998).

During baseline studies prior to the development of EKATI, Arctic foxes were more commonly reported than red foxes in the study area (BHP Billiton 2005). In 1994, nine fox dens were identified in the study area, seven of which were Arctic fox, and the remaining two were red fox (BHP and Dia Met 1995a). However, in 2009, 2010, and 2011 red foxes have become more common near EKATI. Only two Arctic foxes were observed during this three year period. This apparent increase in red fox occurrence near EKATI may be influenced by the difficulty in determining the difference between a red and Arctic fox during the spring and summer. Arctic fox fur changes colour with the seasons: in the winter it is white to blend in with snow, while in late spring (May) it changes to a two-tone brown or even pale bluish-gray. Because fox observations are reported by all mine personnel and not only EKATI Environment Department wildlife staff, the species could get misidentified during the spring and summer. However, Arctic foxes are rarely observed even during the winter months when Arctic foxes are in their white pelage, and misidentification errors are likely minimal during this time.

It has been suggested that the Arctic fox range is limited in the south by competition with the red fox, whose range is limited in the north by cold weather conditions (Bartoń and Zalewski 2007). However, climate change may be facilitating a northward range expansion of the red fox (Hersteinsson and MacDonald 1992). Numerous studies provide evidence that where red and Arctic fox co-exist, the two species compete for prey and denning habitat, with the larger red fox outcompeting the smaller Arctic fox (e.g., Tannerfeldt et al. 2002). Competitive interactions may partly explain why red foxes outnumber Arctic foxes at EKATI in recent years.

Since foxes occur near the mine site, the transfer of rabies from infected foxes to humans is a concern. The rabies virus exists in a number of different strains, named according to the animals that they affect most easily. In northern Canada, the most prevalent strain is the Arctic strain, named after the Arctic fox. The Arctic fox is the primary, permanent reservoir for rabies in the NT, accounting for 83% of all reported cases of the disease in the NT between January 1, 1998, and June 30, 2004 (Walker and Elkin 2005).

Concerns about potentially rabid foxes have been reported at EKATI since 2002. In 2007, there were six confirmed cases of rabid foxes at EKATI: five cases of rabies in red foxes and one in an unknown fox species. No cases of rabies were detected in foxes between 2008 and 2011.

8.2.2.2 Injured Carnivores

The 1995 EIS predicted that vehicle collisions with carnivores were a potential effect. Previous editions of the EIR indicated that one young wolf was killed by a collision with a haul truck in 2001; poor weather conditions and visibility were responsible. One fox was killed in a vehicle collision in 2002 and 2005. One fox was involved in a vehicle collision in 2008. No grizzly bears or wolverines were involved in vehicle collisions or other accidents at EKATI. Prior to 2006 there were three documented wolverine mortalities.

No vehicle-related mortalities for VEC species occurred between 2009 and 2011.

Two fox mortalities were reported at EKATI from October 1, 2008, to September 30, 2009. After seeking advice from the GNWT ENR, both carcasses were incinerated. One fox mortality may have been vehicle-related. The other fox was found deceased between the process plant and the reclaim building.

In 2010, four fox mortalities were reported. One fox was killed by a landing aircraft. Two foxes were found dead at the landfill; causes of death were unknown. The fourth fox was dispatched due to habituation with food waste in the underground complex. Waste management protocols at the underground were reviewed to ensure this type of incident was not repeated. This fox was sent for rabies testing and the result was negative. The other three foxes were incinerated.

There were no mine-related fox mortalities reported at EKATI from October 1, 2010 to December 31, 2011.

There were no mine related mortalities of grizzly bears, wolves, or wolverine between 2009 and 2011 WEMP reporting periods.

8.2.2.3 Habituation to Humans

The overriding aim of managing wildlife incidents is to reduce the potential for wildlife-related safety concerns for employees, and to address potential effects of mine activities on wildlife in accordance with BHP Billiton's Charter, which aspires to Zero Harm to the environment. Natural wildlife activity and ecological processes are left undisturbed unless they could result in harm or risk of harm to BHP Billiton 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) must be managed to minimize risk to wildlife and staff.

BHP Billiton 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 done after successive levels of deterrents do not deter an animal from site and after consultation and approval from the GNWT ENR.

Habituation of carnivores to the presence of humans was indicated as a potential effect in the 1995 EIS. Previous versions of the EIR indicated that:

- seven wolverines were trapped and moved away from the landfill;
- a young grizzly bear that was undernourished and in poor physical condition was killed at Misery Camp by Environmental staff due to repeated incursions into the camp area;
- two grizzly bears that were in poor physical condition and one wolverine posed safety threats to BHP Billiton staff and were destroyed in 2005. Deterrent actions were taken prior to dispatching these individuals, except for one bear because it was in such poor physical condition;
- there were three documented wolverine mortalities at EKATI prior to 2006;
- in 2007, one grizzly bear was relocated away from the mine site after repeated incidents with BHP Billiton staff and mine infrastructure;
- between 2006 and 2008, one grizzly bear sighted inside the airstrip fence was gently deterred through the south-end open gates and one wolverine had to be deterred from Misery Camp on several occasions. After attempts to deter a wolf from the mine site on at least four occasions, the wolf was dispatched with the GNWT ENR approval; and
- foxes continue to be seen at the landfill.

During the 2009 reporting period, 38 wildlife incidents were reported at EKATI, including 19 grizzly bear, 1 wolf, and 13 fox incidents. Of these, 30 involved the use of a deterrent to move the animal(s) away from site.

There were 70 wildlife incidents reported during the 2010 reporting period. The majority (62) of incidents involved deterring grizzly bears and foxes away from site and/or personnel. There were no incidents involving wolves in 2010. Helicopter deterrence of grizzly bears was used on eight occasions to deter bears from the vicinity of the Main Camp. Helicopter deterrence was exercised with caution to ensure the animals' well-being. There was one wolverine incident reported at EKATI on May 7, 2010; an adult wolverine was spotted in the vicinity of a dewatering crew in the Fox Pit DMAG mining shovel laydown. The crew was issued a work stoppage and returned to their vehicles. The animal was monitored, but no deterrent was used. The animal left the area on its own.

In 2010 there were a number of fox incidents (49) and sightings (174 sightings of 200 total individuals). Some of the sightings were of the same individuals observed over multiple occasions. One fox needed to be dispatched due to repeated attraction to the underground facility as a result of improper food disposal. The high number of fox incidents was related to issues surrounding waste management and access to buildings. All waste bins were inspected to ensure that doors sealed properly, and repairs were made where necessary. Site-wide notices were sent to personnel regarding proper waste management protocols. Doors to buildings where animals gained access were repaired, and site-wide notices were sent to personnel reminding everyone to make sure doors closed properly. Waste bins will continue to be monitored as a component of the WEMP to minimize the number of wildlife incidents.

During the 2011 reporting period, there were seven incidents involving carnivores. Helicopter deterrence of grizzly bears was used on four occasions to move bears from the vicinity of Main Camp or Misery Camp. This is a marked reduction from 2010 when 70 incidents were reported. Part of this reduction is due to an increased reliance on monitoring before making a decision to actively deter an animal.

There were no fox incidents in 2011, compared to 49 incidents and one dispatched fox in 2010. This improvement could be related to increased awareness amongst personnel about the importance of proper waste management.

It remains unclear whether grizzly bear numbers near the mine have changed over time. Although the number of grizzly bear sightings in 2011 is among the highest recorded, there were few incidents. The number of observations is not indicative of whether the number of individuals near the mine has remained consistent, as individual bears could have been observed on multiple occasions. The addition of hair snag traps to monitor DNA in hairs left by grizzly bears may resolve this question, as individuals can be identified and number of animals in the study area tracked.

Detailed inspections of EKATI and Misery Camp buildings were conducted weekly in order to determine if wildlife were accessing structures from underneath, and to observe any wildlife sign occurring around the camp. Specifically, surveyors would walk around both EKATI and Misery accommodation buildings, recording any sign of wildlife (e.g., scats, tracks, digs), as well as evidence of damage (e.g., holes, tears) to the skirting or access points leading to underneath the buildings.

During 2009, areas with skirting damage, holes, or no skirting were reported on seven occasions over 42 sampling dates. Over those same sampling dates animal tracks were observed on five occasions. Arctic hare tracks were observed on one occasion, unknown fox tracks were seen on two occasions, one unidentified set of tracks was observed, and one caribou was seen. Any holes detected were repaired and covered to prevent wildlife entry.

During 2010, areas with skirting damage, holes, or no skirting were reported on 19 occasions over 63 sampling dates (93 records). Over those same sampling dates animal tracks were observed on 53 occasions. Arctic hare tracks were observed on five occasions, fox tracks were seen on 32 occasions, wolverine tracks observed on five occasions, wolf tracks on two occasions, eight unidentified tracks were observed, and one caribou was seen. Any holes detected were repaired and covered to prevent wildlife entry.

During 2011, areas with skirting damage, holes, or no skirting were reported once over 39 sampling dates (45 records). Over those same sampling dates, animal tracks were observed on 12 occasions. Arctic hare tracks were observed on four occasions and fox tracks were seen on eight occasions. Misery Camp was surveyed on 37 sampling dates. Skirting damage, holes, or no skirting were reported on six occasions. Animal tracks were observed on 11 occasions: one caribou track, two sets Arctic hare tracks, and eight sets of fox tracks.

8.2.3 Breeding Birds/Habitat

The majority of birds found in the EKATI study area are migratory. The birds arrive in spring for the purpose of breeding and rearing young during the long Arctic summer days. The abundance and diversity of these migratory birds can be considered an index of habitat quality. The 1995 EIS predicted several potential effects of mine development on breeding birds including:

- loss of nesting habitat;
- disturbance from noise, human presence, vehicles, and aircrafts;
- collisions with vehicles (birds other than waterfowl only) and collisions with and disturbance from aircrafts (waterfowl in particular); and
- subsequent reductions in abundance and species diversity.

8.2.3.1 Habitat Loss

The 1995 EIS predicted that there would be a loss of waterfowl habitat due to lake dewatering and disturbances. The previous versions of the EIR indicated that mine operations and lake dewatering caused loons to relocate to nearby lakes in a few cases, but have not reduced the number or nesting pairs. However, between 2006 and 2008 no new dewatering occurred and loons were no longer monitored due to low sample sizes.

This effect was not evaluated during the 2009 to 2011 monitoring years.

8.2.3.2 Changes to Nesting Patterns and Breeding Success

The 1995 EIS did not predict any changes to nesting patterns or breeding success of birds as a result of mine activities. Previous versions of the EIR indicated the following:

- There were no negative effects on density or diversity of upland breeding birds at plots located near the mine versus away from the mine prior to 2005.
- No apparent effect on the presence and nesting frequency of raptors was observed.
- In 2005, changes in density and diversity of upland breeding birds near the mine were detected.
- A decline in Lapland longspurs may be opening up space for the smaller passerines to become more abundant around the mine site.

- There was no evidence that reduced productivity is a result of mine presence because raptor chicks have been produced in both Misery and Panda pits and disturbance from the mine was not causing breeding sites close to the mine to be left unoccupied.
- A decrease in gyrfalcon abundance relative to peregrine falcon abundance in the study area was observed.

Between 2006 and 2008 effects related to changes in nesting patterns and breeding success included the following:

- Changes in density and diversity of upland breeding birds were observed near the mine.
- Areas closer to mining activities appear to have experienced changes in species community composition.
- A decline in Lapland longspurs may be opening up space for the smaller passerines to become more abundant around the mine site.
- In 2008, there were more falcon nests further away from pits.
- An increase in peregrine falcons relative to gyrfalcons has been observed during nest surveys. No gyrfalcons were observed during nest surveys; however, a gyrfalcon nest with three fledglings was incidentally observed on the old atomization building steps at Misery Camp. The decrease in gyrfalcon abundance is likely related to a general decline in relative abundance of gyrfalcons at breeding sites across the region and is probably related to natural cycles in available prey species such as ptarmigan.

Species Density - Community

The North American Breeding Bird Survey is designed to collect long-term data on the population status and trends of breeding birds throughout North America. The survey was initiated in 1996 and is now conducted at approximately 450 locations across Canada each year. These data are managed by the Canadian Wildlife Service and are used to monitor the status and trends of North American bird populations. The survey at EKATI provides an important contribution to this program since northern regions are under-represented in most continental-scale monitoring programs. This program has been conducted at EKATI since 2003.

The survey is conducted along Misery Road and the LLCF Road, stopping at 0.8 km intervals to conduct point counts. Surveys begin at 3:15 am (30 minutes before official sunrise) and require 50 stops to be completed within five hours. At each of the 50 identified stop points along the survey route the observers conduct three-minute point counts, where all birds seen and heard within 400 m are recorded. Start and finish times, as well as weather conditions, are also recorded. The results of the survey are submitted to the Canadian Wildlife Service for inclusion in the Canadian Bird Trends database.

Overall, the number of species and individual birds recorded during the 2009, 2010, and 2011 North American Breeding Bird Survey was lower than in previous years, except for 2007. Weather was cooler and windier in 2009 compared to 2008, which can influence bird activity, potentially accounting for the low number of individual birds observed. Species diversity and equitability values were consistent across all years, except for 2007 and 2009, which both recorded relatively lower diversity values. Inclement weather conditions during 2007 and 2009 likely caused the relatively lower values.

Two previously unobserved species, the parasitic jaeger and the federally and territorially listed short-eared owl, were observed during the survey in 2009. Six species of conservation concern were detected during the 2009 survey: short-eared owl, long-tailed duck, least sandpiper, American tree sparrow, Harris's sparrow, and American pipit. These species are classified as "sensitive" in the NT, meaning they may require special attention or protection to prevent the species from becoming at risk.

Seven species of conservation concern were detected during the 2010 survey: black scoter, long-tailed duck, least sandpiper, American tree sparrow, Harris's sparrow, American pipit, and semipalmated sandpiper. This is the first record for the semipalmated sandpiper since 2006, classified as "sensitive" in the NT. Prior to that, it was observed annually since surveys began in 2003.

One previously unobserved species, sandhill crane, was observed during the survey in 2010, but not again in 2011. The federally listed short-eared owl was recorded in 2009, but not during the 2010 or 2011 surveys. Six species of conservation concern were detected during the 2011 survey: black scoter, long-tailed duck, least sandpiper, American tree sparrow, Harris's sparrow, and American pipit.

8.2.3.3 Vehicle Collisions

The 1995 EIS indicated that there would be some bird mortalities as a result of vehicle collisions. No vehicle collisions were reported prior to 2002. In 2002, one willow ptarmigan was killed in a collision. In 2004, vehicle related wildlife mortalities included two ptarmigans, and in 2005, included a rough-legged hawk, eight willow ptarmigans, and one green winged teal. No vehicle related wildlife mortalities were reported in 2006. In 2007, vehicle related wildlife mortalities included five ptarmigan, and one ptarmigan was involved in a vehicle-caused mortality in 2008.

Between 2009 and 2011, there were seven reported vehicle related mortalities including one ptarmigan in 2009, two ptarmigan in 2010, and three ptarmigan and a common raven in 2011.

8.2.3.4 Possible By-catch of Waterfowl during Fisheries Projects

Although not predicted in the 1995 EIS, some effects on waterfowl as a result of fisheries projects have been observed. Two red-throated loons were caught and died in fish nets used for fishout of lakes. In 2004, a dead gull was found floating in the PDC fish box that may have entered the fish box to capture Arctic grayling held inside the fish trap. In 2005, deceased ducks were found within the PDC fish box (two merganser chicks, one adult green winged teal, and seven green winged teal chicks) and the Upper Pigeon fish box (two juvenile yellow-billed loons – unconfirmed species identification). In 2007, a red-throated loon was entangled and drowned in a net at Kodiak Lake during an AEMP fish survey. The net had been set for one hour before the loon was found. No waterfowl mortalities were observed between 2006 and 2008 in the fish boxes at EKATI; however, a single sparrow was found dead in a fish box in July 2008.

There were no reported mortalities of waterfowl during fisheries projects between 2009 and 2011.

8.2.3.5 Incidents Related to Waterfowl in Mine Pits and Underground Areas

Although not predicted in the 1995 EIS, there have been some historical effects of mine infrastructure on waterfowl. One ruddy duck was rescued from Fox Pit and released at Larry Lake in 2004. In 2005, one long-tailed duck was found underground (approximately 100 m below ground). The GNWT ENR was contacted and the duck was retrieved by BHP Billiton staff. The duck was transported and released near Grizzly Lake.

No incidents related to waterfowl in mine pits or underground areas were reported between 2006 and 2011.

8.2.3.6 Birds Landing in Contaminated Standing Water at Landfarm

The 1995 EIS predicted there would not be any impacts to birds associated with contaminated water at the landfarm. There was one incident in 2002 of three ducks that landed in contaminated standing water in the landfarm. The birds became oil-soaked and died. Since this incident no birds have been observed in the landfarm, likely a result of mitigation measures to cover the open water section of the landfarm with flagging.

8.2.3.7 Birds Nesting on Mine Infrastructure

Although not predicted in the 1995 EIS there have been several cases of birds nesting on mine infrastructure:

- 2000 to 2002 – Peregrine falcon nest on the stairs of large fuel tank on Fox Lake Road; an American robin nest in the Old Camp processing plant.
- 2008 – A gyrfalcon nest with three fledglings observed on the old atomization building steps at Misery Camp.
- 2009 – Two common raven nests with fledglings were observed, one at Paul Lake Bridge on Misery Road and the other at the new incinerator building. One American robin nest was observed under a door stairwell at the maintenance building. A peregrine falcon nest was monitored on top of the Misery atomization building, but no fledglings were observed.
- 2010 – No incidental nest sightings.
- 2011 – A common raven nest on the new incinerator building near the LLCF Road and the nest produced three fledglings.

8.2.3.8 Birds Nesting on Pit Walls

In northern environments, bird species such as peregrine falcons, rough-legged hawks, gyrfalcons, and common ravens nest on ledges and cliff faces. In landscapes with human-made structures, cliff-nesting birds have been observed to nest on human-built ledge structures such as cairns, buildings, towers, mining dredges, and bridges (Kessel 1989). Open pit walls at EKATI resemble steep-sided ledges and offer attractive nesting locations for falcons and other cliff-nesting birds.

Although not predicted in the 1995 EIS there have been several cases of birds nesting on the pit walls:

- 2000 to 2002 – There were several examples of birds found to use the pit walls as nesting sites. A rough-legged hawk nest was observed on a vertical face of Koala Pit wall but was lost in a rock fall. A pair of rough-legged hawks successfully bred on an outer bench of Misery Pit.
- 2003 – A raven nested in Fox Pit, producing two chicks.
- 2004 – Five of six active pits had reported bird activity. Of note, one gyrfalcon potentially fledged from Panda Pit.
- 2005 – All of the open pits were reported to have nesting activity.
- 2006 – Birds and/or potential nesting activity were identified in every pit. Two peregrine falcon chicks were observed at the Beartooth Pit and work was postponed to allow the chicks to fledge.
- 2007 – A rough-legged hawk nest was detected in Beartooth Pit, but there were no observations of chicks. In Koala North Pit, a rough-legged hawk nest produced one chick. Peregrine falcons were observed in Panda Pit, and one nest was confirmed, but no fledglings were observed. Ravens and rough-legged hawks were active in Fox Pit.

- 2008 – One peregrine falcon nest was observed with three fledglings in Fox Pit. Rough-legged hawks nested at Beartooth Pit and produced at least three fledglings.

Very little nesting activity was observed within the EKATI open pits in 2009:

- Rough-legged hawks were observed nesting at Beartooth Pit, with three confirmed fledglings.
- Rough-legged hawk, common raven, and gyrfalcon were reported in Fox Pit. The failure to establish any nests may have been related to a particularly cold spring in 2009 combined with late snowfalls in May.
- A rough-legged hawk nest was observed at Koala North Pit but no eggs or fledglings were observed.

In contrast to 2009, there was nesting activity within all the EKATI open pits in 2010, and all nests produced fledglings, with the exception of Panda Pit:

- Rough-legged hawks were observed nesting in Beartooth Pit and up to four fledglings were confirmed.
- In Misery Pit, an unknown falcon pair nested throughout the breeding season and produced four chicks.
- Rough-legged hawks established a nest in Fox Pit and successfully produced at least four fledglings.
- At Panda Pit, a rough-legged hawk was consistently observed sitting on a nest, but no young were observed. The nest was abandoned by July 17.
- A pair of common ravens nested in Koala Pit, and four chicks fledged.
- Both peregrine falcons and rough-legged hawks nested in Koala North Pit and both produced two fledglings.

There were only two confirmed productive pits in 2011 (Beartooth and Misery) and a possible third (Koala North):

- Rough-legged hawks were observed nesting in Beartooth Pit. The first chicks were observed on July 15. Up to four chicks were observed on July 23 and presumed to have fledged by August 18, 2011.
- Both common ravens and peregrine falcons established nests in Misery Pit and produced chicks.
- Both common ravens and rough-legged hawks were sighted at Koala North Pit. Five common raven chicks were observed on May 28, but the fate of those birds is unknown.

Identified nest sites for gyrfalcon and peregrine falcon have been monitored annually since 1995 in conjunction with the GNWT ENR and Diavik. Nest sites were monitored in 2009 and 2010 to determine occupancy, abandonment, and chick productivity at locations occupied in previous years (1995 to 2010 for occupancy and 1998 to 2010 for abandonment and productivity), and at new nest sites identified near EKATI. The overall goal of the falcon surveys was to look for evidence of mine development and pit operation effects on falcon breeding patterns and success. Regional ENR falcon surveys were not conducted in 2011 and will now be conducted every five years, as per recommendations received from technical and community workshops held on June 28, 2010 and October 5 and 6, 2010, respectively.

In 2009, 54% of nest sites surveyed were occupied by peregrine falcons, with the exception of one gyrfalcon nest in Fox Pit. In 2010, 57% of nest sites surveyed were occupied by peregrine falcons, except one gyrfalcon nest at North Esker. An increase in peregrine falcons relative to gyrfalcons has been observed over the past eight years. In 2009 and 2010, there was no statistically significant relationship between occupied nest sites and distance from the nearest pit. Productivity rates recorded in 2009 and 2010 are similar to those recorded for falcons in previous years (excluding 1998 and 2000). Distance from the nearest pit was not a significant predictor of chick productivity. There is also no evidence of reduced productivity relative to the mine site since chicks have been produced in Misery Pit, Beartooth Pit, Panda Pit, and the old atomization building at Misery Camp.

8.3 LONG-TERM PREDICTIONS

8.3.1 Caribou

8.3.1.1 Aerial Surveys

Variability in herd size and migratory patterns should be considered when interpreting count data from the weekly caribou aerial survey. The Bathurst caribou herd has experienced large changes in population size over the past 13 years, which may influence the numbers of caribou recorded in the EKATI study area. Information collected by the GNWT ENR suggests that the population size of the Bathurst herd has decreased by approximately 80% since 1996 and possibly down to approximately 30,000 individuals in 2009. However, there was an increase in the total number of caribou in the EKATI study area in 2009. Change in caribou numbers over the years may be related to a variety of factors, such as climate change, harvest rates, and development (Gunn et al. 2009).

There is a complex interaction among habitat conditions, caribou foraging, and movement patterns that can result in periodic range shifts and large caribou population fluctuations (Messier et al. 1988; Ferguson et al. 2001). Bathurst caribou have unpredictable migration patterns (Whaèhdôö Nàowoò Kö - Dogrib Treaty 11 Council 2001; Gunn et al. 2002). Even though the location of calving grounds is fairly predictable (Figure 8.2-6), the winter range can vary considerably (Figure 8.2-1), so migration routes to the calving grounds can vary from year to year (Figures 8.2-2 to 8.3-5). These changes in migration routes could contribute to the annual variation in numbers observed within the study area.

The caribou aerial survey was designed to identify trends in annual caribou abundance in the EKATI study area during mine development and operation. Results may reveal a negative or positive correlation between increasing mine development and caribou numbers, but this does not necessarily prove a causal relationship between mine activity and caribou abundance in the study area. In light of the limitations in the data, caution must be used when interpreting annual caribou counts in response to mine effects.

Despite some of the limitations of aerial survey data, it is possible to identify spatial and temporal trends in the study area. The 2009 total caribou count was the highest recorded since 1999, and the second highest recorded over the 13 years of the survey (except 1997); therefore, it appears that large groups of caribou are still using the EKATI regional area in numbers comparable to those seen in the post 1997 years of mine development.

Peaks in caribou numbers during the 2009 summer dispersal and post-calving migration were 541 (July 25) and 2,495 (September 26), respectively. The timing of the peaks in numbers during early and late migration in 2009 occurred within the range of dates observed since 1997. Peaks in migration may be hard to identify if caribou are moving to the calving grounds in smaller groups, rather than in the larger numbers seen in previous survey years.

During the past 13 years, the number of caribou counted within the EKATI study area has varied weekly and annually. Weekly aerial surveys provide a limited picture of the total number of caribou within the study area. Large herds in the study area are potentially missed if they are not observed within the surveyed transects during the brief weekly or bi-weekly window when surveys are conducted. The tendency for caribou to migrate in large, temporally discrete groups means that large groups of individuals could have been missed. Because of the high mobility and clumped spatial and temporal distribution of caribou across the study area, weekly counts provide limited estimates of caribou abundance in the study area.

8.3.1.2 Caribou and Roads

Data from road surveys collected between 2001 and 2010 suggest that single animals may be more likely to use roads than groups. The use of roads may provide easy terrain for energy efficient movement of caribou, relative to surrounding tundra (Banfield 1974; Stuart-Smith and James 1996; Forman and Alexander 1998). Roads could also provide a refuge from insect harassment (Forman and Alexander 1998), which is likely more pronounced in the surrounding lower wet tundra areas that experience relatively less wind exposure. Furthermore, pioneer plant species that invade disturbed roadside habitat may offer preferred grazing for caribou (Forman and Alexander 1998).

Snow track surveys suggest that Misery Road may be acting as a barrier to caribou movement during late winter and the northern migration period. Characteristics that appeared to influence road permeability included height of snow banks at the edge of the road, group size, and year. Elevated roads or roads with snow banks that present visual barriers to caribou are known to deflect caribou movement (Wolfe et al. 2000). Data from EKATI suggest that caribou were deflected from the road when the mean snow bank was 1.6 m high, but crossed the road when the mean snow bank height was 0.5 m.

A camera monitoring program was initiated in 2011 as a potentially more effective means to monitor on-site activities of caribou (and other wildlife) and their interactions with mine infrastructure, in conjunction with concurrent behavioural surveys. Cameras provide 24-hour coverage and remove observer bias associated with visibility or unknown track fate. In one season of camera monitoring, there were more observations of wildlife events near the road than nine years of snow track surveys. In 2011 (and again in 2012), camera monitoring began in June, missing the northern migration. In 2013, the plan is to deploy the cameras between April 1 and October 31 to ensure that all periods of wildlife activity can be captured by the cameras.

The camera monitoring program is not designed to address questions associated with relative distribution or avoidance or to contribute to a broader understanding of the zone of influence. These questions are broader in scale and are best examined using satellite collar data. The cameras are specifically intended to examine the responses of caribou (and other wildlife) to roads and mine infrastructure when animals are already on site. In conjunction with intensive focal and scan behavioural surveys, the expectation is to generate information regarding the state of animals that are on-site and how that might contribute to broader population dynamics. Data collected in 2011 suggest remote camera photography can be an effective means to document wildlife activity at the mine site to address some finer scale questions. Initial results do suggest that Misery Road may not be acting as a barrier to wildlife movements during the snow-free periods. In addition, for those individuals observed deflected by the road in some manner, it appeared that animals may travel along the road until they find an alternate suitable crossing point nearby.

8.3.2 Carnivores

The results of DNA-based population estimates for wolverines and grizzly bears conducted in the EKATI area have been positive and contribute to regional trend studies.

Boulanger and Mulders (2008) found that wolverine DNA sampling was successful in estimating population size, trend, and demographic parameters of wolverine populations. The results of the DNA study suggest that the large scale trend of lower numbers of males may be due to several factors (Boulanger and Mulders 2008). The study further suggested that mining activities were not one of the factors related to changes in wolverine populations (i.e., similar trends were found in all sampling grids including a control site with no mining activity).

Potential impacts to barren ground grizzly bears associated with mining activities are assumed to be minimal, but without detailed information about population status, testing this assumption is difficult. Recommendations from regulators and monitoring agencies at a technical workshop held on June 28, 2010 and from communities at a workshop held on October 5 and 6, 2010 included that the mining industry collaborate together on a large scale regional grizzly bear program to assess population status and monitor trends over the long term. In response, the three diamond mining companies (BHP Billiton, Rio Tinto Canada, and De Beers Canada) operating in the central barrens of the NT have agreed to work together on a large scale, long-term grizzly bear DNA mark-recapture program.

While site-specific activities such as waste management, recording of incidental sightings, and deterrent efforts will continue at each project location, the objective of the regional program is intended to supersede other regional objectives such as determining zone of influence. The population data collected will be provided to the GNWT ENR to assess cumulative impacts, and contribute to their grizzly bear management plan. The regional program commenced in 2012. Specifically, the objective of the grizzly bear DNA program is to:

- Determine if mine mine-related activities influence the relative abundance and distribution of grizzly bears over time.

Two separate study areas have been delineated; a northern study area in the Lac de Gras region (coordinated by BHP Billiton and Rio Tinto Canada) and a southern study area in the transition zone north of tree line (coordinated by De Beers Canada). The designation of two study areas considers that both regions are likely to differ significantly in grizzly bear density, and sampling will be conducted in alternate years. A grid pattern consisting of 12 x 12 km cells will be used. In the EKATI-Rio Tinto Canada study area, the 12 x 12 km grid consists of 113 cells (about 16,000 km^2). A study area of approximately 30,000 km^2 is being proposed, which will be shared collectively amongst the three diamond mine companies.

8.3.3 Breeding Birds

Surveys for tundra breeding birds began in 1996, with five control plots and six mine plots. Uncertainty in the tundra breeding birds monitoring data at EKATI was a risk identified by BHP Billiton, and in response the survey effort for breeding bird surveys increased as the footprint of the mine expanded and additional survey plots were added to the study. Since 2003, there have been 10 control and 11 mine sites surveyed annually.

In 2005 and 2006, the IEMA recommended that the tundra breeding bird survey could be reduced in frequency to every second year at EKATI (IEMA 2005). BHP Billiton decided to continue the annual monitoring program from 2005 through 2008 because the tundra breeding bird study is one of the most rigorous monitoring components of the WEMP. A valuable long-term data set has been amassed through this work and results of this study have been published in the scientific literature (e.g., Smith et al. 2005). After consultation with the GNWT ENR and other stakeholders in 2008, the tundra breeding bird spring surveys were terminated in 2009.

The goal of the breeding bird survey at EKATI was to document the presence of tundra breeding bird species in the EKATI study area. The objectives of the Breeding Bird Monitoring Program were to:

- determine if there has been a change in the overall species density, richness, diversity, and equitability of all species in the tundra breeding bird community from 1996 to 2008;
- determine if there has been a change in individual species densities from 1996 to 2008; and
- identify species of conservation concern breeding in the EKATI study area.

A summary of the results from the 13-year Breeding Bird Monitoring Program, conducted from 1996 to 2008 at EKATI, was completed in 2010 (Report 21). The long-term results indicated that there was an observed trend in changes to breeding bird abundance and diversity at EKATI (Plate 8.3-1; Figure 8.3-1).

a) American Golden Plover

b) Lapland Longspur

c) Rock Ptarmigan

Plate 8.3-1. Tundra breeding bird species observed at EKATI.

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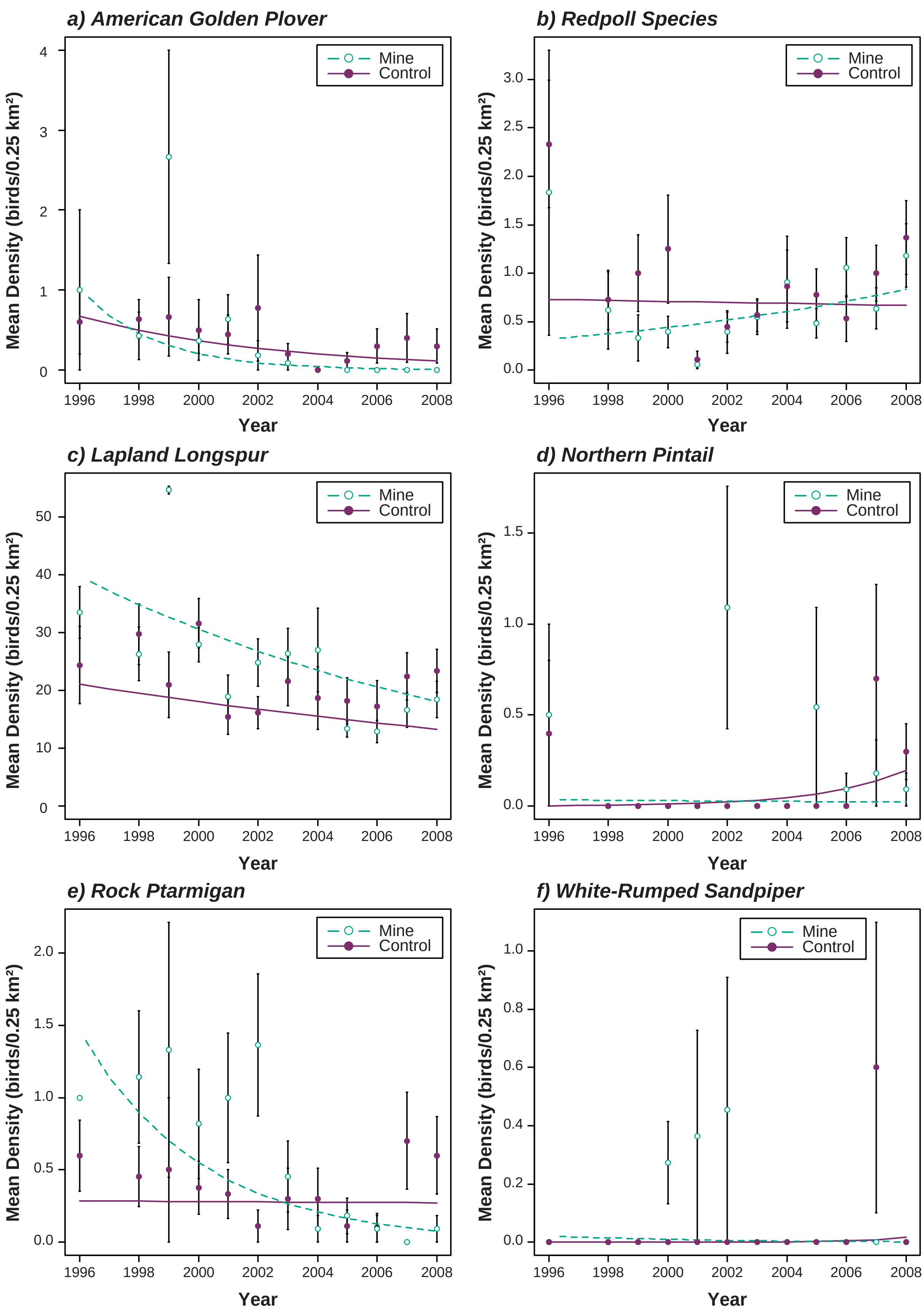

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Individual Bird Species with Significantly Different Mean Densities and Different Trends at Mine and Control Plots Over Time (1996 to 2008)

Figure 8.3-1

Data from long-term breeding bird surveys identified some trends in breeding bird abundance and diversity at EKATI (Plate 8.3-1; Figure 8.3-1). Redpoll species (hoary redpoll and common redpoll) have increased near the mine over time, while populations have remained relatively stable at control sites. Redpoll species may have benefited by alterations that occurred on the mine sites, such as reductions in species they compete with or increased preferred forage on site. Furthermore, redpoll species may be more successful at utilizing human-modified habitats such as buildings for nesting. For example, both common and hoary redpolls were more often observed at human-influenced habitat (e.g., town sites) then in natural habitat (e.g., shore and tundra) in Nunavut (Staniforth 2002).

For the three species that declined over time near the mine (American golden plover, Lapland longspur, and rock ptarmigan), determining the ultimate cause for the observed declines is challenging as there may be complex interactions occurring due to anthropogenic or natural effects. Human disturbance may reduce breeding success (Bechet et al. 2004) or have more subtle effects on bird behaviour and physiology (Berger 1992; Burger and Gochfeld 1999, 2001). The ability to adapt and habituate to disturbance is likely species-specific (Scott et al. 1996; Conomy et al. 1998; Fitzpatrick and Bouchez 1998).

Arctic areas have experienced climate change in recent decades, which may be influencing the distribution and behaviour of tundra breeding bird species in the EKATI study area (Wormworth and Mallon 2006). Impacts to Arctic life associated with a changing climate, such as rising temperatures and precipitation, and a reduction in snow cover, are expected to be significant (Tulp and Schekkerman 2008). Potential effects of climate change on tundra breeding birds include earlier egg laying, change in migration times (earlier arrival dates and delayed fall migration departures), shifts in distribution to higher latitudes and/or altitudes, and possible changes in community structure (Wormworth and Mallon 2006). Anthropogenic development may attract or augment certain nest predators, increasing local nest predation (Haskell et al. 2001; Marzluff 2001). The influence of subsidized nest predators may extend beyond infrastructure because the key predators involved, such as foxes or common ravens, are highly mobile (Eberhardt et al. 1982; Poole et al. 2003). If predator distribution and abundance is sufficiently altered by human activity, productivity of tundra birds could be affected at a regional scale (Liebezeit et al. 2009). However, any increase in predation pressure is likely to be ubiquitous and not specific to a few species.

Overall, human disturbance of wildlife is significant when survival or fecundity is affected, possibly causing population declines. It is important to know whether avoidance of disturbance does in fact result in population change (Sutherland 1996, 1998; Gill and Sutherland 2000). A strong negative response to disturbance (e.g., American golden plover, Lapland longspur, and rock ptarmigan at EKATI) could in fact be the result of individuals of these species moving to alternative suitable habitat that might be available elsewhere.

8.4 ENVIRONMENTAL RISKS AND MANAGEMENT

8.4.1 Caribou Migration Routes

As indicated in Section 8.3.1.1 there is a complex interaction among habitat conditions, caribou foraging, and movement patterns that can result in periodic range shifts and large caribou population fluctuations. Thus one of the key risks identified by BHP Billiton, stakeholders, and regulators is that avoidance of mine activities and/or mine infrastructure may be related to the observed changes in movement patterns during migration. The resultant changes in migration routes could contribute to the annual variation in numbers observed within the study area.

To address the risk of changes in caribou migration routes, BHP Billiton has implemented a long-term monitoring program that has been improved upon throughout operation. BHP Billiton's WEMP includes several studies of the Bathurst caribou herd as it moves through the EKATI study area to measure the potential effect of the mine on caribou. The caribou aerial survey, completed between 1997 and 2009, was designed to identify trends in annual caribou relative distribution in the EKATI study area during mine development and operation. Aerial surveys will again be completed in 2012. In addition studies that incorporate ground-based monitoring by WEMP Wildlife Technicians and by BHP Billiton staff are completed yearly. As a result of the regional nature of caribou migration, BHP Billiton also has participated in government regional studies and workshops to improve on monitoring caribou and examine opportunities to synchronize monitoring with other mines and government. Community site visits are completed regularly to share caribou monitoring knowledge and address improvements to monitoring at EKATI. BHP Billiton continues to seek improvements to its caribou monitoring and contributions to understanding mining impacts on caribou populations. Many of the recommendations from the technical and community workshops have been incorporated into the 2012 WEMP and will continue on into future years.

8.4.2 Caribou Interaction with Roads

BHP Billiton has also identified roads acting as barriers as a key risk for caribou, which can change their movement patterns around the mine site. In addition, caribou injuries and mortalities may occur as a result of vehicle interactions.

Several mitigation and management strategies have been adopted at EKATI to prevent roads from acting as barriers to caribou movement and to prevent caribou from being injured as a result of vehicle encounters (Table 8.4-1).

Table 8.4-1. Management of Caribou Interactions with Roads

Issue	Mitigation Measure(s)	Results of Mitigation
Roads acting as barrier to caribou movement	• Adding caribou crossing signs in areas of high quality habitat or established caribou trails. • Roads are closed to traffic when large herds of caribou are located near the mine. • Misery Road surface height was constructed close to surrounding land surface to facilitate easy access for caribou to roadways. • Designing roads that have low side slopes and low banks to facilitate caribou crossing. Many rock berms at EKATI are built to adhere to the NT *Mine Health and Safety Act* (1994) requirements. EKATI is currently reviewing the construction and placement of Misery Road berms. The goal of this review is to explore options to minimize caribou deflections from the road while still maintaining compliance with the *Mine Health and Safety Act* (1994). • Working with elders to monitor caribou movement and use TK to develop accessible roads.	• Results from the first year of camera monitoring suggest that Misery Road may not be acting as a barrier to wildlife movements, at least during the snow-free periods.

(continued)

Table 8.4-1. Management of Caribou Interactions with Roads (completed)

Issue	Mitigation Measure(s)	Results of Mitigation
Caribou interactions with vehicles	• Wildlife always has the right-of-way. • Speed limits are posted and enforced; speed limits are 60 km/h along haul roads, 20 km/h around the Main Camp, and 40 km/h along other roads. • Signs are posted at constructed caribou crossings. • Roads are closed to traffic when large herds of caribou are located near the mine. • Vehicles encountering wildlife on roads are required to communicate the presence of wildlife on the road(s) to the EKATI Environment Department and others in the area.	• There have been no vehicle- or aircraft-related caribou deaths reported as a result of collisions.

Some strategies have been more successful than others and have been adopted as regular ongoing practices at EKATI (Table 8.4-1). For example, road closures are regularly implemented when large herds of caribou are located near the mine.

Noise (e.g., vehicle noise) has the potential to influence caribou behaviour and should be considered in environmental monitoring programs. Stopping traffic when large groups of caribou are migrating through the area reduces noise and other sources of disturbance at times when they are likely to affect large numbers of individuals.

Several mitigation measures have been implemented at EKATI to address the effects of roads and road traffic on caribou movement patterns (Table 8.4-1). A significant addition to the WEMP was the deployment of 70 motion sensor wildlife cameras to monitor the interaction of wildlife with mine infrastructure, with a particular focus on Misery Road. Cameras were also placed along the pigeon spur road that connects the Pigeon Test Pit to the LLCF. The camera program is intended to replace the caribou on roads and the snow track surveys, both of which have provided limited data with respect to wildlife distribution along, and interaction with, roads.

8.4.3 Ability to Detect Changes in Carnivore Populations

BHP Billiton recognized that monitoring information on carnivores, particularly wolverines and grizzly bears, contained uncertainty related to the incidental observations and sign surveys. This risk to BHP Billiton's ability to detect changes in carnivore populations related to mine activities was brought forward in the previous version of the EIR. A cooperative DNA study with the GNWT ENR was undertaken in 2005-2006 and again in 2010-2011 in order to monitor wolverine density, abundance, and movement on a regional scale.

In 2010, EKATI explored the feasibility and logistics of a DNA grizzly bear hair snagging study by establishing a pilot grid of eight 10 x 10 km cells surrounding EKATI. This was expanded to 13 cells in 2011. To maximize capture probabilities, site locations were based on seasonal habitat suitability models, and barbed-wire tripods (Plate 8.4-1) were relocated between sessions. Different scented lures (combinations of commercial bear bait, fish oil, beaver castor, anise oil, and vanilla extract) were tried during each session.

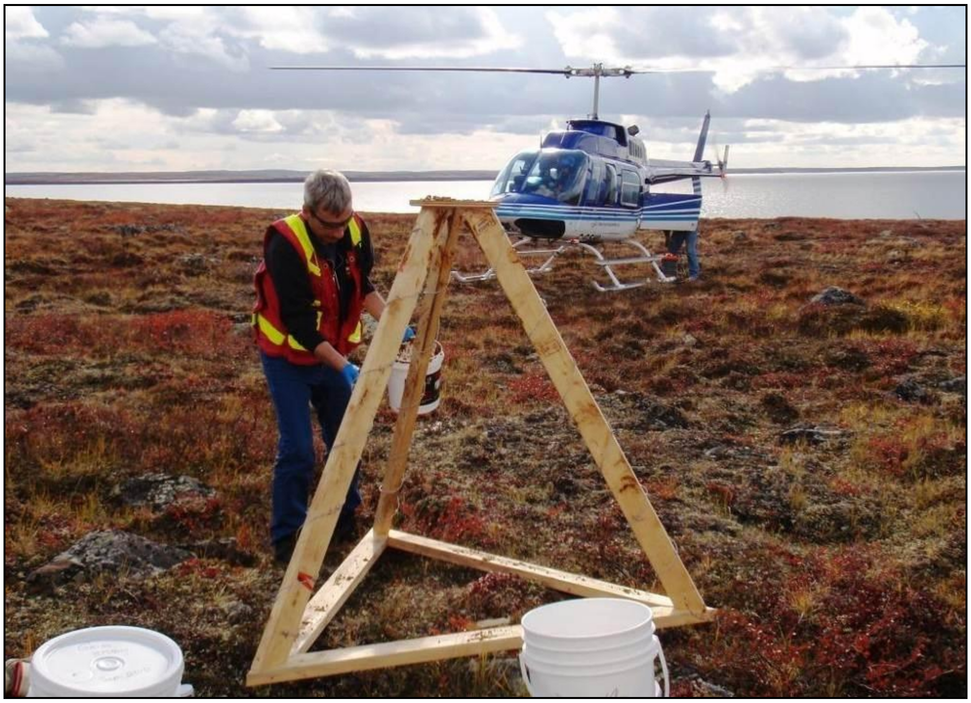


Plate 8.4-1. Example of barbed wire tripod used to snag grizzly bear hairs during EKATI pilot DNA study.

A DNA-based population study for the EKATI region was found to be feasible, and would provide sufficient samples for analysis (see Section 8.3.2). Similarly with the monitoring of caribou, regulators, monitoring agencies, and communities have requested that EKATI and Diavik collaborate on grizzly bear studies to increase the effectiveness of tracking impacts of mining activities on grizzly bear populations. In 2012-2013, Diavik and EKATI plan to collaboratively implement a long-term and large-scale regional grizzly bear DNA program covering an area of approximately 16,000 km^2 in the Lac de Gras region between Mackay Lakes and the Nunavut border.

In 2012, twenty motion sensing cameras were also placed near the bear posts to capture bear behaviour as they interacted with the posts and other incidental wildlife in the area. These additional observations are intended to correlate pictures of animals visiting the posts with DNA samples to quantify biases in the final population estimate. For example there may be cases when an individual visits a post (and is captured on camera) but does not leave hair. In addition the additional photos will allow better analysis of sub-sampling procedures if/when more than one bear visits a post. The photos can also provide additional information on family groups i.e., cubs may scratch the post but generally don't leave much hair behind.

8.4.4 Caribou Interactions with Mine Activities and Infrastructure (Other than Roads)

Where possible, caribou are deterred from interacting with mine infrastructure and/or mine activities; however, there still exists risks to caribou while travelling through the site.

Several mitigation and management strategies have been adopted at EKATI to prevent caribou from being injured as a result of mine infrastructure and/or mine activities (Table 8.4-2).

The interaction between wildlife and aircraft at the EKATI airport was identified as a high risk event. An airport fence was constructed with the intent of preventing harmful interactions—protecting planes during landing procedures and re-directing migrating wildlife around the runway (Table 8.4-2).

Although effective in protecting aircraft, several caribou were discovered to have become entangled in the fence itself. In response to the mortalities associated with the electric fence in 2009, BHP Billiton painted the tops of fence posts a bright colour to provide a greater colour contrast and initiated a comprehensive fence surveillance program, which was conducted by the EKATI Environment Department.

Table 8.4-2. Management of Caribou Interactions with Mine Activities and Infrastructure

Issue	Mitigation Measure(s)	Results of Mitigation
Interaction of caribou and aircraft landing/taking off	• A fence was constructed around the EKATI Airport to prevent caribou access. • Airstrip inspections for wildlife are completed prior to take-off and landing of all aircraft.	• The fence has been modified several times in response to field observations that it was an unsuccessful deterrent (i.e., in 2001, caribou reportedly gained access to the airstrip on several occasions), and this resulted in caribou mortalities due to interactions with the electric fencing. Following installation of a heavy weight orange barrier fence around the airstrip in 2010 no issues were identified and animal tracks were observed to be directed around the airport. Recent observations indicated that the airport fence was not entirely effective at keeping caribou off the airport/airstrip thus the height of the fence will be extended in target areas. • There have been no caribou mortalities as a result of aircraft collision.
Caribou interactions with mine infrastructure	• Areas of high risk (e.g., Pigeon Bulk Sample Pit, Beartooth Pit) have a heavy weight orange barrier fence to deter caribou. • An Inuit Elders Advisory Committee visits EKATI annually to monitor wildlife interactions with the mine and develop and test mitigation strategies for minimizing conflict between the wildlife and the mine with a special focus on roads. • Inokhoks (traditional rock structures) are placed at intervals around the airstrip, Beartooth Pit, Fox Pit, and other potentially hazardous mine structures to deter caribou from these areas. • Guy wires on site were secured and removed if deemed unnecessary. • In support of LLCF reclamation research, a wildlife and human health risk assessment of the potential risks to wildlife and human receptors exposed to metals from the LLCF was completed.	• Other than the airstrip fencing, there has been limited interaction of caribou and mine infrastructure since the mine's opening. Incidents that do occur are reported annually in the WEMP. • There have been no documented cases of caribou falling into mine structures. • In 2005, there was a single incident of a caribou becoming entangled in support guy wires of a tower, and the caribou was successfully freed after some of its antlers were cut off.

A new strategy was attempted in 2010 with the construction of a new airport runway fence. Based on a test section and community consultation, BHP Billiton erected a heavy weight orange barrier fence around the airstrip (as well as the Pigeon Test Pit) as an alternative to deterring wildlife. The fence was erected in August 2010 and is monitored as part of the WEMP. The new design features a heavy grade orange plastic fencing material that is 1.3 m high with a 5 cm diamond shaped mesh. The new fencing was intended to deter wildlife, while providing additional protection to wildlife. It is believed this plastic fence will not become entangled with antlers, but should this occur, it will break and the animal will be able to escape without harm. Recent observations indicated that the airport fence was not entirely effective at keeping caribou off the airport/airstrip. Therefore during the winter of 2012, BHP Billiton will extend the height of the fence in order to further reduce the likelihood that caribou will jump the fence. Observation made by the wildlife technicians indicated that caribou only jumped the fence in areas where their head was completely above the height of the fence. These areas have been targeted for priority fixes.

As indicated in Section 8.4.2, motion sensor wildlife cameras to monitor the interaction of wildlife with mine infrastructure have been installed on fences and Inokhoks designed to deter caribou.

Northern communities have raised concerns that the health of wildlife (and subsequently humans) could potentially be affected by the ingestion of metals in PK. In support of LLCF reclamation research, a wildlife and human health risk assessment of the potential risks to wildlife and human receptors exposed to metals from the LLCF was completed (Rescan 2006b). Potential risks to wildlife receptors were evaluated by comparing the estimated daily intake of metals for each wildlife receptor to toxicity benchmark values. Exposure pathways identified for caribou included direct route from ingestion of soil-amended processed kimberlite as well as indirectly from vegetation. Acceptable risks were predicted for wildlife receptors at the individual and population level from exposure to all evaluated metals, except aluminum and magnesium.

Further research on metals bioaccumulation will be conducted as part of BHP Billiton's Reclamation Research Plan. Specifically, a future Human Health and Ecological Risk Assessment (HHERA) is planned, as per the ICRP approved by the WLWB. The HHERA will assess both contaminant pathways (ingestion via vegetation and direct ingestion of FPK) based on site-specific information collected through the Cell B Reclamation Pilot Study. The results of the pilot study will more closely represent the future-vegetated scenario.

In addition to the reclamation research, an increase to the frequency of wildlife surveys in the LLCF will commence in 2012 to ensure a better understanding of wildlife activity as reclamation activities progress.

8.4.5 Habituation of Carnivores

Habituation of carnivores to the presence of humans was indicated as a potential effect in the 1995 EIS and continues to be a key risk to both carnivore populations and humans that BHP Billiton is managing (Table 8.4-3).

Continuing to actively deter wildlife away from the mine site will minimize the potential for habituation. Dead animals (from carnivore kills) are moved away from roadways and camps to prevent attraction of carnivores and scavengers to roadways and camp sites.

Carnivore incidents began to be recorded in 2001; the incidents mostly involved wolverine and fox encounters at Misery and EKATI camps. In 2002, improvements to incidental reporting procedures were made to include observations of interesting or unusual wildlife-mine interactions. Other improvements implemented in 2002 included the development of a formal procedure and reporting system to provide details of wildlife incidents to government, regulatory agencies, and other stakeholders (via email) immediately after the occurrence of an incident. This reporting system allowed for consultation with the GNWT ENR. In 2004, the reporting system became more specific in what qualified as an incident.

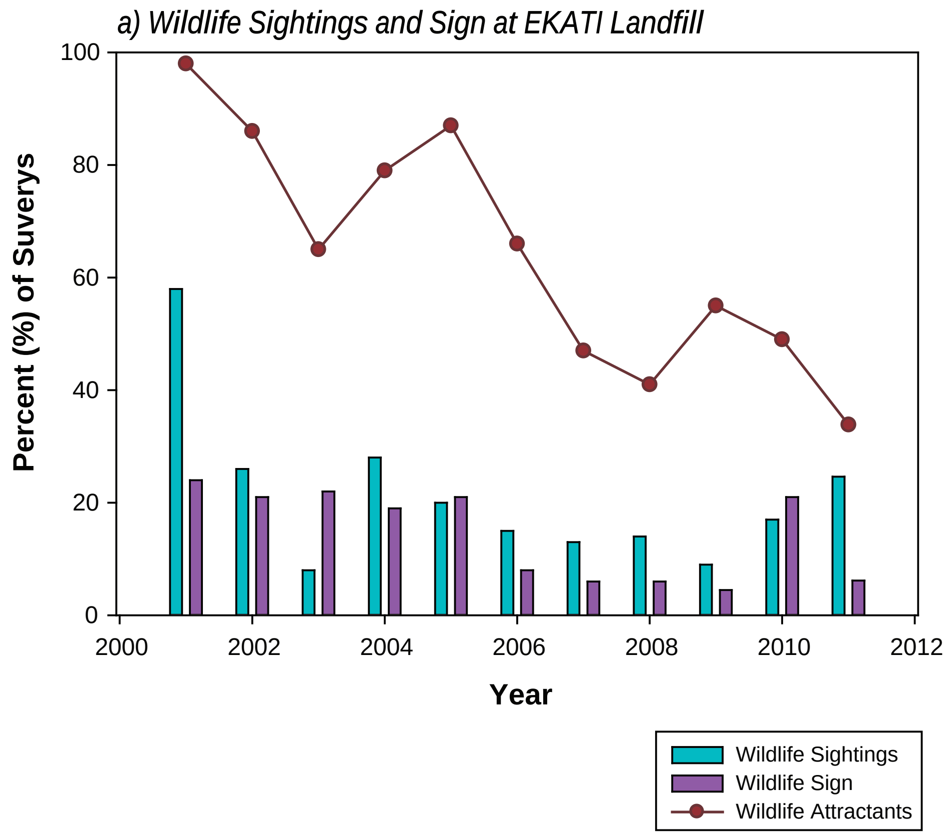
Table 8.4-3. Management of Carnivore Interactions with Mine Activities and Infrastructure

Issue	Mitigation Measure(s)	Results of Mitigation
Carnivore interaction with mine infrastructure and employees	• Dead animals (from carnivore kills) are moved away from roadways and camps. • Carnivore incident recording beginning in 2001 with formal procedures and improvements made in 2002 and 2004. • Annual building skirting inspection. • Beginning in 2011 there was an increased reliance on monitoring before making a decision to actively deter an animal	• Recent observations (2009 to 2011) suggest animals are being diverted away from buildings as a result of all openings being repaired during regular skirting inspections. • There was a marked reduction in carnivore incidents in 2011. For example, there were seven incidents in 2011 compared to 70 in 2010.
Habituation of carnivores to humans	• Waste management procedures, site awareness (e.g., closing doors), and wildlife interactions continue to be a part of the orientation that new employees receive. • Incinerator enclosure and frequent burning of camp waste were implemented. • Juice boxes are no longer used. • Signs have been added in lunchrooms and additional labels have been added to waste bins to facilitate proper waste sorting and disposal. • Employee education on waste management practices and issues surrounding habituation has been increased. • Increased frequency of inspections of landfill sites and waste storage areas.	• Monitoring of waste bins and landfills during the 2009, 2010, and 2011 WEMP monitoring years indicates that progress in waste management continues to be made.

A further improvement made after 2005 was the introduction of the Accommodations Skirting and Wildlife Inspections Form. Because many of the wolverines observed in 2005 were found to be accessing areas underneath buildings, a chain-link fence was erected along the base of buildings at both the EKATI and Misery camps to prevent wildlife access. In 2006, an inspection program was initiated to monitor whether skirting was successful in restricting wildlife access to buildings and to look for the presence of animal tracks around buildings. This building skirting inspection program was continued in 2009, 2010, and 2011.

The continuation and implementation of BHP Billiton's waste management education and awareness programs will also help minimize the occurrence of wildlife attractants on site. Waste management procedures, site awareness (e.g., closing doors), and wildlife interactions continue to be a part of new employee orientation to the mine site via a separate wildlife video module.

Monitoring waste bins and landfills during the 2009, 2010 and 2011 WEMP monitoring years indicated that progress in waste management continues to be made (Figure 8.4-1). The percentage of surveys detecting food packages at the EKATI landfill has been highly variable (Table 8.4-4). Improper disposal of waste is an ongoing challenge that BHP Billiton takes very seriously. This issue continues to be addressed through regular employee education efforts that stress the dangers posed to wildlife and personnel from improperly discarded waste. Beginning in 2010, new employee orientation included a new video module (Environmental Awareness) focusing on wildlife and waste management practices. All existing employees were also required to view this new module. Continued education and waste management awareness, particularly on disposal of cigarettes and cigarette packages, will continue to minimize the amount of misdirected waste.



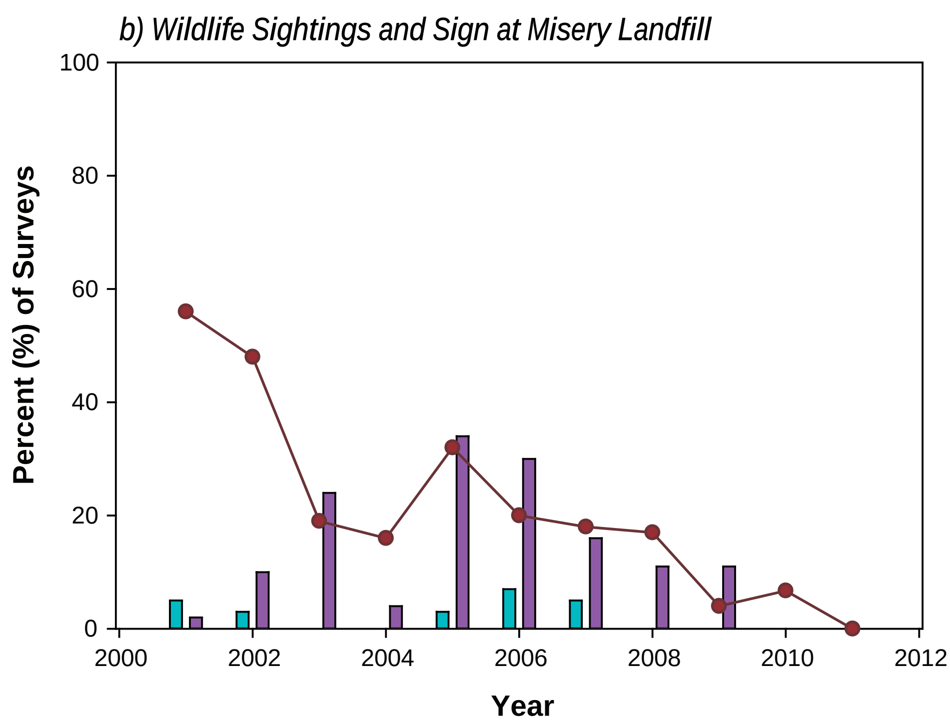


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Figure 8.4-1

Wildlife Sightings and Signs Observed at the EKATI and Misery Landfills, 2001 to 2011

Table 8.4-4. Percent of Surveys that Yielded Attractants or Misdirected Waste at the EKATI and Misery Landfills, 2000 to 2011

	2000[a]	2001	2002	2003	2004[b]	2005	2006	2007	2008	2009	2010	2011
EKATI	95%	98%	86%	65%	79%	87%	66%	47%	41%	55%	46%	68%
(total no. of surveys)	(35)	(45)	(42)	(91)	(47)	(84)	(74)	(85)	(81)	(67)	(52)	(65)
Misery	-	56%	48%	19%	16%	32%	20%	18%	17%	4%	7%	0%
(total no. of surveys)		(43)	(40)	(21)	(25)	(65)	(56)	(38)	(64)	(27)	(15)	(12)

Note: Winter Landfill surveys began in 2002; Misery Landfill did not exist in 2000.
[a] *Includes only food items.*
[b] *Winter surveys not included.*

A decrease in the numbers of wildlife observations (wildlife and wildlife signs) at the EKATI and Misery landfills also suggests that waste management practices implemented by BHP Billiton have been effective (Figure 8.4-1). Observations of wildlife, wildlife signs, and attractants at the Misery Landfill have decreased continually since 2005. With the increased activity at Misery Camp and Pit, surveys of the EKATI Landfill will increase in 2012. The Misery Landfill ceased operating in September 2011, and waste is currently being trucked to the EKATI Landfill.

8.4.6 Breeding Bird Interactions with Mine Activities and Infrastructure

Although monitoring of tundra breeding birds at EKATI has revealed minimal effects of the mine on densities and breeding (see Section 8.2.3), some risk to birds still exists. A number of birds are killed each year by vehicles at the mine site. Management strategies to reduce vehicle-related mortalities of mammals also protect birds, e.g., speed limits.

An apparent increase in waterfowl mortalities in fish boxes was observed prior to 2005; however, since 2005, no waterfowl mortalities have been observed at the fish boxes. No mitigation techniques can be applied to fish nets; however, checking nets regularly should limit the possibility of waterfowl encroaching on nets. In 2005, BHP Billiton improved the fish boxes by placing mesh over the box to just below the water line. The mesh prevents the birds form entering the boxes. No by-catch of waterfowl in fish boxes was observed after the mesh was placed over the boxes in 2005.

Birds continue to use mine infrastructure as nesting sites. Removal of early stage nests (e.g., nests without eggs) took place in some cases to prevent nesting activity in hazardous areas (these were conducted with the approval of the GNWT ENR). Nests on mine infrastructure with eggs or chicks have not been destroyed. BHP Billiton has found that employee education in communicating nesting activity has been the best strategy to address potential impacts to birds nesting on mine infrastructure. Education and awareness programs at EKATI include site-wide presentations and posters aimed at increasing the awareness of BHP Billiton staff to the presence of birds at EKATI and potential concerns regarding effects of pit activities on the birds.

A formal monitoring and reporting program for bird nesting activity along pit walls was initiated in 2004 and has continued through 2011. Pit walls were monitored on an informal and largely incident-based capacity prior to 2004. Beginning in 2006, the Fox Fuel Farm and Long Lake Road power poles were also monitored for bird nesting activity. Removal of early stage nests (e.g., nests without eggs) took place in some cases to prevent nesting activity in hazardous areas (these were conducted with the approval of the GNWT ENR). Again, continued documentation of bird use of pit walls and employee education to ensure minimal disturbance of nest sites has been successful in minimizing impacts.

8.5 SUMMARY AND CONCLUSIONS

8.5.1 Key Environmental Risks

Looking forward, the greatest risks for wildlife VECs are the risks to caribou populations as a result of changes in migration routes and from interactions with mine infrastructure and activities, as well as the risks associated with uncertainty in monitoring carnivore populations (Table 8.5-1). Caribou herds are a key public concern and BHP Billiton will continue to provide site-specific information relevant to regional work. When possible, collaboration with Diavik will better address the overall impacts of mining on caribou populations (e.g., integrated methodology for behavioural and other ground-based surveys).

Collaborative work with the GNWT, communities, and monitoring agencies on the carnivore monitoring programs continue; this collaboration is intended to address the uncertainty in program objectives and implementation. BHP Billiton's participation in DNA studies has produced useful results, and it is anticipated that future work will provide improvements in the ability to detect mine impacts on carnivore populations (Table 8.5-1).

8.5.2 Looking Forwards

BHP Billiton has participated in several workshops and technical discussions in support of revising the current EKATI WEMP. As part of the overall wildlife monitoring review process, a workshop attended by representatives of three operating diamond mines (EKATI, Diavik, and Snap Lake), governments, monitoring agencies and communities was held in Yellowknife in September, 2009. Each mine discussed results from this workshop with communities and a joint response to recommendations from the workshop was issued on June 16, 2010.

On June 28, 2010 a technical workshop was conducted to obtain recommendations from regulators and monitoring agencies to improve wildlife monitoring. The purpose of this meeting was a focused technical discussion of proposed revisions to the existing wildlife monitoring programs. Outcomes from the meeting included specific recommendations and considerations for the mining companies to consider incorporating in the objectives, design, and methods of their monitoring programs, with an interest in standardizing approaches across all the mines. Attending the June technical workshop were representatives from the three diamond mines, monitoring agencies (Environmental Monitoring Advisory Board, IEMA, and Snap Lake Environmental Monitoring Agency), the GWNT ENR, and the Yellowknives Dene First Nation.

A community workshop held on October 5 and 6, 2010 was the culmination of this wildlife monitoring review process. In preparation for the community workshop, a site visit to the EKATI and Diavik mines was arranged for September 16 and 17, 2010. The purpose of the visit was to allow community representatives to see the mine sites and learn about the wildlife monitoring programs. As part of their commitment to the environment, the mines are mandated under their environmental agreements to incorporate available TK into environmental monitoring programs. The community workshop was another opportunity for community representatives and TK holders to have input on proposed changes before the mines began preparing their 2011 wildlife monitoring permit applications. The main objectives of the community workshop was to discuss the use of TK in monitoring wildlife. Present at this meeting were representatives from the Tlicho Government, Yellowknives Dene First Nation, North Slave Metis Alliance, KIA, and the Lutselk'e Dene First Nation. Representatives were nominated to attend by their respective organizations.

Table 8.5-1. Key Environmental Risks for Wildlife

Caribou Migration Routes
Management • Collaboration with Diavik and government agencies to assess migration routes. • Participate in regional studies and workshops to improve on caribou monitoring and examine opportunities to synchronize monitoring with other mines. • Community site visits to share knowledge of the caribou monitoring and address monitoring improvements.
Residual Risk • Caribou avoidance of mine.
Future Actions • Continue monitoring in collaboration with Diavik (incidental observations). • BHP Billiton will take part in future GNWT ENR management plans.
Caribou Interaction with Roads
Management • Wildlife always has the right-of-way on roads. • Speed limits are posted and enforced. • Signs are posted at constructed caribou crossings. • Roads are closed to traffic when large herds of caribou are located on or adjacent to roads near the mine. • Vehicles encountering wildlife are required to communicate the presence of wildlife on roads. • Construction of caribou crossings. • Misery road surface height was constructed close to surrounding land surface to facilitate easy access for caribou to roadways. • Designing roads that have low side-slopes and low banks to facilitate caribou crossing. Many rock berms at EKATI are built to adhere to NT *Mine Health and Safety Act* (1994) requirements. • Working with Elders to monitor caribou movement and use TK to create accessible roads.
Residual Risk • The roads may act as a barrier to caribou movement and as a result deflect caribou and change their movement patterns. • Caribou injuries and mortalities as a result of vehicle interactions.
Future Actions • A significant addition to the WEMP was the deployment of 70 motion sensor wildlife cameras to monitor the interaction of wildlife with mine infrastructure, with a particular focus on Misery Road. The camera program is intended to replace the caribou on roads and the snow track surveys, both of which have provided limited data with respect to wildlife distribution along and interaction with roads. • EKATI is currently reviewing the construction and placement of Misery Road berms. The goal of this review is to explore options to minimize caribou deflections from the road while still maintaining compliance with the *Mine Health and Safety Act* (1994).
Ability to Detect Changes in Carnivore Populations
Management • BHP Billiton recognized that monitoring information on carnivores, particularly wolverines and grizzly bears contained uncertainty related to the incidental observations and sign surveys. • This risk to BHP Billiton's ability to detect changes in carnivore populations related to mine activities was brought forward in the previous version of the EIR. • In collaboration with the GNWT ENR, a DNA-based study was initiated in 2004 to better track wolverine population abundance. The study was undertaken in 2005-2006 and in 2010-2011 in order to monitor wolverine density, abundance, and movement on a regional scale. • In 2010 and 2011 BHP Billiton explored the feasibility and logistics of a DNA Grizzly based study to address concerns of monitoring grizzly bear populations in response to mine activities.

(continued)

Table 8.5-1. Key Environmental Risks for Wildlife (continued)

Ability to Detect Changes in Carnivore Populations *(cont'd)*

Residual Risk

- The EKATI-specific monitoring program of grizzly bear populations would not be representative of actual grizzly bear populations.

Future Actions

- In 2012-2013, Diavik and EKATI plan to collaboratively implement a grizzly bear DNA program covering an area of approximately 16,000 km^2 in the Lac de Gras region between Mackay Lakes and the Nunavut border.
- Twenty motion sensing cameras were deployed at DNA bear posts in 2012. These additional observations are intended to correlate pictures of animals visiting the posts with DNA samples to quantify biases in the final population estimate.

Caribou Interactions with Mine Activities and Infrastructure (Other than Roads)

Management

- Construction of an airport fence and improvements to the fence have been made (the fence is now replaced with a heavy weight orange barrier fence) to deter caribou from the airstrip with minimal risk to the caribou.
- Areas of high risk (e.g., Pigeon Bulk Sample Pit, Beartooth Pit) have a heavy weight orange barrier fence to deter caribou.
- In support of LLCF reclamation research, a wildlife and human health risk assessment of the potential risks to wildlife and human receptors exposed to metals from the LLCF was completed.
- Airstrip inspections for wildlife are completed prior to take-off and landing of all aircrafts.
- Inokhoks are placed at intervals around the airstrip, Beartooth Pit, Fox Pit, and other potentially hazardous mine structures to deter caribou from these areas.
- Guy wires on site were secured and removed if deemed unnecessary.

Residual Risk

- Caribou mortalities and injuries as a result of mine infrastructure and/or mine activities can have further impacts to regional populations and migration routes.

Future Actions

- Continue current management.
- A significant addition to the WEMP was the deployment of 70 motion sensor wildlife cameras to monitor the interaction of wildlife with mine infrastructure. In addition to roads, cameras were placed on fences and inokhoks.
- Further research on metals bioaccumulation related to caribou interaction with PK deposited in the LLCF will be conducted as part of BHP Billiton's Reclamation Research Plan. In addition to the reclamation research, an increase to the frequency of wildlife surveys in the LLCF will commence in 2012 to ensure a better understanding of wildlife activity as reclamation activities progress.
- During the winter of 2012, BHP Billiton will extend the height of the airport fence in order to further reduce the likelihood that caribou will jump the fence.

Habituation of Carnivores

Management

- Incident reporting as part of the WEMP and actively deterring wildlife away from the mine site.
- Dead animals are moved away from roadways and infrastructure.
- Regular inspection of skirting installed around buildings to prevent wildlife access of buildings.
- Training and education for each department at EKATI and new employees on the importance of following waste management policies and practices and wildlife awareness in order to reduce misdirected waste and feeding or other inappropriate animal interactions.
- Waste management practices, in addition to the education and awareness programs for new and current employees include:
  - Frequent burning of camp waste are implemented to reduce chance of wildlife encounters.
  - Juice boxes are no longer used.

(continued)

Table 8.5-1. Key Environmental Risks for Wildlife (completed)

Habituation of Carnivores *(cont'd)*
Management *(cont'd)* - Signs have been added in lunchrooms and additional labels have been added to waste bins to indicate proper waste disposal. - The frequency of landfill sites and waste storage areas' inspections have been increased. Improved waste management practices have reduced the amount of attractants in landfills since 2001, and there has been a decrease in the numbers of wildlife observations at the Misery Landfill.
Residual Risk • At EKATI, the habituation of carnivores to the presence of humans is managed; however, there is still a safety risk for humans that can lead to the destruction of an animal.
Future Actions • Wildlife attractants are an important wildlife management issue at EKATI, and continued efforts to reduce interactions of carnivores and mine infrastructure, mine activities, and humans will be implemented over the next three years. • Training and education on the responsibilities for reporting incidental wildlife sightings will be provided to each department at EKATI and new employees.
Breeding Bird Interactions with Mine Activities and Infrastructure
Management • Management strategies to reduce vehicle-related mortalities of mammals also protects birds. • Mesh was placed over fish boxes (installed as part of the PDC monitoring) to prevent by-catch of waterfowl. • Pit and mine infrastructure monitoring for waterfowl and nesting activities has increased. • Nest removal of early stage nests (e.g., nests without eggs) took place in some cases to prevent nesting activity in hazardous areas (with approval from the GNWT ENR). • Training and education was provided to each department at EKATI to increase awareness of the presence of birds at EKATI and to communicate potential concerns about effects of mine activities on birds. • Formal monitoring and reporting of bird nesting activity along pit walls occurred.
Residual Risk • There is a risk to birds interacting with mine infrastructure and mine activities (e.g., vehicle-related bird mortalities), although monitoring information of breeding birds has detected minimum effects on bird densities and breeding at EKATI.
Future Actions • Maintain current management practices.

BHP Billiton is committed to communicating with mining-impacted communities to explain proposed changes to the WEMP (as they relate to their wildlife permit applications), to listen to comments, respond to questions, and consider suggestions to improve the wildlife monitoring programs. BHP Billiton continues to seek improvements to its WEMP, and many of the recommendations from the technical and community workshops have been incorporated into the 2012 WEMP and will continue on into future years.

In response to stakeholder reviews, changes continue to be made to the WEMP annual report, including further reorganization to streamline its presentation and ensure all the information is more readily accessible. For example:

- The 2011 reporting year covers October 1, 2010 to December 31, 2011. In future reports, the reporting period will be the 12-month calendar year from January 1 to December 31 to fully capture the annual caribou fall migration.
- All raw wildlife monitoring data, weather data, and copies of data forms have been removed, but they are available upon request.

- Wildlife attractants are an important wildlife management issue, and those data are presented in a stand-alone chapter called Waste Management.
- Regional GNWT ENR falcon surveys were not conducted in 2011, as per recommendations received from technical and community workshops held on June 28, 2010 and October 5 and 6, 2010, respectively.
- A significant addition to the WEMP was the deployment of 70 motion sensor wildlife cameras to monitor the interaction of wildlife with mine infrastructure, with a particular focus on Misery Road. These data will be presented separately as an addendum to the WEMP.

The camera program is intended to replace the caribou on roads and the snow track surveys, both of which have provided limited data with respect to wildlife distribution along, and interaction with, roads.

In 2012, EKATI plans to conduct both scan and focal surveys to better categorize caribou behaviour around mine infrastructure. EKATI will continue to collaborate with Diavik in future behaviour studies (e.g., scan surveys) to examine caribou behaviour at varying distances from the mine. This study design will be improved through collaboration with Diavik, increasing sample sizes, survey area, and effort.

9. Summary and Conclusions

9. Summary and Conclusions

Key environmental risks are identified in each of the VEC categories (Air, Land, Water, and Wildlife) for which BHP Billiton must either continue current mitigations measures to ensure that the mine has left a manageable footprint on the EKATI claim block or develop new management practices to address the risk. Table 9-1 lists all 22 risks included in Tables 5.5-1, 6.5-1, 7.5-1, and 8.5-1; however, they are ranked in order of importance as identified by stakeholders and regulators during the EIR technical sessions, as well as by EKATI Environment Department Environment Advisors.

The top two risks identified are (Table 9-1):

1. The aquatic receiving environment downstream of the LLCF and KPSF.
2. Caribou migration routes.

BHP Billiton has focused the management of the LLCF through identification of long-term water quality trends and models to predict future water quality trends downstream of the LLCF. In addition, BHP Billiton has focused on reducing nitrate (related to blasting) and chloride (from underground mine water), as well as management in response to observed increases in AEMP water quality variables (e.g., development of SSWQO). Further improvements to water quality downstream of the LLCF will continue with the implementation of a FPK deposition plan that currently plans to retain the use of Cell D as a mine water management pond by optimizing the use of Cells A and C as well as Beartooth Pit. The use of Beartooth Pit for underground mine water storage will continue, and will also store FPK slurry beginning in September 2012. BHP Billiton recently submitted its renewal of the existing Water Licence (expiring in August 2013), which included a 15-year environmental record of environmental monitoring data as well as a review of aquatic protection measures. In addition to identifying potential contaminants of concern, a key component of the Water Licence renewal is the broadly inclusive Response Framework that provides a structured ”early warning system” for the receiving environment.

EKATI and other mines (e.g., Diavik) are located within the spring migration and summer and fall ranges of the Bathurst caribou herd. Whether the mines are affecting the movements of the caribou is of primary importance to BHP Billiton, regulators, and communities. The caribou aerial survey was designed to identify trends in annual caribou abundance in the EKATI study area during mine development and operation. Despite some of the limitations of aerial survey data, it is possible to identify spatial and temporal trends in the study area. However, to ensure BHP Billiton’s assessments of caribou populations and movement patterns are reflective of the region, EKATI wildlife advisors have participated in regional government studies and workshops to improve on monitoring caribou and examine opportunities to synchronize monitoring with other mines. Community site visits are completed on a regular basis to share knowledge of the caribou monitoring and address improvements to be made to monitoring at EKATI.

Also noteworthy and within the top ten environmental risks for EKATI are caribou interaction with roads, and the ability to detect changes in carnivore populations and fish biology (Table 9-1). The roads at EKATI may act as a barrier to caribou movement and as a result deflect caribou and change their movement patterns. In addition, caribou injuries and mortalities can occur as a result of vehicle interactions. A significant addition to the WEMP was the deployment of 70 motion sensor wildlife cameras to monitor the interaction of wildlife with mine infrastructure, with a particular focus on Misery Road to address this key risk. In addition to the enforced speed limits and constructed caribou crossings (for a complete listing see Table 9-1), EKATI is currently reviewing construction and placement of the Misery Road berms. The goal of this review is to explore options to minimize caribou deflections from the road while still maintaining compliance with the *Mine Health and Safety Act* (1994).

Table 9-1. Key Environmental Risks for EKATI

The Aquatic Receiving Environment Downstream of the LLCF and KPSF
Management • Models predicting future water quality trends and potential contaminants of concern in the LLCF and downstream. • The AEMP is evaluated every three years to examine relationships between water quality and aquatic assemblages. • Identification of long-term water quality trends and development of site-specific water quality benchmarks as a screening tool. • Development of SSWQOs for chloride, molybdenum, nitrate, potassium, sulphate, and vanadium. • Discharge from the LLCF is scheduled to reduce contaminant loads to the receiving environment. • Underground (chloride-rich) mine water is pumped to Beartooth Pit. • Experimental testing of an in situ nitrate reduction method was conducted in the LLCF.
Residual Risk • Discharges from the LLCF and KPSF have an effect on downstream water quality. The 2011 AEMP indicated changes to phytoplankton community composition and zooplankton community composition related to changes in water quality in lakes downstream of the LLCF. These effects are expected to be short-term (with management of water quality); however, risks to aquatic ecosystem (i.e., food web dynamics) exist. • The 2011 AEMP identified 16 water quality variables that have increased downstream of the LLCF and 11 water quality variables that have increased downstream of the KPSF due to mine activities. Out of these variables, nitrate downstream of the LLCF has been identified as the highest risk.
Future Actions • Implementation of a FPK deposition plan that retains the use of Cell D as a mine water management pond by optimizing the use of Cells A and C as well as Beartooth Pit. • BHP Billiton has developed a Response Framework that provides a structured early warning system for the receiving environment. This framework will be reviewed during the Water Licence renewal process.
Caribou Migration Routes
Management • Collaboration with Diavik and government agencies to assess migration routes. • Participate in regional studies and workshops to improve on caribou monitoring and examine opportunities to synchronize monitoring with other mines. • Community site visits to share knowledge of the caribou monitoring and address monitoring improvements.
Residual Risk • Caribou avoidance of mine.
Future Actions • Continue monitoring in collaboration with Diavik (incidental observations). • BHP Billiton will take part in future GNWT ENR management plans.
Caribou Interaction with Roads
Management • Wildlife always has the right-of-way on roads. • Speed limits are posted and enforced. • Signs are posted at constructed caribou crossings. • Roads are closed to traffic when large herds of caribou are located on or adjacent to roads near the mine. • Vehicles encountering wildlife are required to communicate the presence of wildlife on roads. • Construction of caribou crossings. • Misery road surface height was constructed close to surrounding land surface to facilitate easy access for caribou to roadways. • Designing roads that have low side-slopes and low banks to facilitate caribou crossing. Many rock berms at EKATI are built to adhere to NT *Mine Health and Safety Act* (1994) requirements. • Working with Elders to monitor caribou movement and use TK to create accessible roads.

(continued)

Table 9-1. Key Environmental Risks for EKATI (continued)

Caribou Interaction with Roads *(cont'd)*
Residual Risk • The roads may act as a barrier to caribou movement and as a result deflect caribou and change their movement patterns. • Caribou injuries and mortalities as a result of vehicle interactions.
Future Actions • A significant addition to the WEMP was the deployment of 70 motion sensor wildlife cameras to monitor the interaction of wildlife with mine infrastructure, with a particular focus on Misery Road. The camera program is intended to replace the caribou on roads and the snow track surveys, both of which have provided limited data with respect to wildlife distribution along and interaction with roads. • EKATI is currently reviewing the construction and placement of Misery Road berms. The goal of this review is to explore options to minimize caribou deflections from the road while still maintaining compliance with the *Mine Health and Safety Act* (1994).
Ability to Detect Changes in Carnivore Populations
Management • BHP Billiton recognized that monitoring information on carnivores, particularly wolverines and grizzly bears contained uncertainty related to the incidental observations and sign surveys. • This risk to BHP Billiton's ability to detect changes in carnivore populations related to mine activities was brought forward in the previous version of the EIR. • In collaboration with the GNWT ENR, a DNA-based study was initiated in 2004 to better track wolverine population abundance. The study was undertaken in 2005-2006 and in 2010-2011 in order to monitor wolverine density, abundance, and movement on a regional scale. • In 2010 and 2011 BHP Billiton explored the feasibility and logistics of a DNA Grizzly based study to address concerns of monitoring grizzly bear populations in response to mine activities.
Residual Risk • The EKATI-specific monitoring program of grizzly bear populations would not be representative of actual grizzly bear populations.
Future Actions • In 2012-2013, Diavik and EKATI plan to collaboratively implement a grizzly bear DNA program covering an area of approximately 16,000 km2 in the Lac de Gras region between Mackay Lakes and the Nunavut border. • Twenty motion sensing cameras were deployed at DNA bear posts in 2012. These additional observations are intended to correlate pictures of animals visiting the posts with DNA samples to quantify biases in the final population estimate.
Caribou Interactions with Mine Activities and Infrastructure (Other than Roads)
Management • Construction of an airport fence and improvements to the fence have been made (the fence is now replaced with a heavy weight orange barrier fence) to deter caribou from the airstrip with minimal risk to the caribou. • Areas of high risk (e.g., Pigeon Bulk Sample Pit, Beartooth Pit) have a heavy weight orange barrier fence to deter caribou. • In support of LLCF reclamation research, a wildlife and human health risk assessment of the potential risks to wildlife and human receptors exposed to metals from the LLCF was completed. • Airstrip inspections for wildlife are completed prior to take-off and landing of all aircrafts. • Inokhoks are placed at intervals around the airstrip, Beartooth Pit, Fox Pit, and other potentially hazardous mine structures to deter caribou from these areas. • Guy wires on site were secured and removed if deemed unnecessary.
Residual Risk • Caribou mortalities and injuries as a result of mine infrastructure and/or mine activities can have further impacts to regional populations and migration routes.

(continued)

Table 9-1. Key Environmental Risks for EKATI (continued)

Caribou Interactions with Mine Activities and Infrastructure (Other than Roads) *(cont'd)*
Future Actions • Continue current management. • A significant addition to the WEMP was the deployment of 70 motion sensor wildlife cameras to monitor the interaction of wildlife with mine infrastructure. In addition to roads, cameras were placed on fences and inokhoks. • Further research on metals bioaccumulation related to caribou interaction with PK deposited in the LLCF will be conducted as part of BHP Billiton's Reclamation Research Plan. In addition to the reclamation research, an increase to the frequency of wildlife surveys in the LLCF will commence in 2012 to ensure a better understanding of wildlife activity as reclamation activities progress. • During the winter of 2012, BHP Billiton will extend the height of the airport fence in order to further reduce the likelihood that caribou will jump the fence.
Fish Biology
Management • During the 2007 AEMP, the sampling mortality of fish was reduced by adhering to catch limits recommended by DFO (this is in addition to sampling every five years).
Residual Risk • The sampling programs at EKATI have affected fish populations. Without changes to the monitoring program this effect could be long-lasting.
Future Actions • Changes to the fish monitoring program in the summer of 2012 will include the following components to address the potential impacts to fish populations: - the addition of slimy sculpin for use as a sentinel species in all AEMP lakes for all biological parameters, metals analyses, and PAHs , with a sampling frequency of every three years; - the application of a non-lethal sampling program for lake trout using dermal punch tissue extraction methodologies; - decreasing the sampling frequency of lake trout and round whitefish to every once in every six years unless data show a need for special effects studies on large-bodied fish prior to the next scheduled sampling year, instead of the current once in every five years, to further minimize total sampling mortality and to link it with the sampling of slimy sculpin every three years; and - inviting community members to participate in the fish monitoring program and share local knowledge.
Permafrost Exposure
Management • Annual geotechnical inspections of mine structures of dams and dikes. • Engineering design and construction supervision of engineered structures in permafrost (e.g., PSD). • Winter construction and soil excavation in permafrost areas where lakes and streams are potentially affected by sedimentation (dams, dikes, culverts, and bridges). • Preferentially dewatering lakes during winter. • Exploratory drilling on land and in lakes and temporary road construction for exploration, preferentially during winter months. • Capping of exposed permafrost to reduce thermal degradation and erosion (e.g., Fred's Channel). • Assessment of ground temperatures (e.g., thermistors) prior to placement of mine water in Beartooth Pit and commencement of the Misery Pit "push-back" project.
Residual Risk • Exposure of permafrost can result from mine activities such as development of pits. If permafrost degrades or does not develop it could lead to several environmental risks including changes in hydrological patterns and soil stability. At EKATI the risk of permafrost exposure is managed; however, there remains a risk of localized permafrost degradation that can affect mine infrastructure.

(continued)

Table 9-1. Key Environmental Risks for EKATI (continued)

Permafrost Exposure *(cont'd)*
Future Actions • Maintain current management practices. • The development of Pigeon Pit and construction activities associated with the PSD will use practices to minimize disturbance to permafrost (e.g., over excavation and backfilling of thaw stable material for the PSD).
Groundwater Quality and Quantity
Management • Utilization of Beartooth pit for mine water storage until mine water can be managed through the LLCF. • A site-specific water quality objective for chloride was developed for EKATI. • Modelling assessment on predicted LLCF water quality.
Residual Risk • Increased concentrations of chloride related to underground water can have negative impacts on aquatic biology in downstream receiving environments. There is a risk that underground water quality and quantity (with associated chloride loads) will require additional management to what is currently being completed for the LLCF and of the pit lake water quality at mine closure. • Mine development affects the regional groundwater flow pattern.
Future Actions • BHP Billiton will continue to use Beartooth Pit for mine water storage through the mine life. • Predictive water quality modelling is being undertaken as part of the ICRP to address regional groundwater behaviour during pit flooding during the closure phase. This research will assist BHP Billiton's management plans for pit lake water at mine closure and improve the current understanding of groundwater.
The Physical or Terrestrial Environment
Management • Land disturbance procedures in place that require approval of the EKATI Environment Department prior to any new land disturbance. • Design and locate mine infrastructure to minimize footprint expansion. • Stabilizing disturbed sites no longer part of the operations, through progressive reclamation. • Focused reclamation research planning to ensure that reclamation activities identified for mine closure will serve their purpose.
Residual Risk • Mining related changes in the physical/terrestrial environment results in a loss of habitat and displacement of wildlife. • Disturbed areas are not adequately reclaimed.
Future Actions • Undertake focus reclamation research to reduce risks at mine closure. • Best practices, lessons learned and mitigation measures will be implemented to minimize land disturbance and vegetation loss during the Misery Pit "push-back" project and development of Pigeon Pit and the associated WRSA.
Habituation of Carnivores
Management • Incident reporting as part of the WEMP and actively deterring wildlife away from the mine site. • Dead animals are moved away from roadways and infrastructure. • Regular inspection of skirting installed around buildings to prevent wildlife access of buildings. • Training and education for each department at EKATI and new employees on the importance of following waste management policies and practices and wildlife awareness in order to reduce misdirected waste and feeding or other inappropriate animal interactions.

(continued)

Table 9-1. Key Environmental Risks for EKATI (continued)

Habituation of Carnivores *(cont'd)*
Management *(cont'd)* • Waste management practices, in addition to the education and awareness programs for new and current employees include: - Frequent burning of camp waste are implemented to reduce chance of wildlife encounters. - Juice boxes are no longer used. - Signs have been added in lunchrooms and additional labels have been added to waste bins to indicate proper waste disposal. - The frequency of landfill sites and waste storage areas' inspections have been increased. Improved waste management practices have reduced the amount of attractants in landfills since 2001, and there has been a decrease in the numbers of wildlife observations at the Misery Landfill.
Residual Risk • At EKATI, the habituation of carnivores to the presence of humans is managed; however, there is still a safety risk for humans that can lead to the destruction of an animal.
Future Actions • Wildlife attractants are an important wildlife management issue at EKATI, and continued efforts to reduce interactions of carnivores and mine infrastructure, mine activities, and humans will be implemented over the next three years. • Training and education on the responsibilities for reporting incidental wildlife sightings will be provided to each department at EKATI and new employees.
Low Under-ice Dissolved Oxygen
Management • Under-ice DO was monitored in Kodiak and Cujo lakes bi-weekly each winter. • Adaptive management to address low under-ice DO (e.g., snow clearing to promote the production of oxygen by stimulating phytoplankton growth and aeration to introduce DO).
Residual Risk • Low DO in lakes can occur naturally and its effects on aquatic organisms can be lethal and/or result in changes in physiology or behaviour. Sampling in Cujo Lake has shown low DO levels in the winter however there is no indication of effects on fish populations. However there remains a risk of low DO and its potential effects to fish in Cujo Lake.
Future Actions • Management and bi-weekly monitoring of Kodiak Lake for low under-ice DO is no longer required except for the AEMP late winter sampling. • Cujo Lake will be continued to be monitored bi-weekly for under-ice DO during the winter. • Continue with adaptive management actions at Cujo Lake based on monitoring results.
Water Quality of Waste Rock Seepage
Management • WRSAs are being constructed according the WROMP: coarse granite layer as base layer, stepped side slopes to enhance permafrost growth, encapsulation of metasediment within 5 m of granite waste rock, and in some cases toe berms. • The WROMP provides for specific management actions in response to monitoring results (e.g., movement of metasediment from Misery WRSA in response to monitoring results at SEEP 052). • WRSAs have a minimum setback of 30 m from waterbodies. • Increased sampling frequency at seeps identified as areas of interest.
Residual Risk • Waste rock seepage flowing into the receiving environment can pose a risk to water quality and aquatic assemblages. At EKATI, seepage is managed and risks to the receiving environment are low.

(continued)

Table 9-1. Key Environmental Risks for EKATI (continued)

Water Quality of Waste Rock Seepage *(cont'd)*
Future Actions • Maintain current management practices.
Water Quality Associated with Misery Pit "Push-Back"
Management • The Misery water management system consists of the Misery Pit sump, Desperation Pond, Waste Rock Dam Pond, and the KPSF. The KPSF receives inflows from the other water bodies (including the pit sump), and excess water from the KPSF is pumped to the receiving environment, when water quality complies with the site Water Licence. • Predicted flow volume, waste dump runoff and pit wall runoff water quality, waste rock runoff water quality, and anticipated water quality in the KPSF were assessed. • An assessment of waste rock management options was completed and resulted in the modification of the design of the WRSA to address the risks to the aquatic receiving environment.
Residual Risk • Some of the waste rock to be mined at Misery Pit is metasediment (biotite schist), which is potentially acid-generating and metal leaching. There is a risk that contaminants released from this material require additional management responses to comply with the site Water Licence.
Future Actions • Encapsulate metasediment waste rock within 5 m of granite waste rock (to maintain permafrost within the metasediment). • Flood the Misery Open Pit with clean water when mining is complete (to submerge metasediment wall rock under water).
Water Quality and Quantity Associated with Pigeon Pit Development
Management • Development of models and predictions of water quality, flow, and runoff related to Pigeon Pit. • Pigeon Pit sump water will be pumped to the LLCF, and runoff from the WRSA will flow to and be managed in the LLCF.
Residual Risk • Some of the waste rock to be mined at Pigeon Pit is metasediment (biotite schist), which is potentially acid generating and metal leaching. There is a risk that contaminants released from this material require additional management response to comply with the site Water Licence.
Future Actions • Encapsulate metasediment waste rock within 5 m of granite waste rock (to maintain permafrost within the metasediment). • Flood the Pigeon Open Pit with clean water when mining is complete (to submerge metasediment wall rock under water). • Implementation of the Pigeon AEMP.
Particulate Emissions
Management • Initiatives and activities to reduce fuel consumption including the use of low sulphur diesel fuel and preventative maintenance programs on machinery to ensure optimum operation of all combustion and fugitive emission sources. • Improvements to the AQMP including moving the CAM building to a more suitable location. • Community engagement tour to address future improvements of the AQMP.
Residual Risk • Particulates and gaseous emissions produced as a result of mine activities (e.g., emissions from diesel-fired power generation) pose a risk to vegetation performance and wildlife indirectly.

(continued)

Table 9-1. Key Environmental Risks for EKATI (continued)

Particulate Emissions *(cont'd)*
Future Actions • Will continue to manage emissions and make further practical reductions to air emissions (e.g., new incinerator). • Commissioning of new incinerator in 2012.
Fugitive Dust
Management • Control of fugitive dust through road watering and the use of approved dust suppressants. • Speed limits are posted and enforced.
Residual Risk • Fugitive dust produced as a result of mine activities poses a risk to vegetation performance and wildlife indirectly. • Fugitive dust has the potential to affect aquatic environments by increasing the level of contaminants in waterbodies. The elevated level of contaminants may impact aquatic assemblages (i.e., concentration is greater than an applicable benchmark value). Following evaluation of the magnitude of the contribution of dustfall to the aquatic environment using results of a decay function, results indicated that the equivalent concentration calculated from dustfall is at least three orders of magnitude smaller than the average concentration observed in EKATI streams.
Future Actions • Following IEMA's suggestions, the contribution of dustfall to the aquatic environment will again be evaluated in the 2012 AEMP re-evaluation. • Dustfall monitoring stations will be placed in the vicinity of the Fox WRSA to assess fugitive dust levels.
Hydrocarbon Contamination Downstream of the LLCF and KPSF
Management • Fuel handling procedures. • Internal spill reporting and clean-up. • Fuel storage is with secondary containment. • Drip trays under all portable light stands. • Spill kits are available at fuel transfer areas. • Electric pumps were installed at the Cell E outlet dam.
Residual Risk • The 2007 AEMP indicated that fish in EKATI lakes downstream of the LLCF were exposed to hydrocarbons; however, there was no evidence that the hydrocarbon exposure influenced fish health. Water and sediment in the LLCF and its downstream lakes were sampled for the presence of hydrocarbons in 2008, 2010, and 2011. The sampling did not detect hydrocarbons in these lakes. Therefore, hydrocarbons represent a low risk to the aquatic environment.
Future Actions • The 2012 AEMP will integrate a hydrocarbon sampling program into the study design of the fish component to further evaluate the risk of hydrocarbons in the aquatic environment and potential effects on fish. • Employee awareness program on hydrocarbon storage underground.
Ability to Detect Changes in Ambient Air Quality
Management • The CAM building was moved to a more suitable location in 2008. • The monitoring program has been peer reviewed and improvements were made including implementation of dustfall monitoring in 2006 and improvements to the lichen monitoring.
Residual Risk • There is a risk that BHP Billiton will be unable to identify changes to ambient air quality because of limitations in the monitoring program.

(continued)

Table 9-1. Key Environmental Risks for EKATI (continued)

Ability to Detect Changes in Ambient Air Quality *(cont'd)*
Future Actions • Improvements to the 2012 and 2013 AQMP program will be made based on recommendations as a result of review of the 2011 AQMP. • Alternative technologies are being investigated to increase the reliability and accuracy of TSP measurements.
Disturbance of Archaeology Sites
Management • Exploration drill sites or land development are preceded by summer investigations for archaeological sites or heritage sites to ensure disturbance is avoided or mitigated. • When archaeological sites are identified, the likelihood of impacts as a result of mine activities is assessed and suitable mitigation measures are recommended if site avoidance is not possible. • A chance find procedure is initiated when archaeological sites are found. • Land disturbance procedures are in place that requires approval of the EKATI Environment Department prior to any new land disturbance.
Residual Risk • Despite archaeological investigations prior to land disturbance, there remains a risk of impacting archaeological sites when ground is disturbed.
Future Actions • No new proposed drill sites or land development is currently planned in areas that have not already been assessed.
Breeding Bird Interactions with Mine Activities and Infrastructure
Management • Management strategies to reduce vehicle-related mortalities of mammals also protects birds. • Mesh was placed over fish boxes (installed as part of the PDC monitoring) to prevent by-catch of waterfowl. • Pit and mine infrastructure monitoring for waterfowl and nesting activities has increased. • Nest removal of early stage nests (e.g., nests without eggs) took place in some cases to prevent nesting activity in hazardous areas (with approval from the GNWT ENR). • Training and education was provided to each department at EKATI to increase awareness of the presence of birds at EKATI and to communicate potential concerns about effects of mine activities on birds. • Formal monitoring and reporting of bird nesting activity along pit walls occurred.
Residual Risk • There is a risk to birds interacting with mine infrastructure and mine activities (e.g., vehicle-related bird mortalities), although monitoring information of breeding birds has detected minimum effects on bird densities and breeding at EKATI.
Future Actions • Maintain current management practices.
Long-Term Performance of the PDC
Management • Clearing the PDC of snow in the spring. • A layback of the channel walls was necessary, and the first phase of the slope stabilization was completed in the winter of 2010/2011.
Residual Risk • Constructed fish habitat channels have a risk of not performing as intended; however, 14 years of PDC monitoring has shown that the PDC is successfully providing self-sustaining fish habitat. • In some areas of the PDC there is a risk that wall stability will impact the performance of the channel and its fish habitat.

(continued)

Table 9-1. Key Environmental Risks for EKATI (completed)

Long-Term Performance of the PDC *(cont'd)*
Future Actions • Installation of additional rock structures to further enhance fish habitat in middle reaches. • Transplantation of instream vegetation mats to the PDC in the summer of 2012. • Continued slope stabilization work.
Fay Bay Water Quality and Aquatic Life
Management • Emergency response plan (e.g., initial response to unplanned release of FPK included clean-up and installation of silt curtains in Fay Bay). • A monitoring program was implemented and completed to assess both short- and long-term effects of the PK release. • Construction work was completed at Cell B to minimize future risks of PK release. • Enhancement of procedures for PK deposition at the upper end of Cell A. • Additional regular inspections of LLCF to verify deposition is according to the deposition plan. • PK is no longer deposited in the northern portion of Cell B. • Strategic management of snow as part of freshet erosion control.
Residual Risk • Following monitoring in 2010, it was concluded that there were no long-term risks to water quality or aquatic life associated with the unplanned release of PK into Fay Bay in 2008.
Future Actions • Maintain current management practices.

BHP Billiton recognized that monitoring information on carnivores, particularly wolverines and grizzly bears, contained uncertainty related to the previously conducted incidental observations and sign surveys (Table 9-1). Thus with the successful completion of the 2005 to 2006 and 2010 to 2011 wolverine DNA based studies, EKATI (in collaboration with Diavik) planned a grizzly bear DNA program covering an area of 16,000 km^2 in the Lac de Gras Region between Mackay Lakes and the Nunavut border for 2012 to 2013. It is anticipated that the data collected as a result of these large scale wolverine and grizzly bear DNA studies will provide better information on density, abundance, and movement on a regional scale.

Following the 2007 fish sampling, BHP Billiton identified changes in lake trout populations as a result of the sampling programs at EKATI as a long-lasting effect and environmental risk that requires mitigation (Table 9-1). Thus, the 2012 proposed fish sampling program was designed to address mitigation and provide an understanding of historical effects related to sampling mortality. Slimy sculpin was added as a sentinel species for the AEMP, thereby reducing sampling mortality of round whitefish and lake trout. In addition, the application of a non-lethal sampling program for lake trout using dermal punch tissue extraction methodologies will be implemented in 2012. To further reduce total sampling mortality, the sampling frequency of lake trout and round whitefish will be completed once in every six years (instead of once every five years), unless data show the need for special effects studies on large bodied fish prior to the next scheduled sampling year and link it with the sampling of slimy sculpin every three years.

At the bottom of the list of key environmental risks is the long-term performance of PDC and Fay Bay water quality and aquatic life (Table 9-1). Both risks require few additional mitigation measures and BHP Billiton feels they represent little environmental risk. Fourteen years of monitoring the PDC has indicated that it is successful in providing self-sustaining fish habitat. However, some additional habitat enhancements in the middle reaches of the PDC (rock structures to be installed during the winter of

2012/2013) still need to be added prior to completion of the program. In addition there are some areas of the PDC that pose a risk to the wall stability for closure, which has been addressed with the slope stabilization work in 2010 and 2011. For Fay Bay, the 2010 monitoring concluded that there were no long-term risks to water quality or aquatic life associated with the unplanned release of FPK into Fay Bay in 2008. Current management practices will therefore be continued to ensure that an unplanned release does not occur again (e.g., additional regular inspections of LLCF to verify deposition is according to the deposition plan).

For the key environmental risks identified in Table 9-1, a list of future actions has been identified. Whether the future action is to continue current management or employ new strategies and monitoring to address the risk, BHP Billiton will strive to achieve these plans to ensure that there is “Zero Harm” to the environment at EKATI. As identified in this report, BHP Billiton has had several mitigation successes and continues to support a variety of management practices and monitoring programs as part of the long-term plans to return the site to a condition that will be compatible with the original uses of the area.

◎ Table of Contents

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◎ Table of Contents

Appendix A
Comments on the 2009 EIR

Appendix A. Comments on the 2009 EIR

ID	Topic	Comment	Response
EC-1	Air	Classification of air effects as "negligible" is premature given that the CAM building was not operating during the reporting period and that the 2008 monitoring results were not available to be incorporated into the EIR.	BHP Billiton agrees that the data now being collected at the CAM building and the information from the 2008 AQMP monitoring program will add substantially to the confidence of the effect rating for the next EIR. BHP Billiton also feels that providing an effect rating based on the information at hand, while recognizing the limitations and uncertainties in the data, is appropriate. For added clarity the February 2010 Technical Addendum and Close-Out Report will document that the available data does not include the sources identified by Environment Canada and that more comprehensive data will be available for the next EIR.
YKDFN-4	Air	Long-term persistent chemicals in air emissions may persist in the environment for many years after mine closure.	BHP Billiton works hard to effectively managing air emissions to reduce long term effects in the environment. BHP Billiton has improved the Air Quality Monitoring and Management Program within the past 3 years to better identify the chemical constituents and spatial distribution of parameters of interest in air emissions over time. Also, BHP Billiton achieved success in reducing fuel use, greenhouse gas emissions and dust from haul roads in order to reduce the impacts that such emissions might have. Refer also to Response to Comment EC-1
IEMA-6	Air	An effect rating for air quality can not be made because of the lack of current monitoring data.	Refer to Response to Comment EC-1.
INAC-2	Water	Discrepancy in reporting of the 1995 Predicted Effect for water quality downstream of LLCF.	There is an inadvertent error in the Summary Report and in the text of the Technical Report where this effect is reported as "not predicted" in 1995. This effect was predicted in 1995 and was rated as "negligible". This correction is included in the Technical Addendum and the Close-Out Report.
INAC-3	Water	The effect rating for water quality downstream of LLCF should be "moderate" rather than "minor" as is reported by BHP Billiton.	BHP Billiton has reviewed its decision-making for this effect a second time and believes that "minor" is appropriate. The February 2010 Technical Addendum provides a more in-depth description of the general methodology used for rating effects and the specific re-assessment of this effect. BHP Billiton agrees that future circumstances may require a change in this, or other, effect ratings (upwards or downwards).

Appendix A. Comments on the 2009 EIR

ID	Topic	Comment	Response
INAC-4 DFO-1 IEMA-7	Water	Observed water quality versus CCME guidelines.	BHP Billiton recognizes that the presentation materials for the EIR workshops did not provide the intended clarity on distinguishing between measured data values, predicted means (from data regression analysis), effluent quality released from the LLCF and water quality in the receiving environment. To be clear: Winter concentrations of molybdenum and nitrate in Leslie and Moose Lakes (i.e., the receiving environment) in 2006 to 2008 have been greater than the current CCME guideline value for molybdenum (0.073 mg/L) and the IPS value for nitrate (4.7 mg/L NO3-N), which apply in the receiving environment. The predicted means that are developed through regression analysis are statistically robust in identifying current or projected trends; this is an established statistical approach that is used when there is adequate historical data upon which to base the regression analysis; this approach was proposed and accepted by the WLWB as part of the last (2006) 3-Year AEMP Review. There is also value in visual assessment of the measured data values over time; these time-series graphs for AEMP-assessed parameters will be included in AEMP Annual Reports.
INAC-5	Water	Application of the Minimum Detectable Difference (MDD).	The MDD is an established statistical method. MDDs will be discussed in further detail through the AEMP Annual Reports and 3-Yr Review.
EC-2	Water	Three corrections are suggested to table and figure references.	EC's suggested corrections are included in the February 2010 Technical Addendum.
EC-3	Water	Question the classification of effects to groundwater as "negligible" because of the lack of groundwater sampling.	BHP Billiton feels that providing an effect rating based on the information at hand, while recognizing the limitations and uncertainties in the data, is appropriate. For added clarity the February 2010 Technical Addendum and Close-Out Report will document that the availability of specific monitoring data on the deep groundwater regime (both regionally and at EKATI specifically) is limited. As part of or prior to the next EIR, BHP Billiton will include a specific report on the effects to groundwater that presents the available information and reviews this against the issues raised by Environment Canada during the 1995 EIS.
EC-4	Water	If significant changes in biomass occur in future coupled with changes in diversity and density of phytoplankton, an increase in effect rating would be required.	BHP Billiton agrees that future circumstances may require a change in this, or other, effect ratings (upwards or downwards).
EC-5	Water	Assessment of various aquatic parameters should include combined/additive effects to assess effects on the aquatic ecosystem in addition to its individual components. Water quality modeling should be updated to assess increasing trends.	BHP Billiton agrees that assessment for additive effects is important and will work to improve this type of assessment through the annual AEMP Reports and the next EIR Report. BHP Billiton will update the water quality predictions for key water quality parameters in or around June 2010 and will circulate these externally for discussion.

Appendix A. Comments on the 2009 EIR

ID	Topic	Comment	Response
IEMA-2	Water	Water quality downstream of the LLCF is one of the primary effects of the mine and should have a higher effect rating.	See Response to Comment INAC-3.
IEMA-18	Water	Loss of lake habitat should be rated higher than "minor".	This is a very well-defined effect in that the lake habitat to be lost was well understood in 1995 and has occurred as anticipated (with recognition of the Leslie/SPB exchange). It is appropriate, therefore, to maintain the same effect rating as was assigned in 1995.
IEMA-19	Water	Unclear reference to a "palatability study".	A palatability study can take different forms. The analytical approach taken by BHP Billiton is a valid approach that avoids the need to expose people to food of yet undetermined quality. The food (fish) is analysed for chemicals for which people are known to be able to detect a taste change. This is the set of analyses, for example, that detected the presence of hydrocarbon-induced metabolites in the bile of lake trout and whitefish.
ENR-2	Land	Question whether the mine footprint is "reversible" (EIR pg 4&24, para 2)	The reclamation objectives and criteria are described in the Interim Closure and Reclamation Plan. BHP Billiton accepts ENR's statement and has amended these two statements in the February 2010 Technical Addendum to read "… the mine occupies a small portion of the current EKATI claim block."
ENR-4	Land	Reference to the number of reclamation research studies should be consistent with the ICRP.	BHP Billiton agrees and in light that the ICRP is currently under review has amended the statement in S.5.3.3.2, pg 192 in the February 2010 Technical Addendum to read "Research topics were identified and proposed to be completed …".
ENR-9 IEMA-21	Land	The 2008 unplanned release of processed kimberlite at Fay Lake should be better documented in the EIR.	BHP Billiton has documented this event in the February 2010 Close-Out Report. Additionally, BHP Billiton plans to release a Fay Lake monitoring update report by April 2010 that will summarize the monitoring results to date.
IEMA-11	Land	Permafrost in the waste rock piles is not a positive effect as is reported in the 2009 EIR.	BHP Billiton wishes to work with clearly defined effects. This effect is occurring and provides an engineering benefit but does not link back to the 1995 EIS (not predicted). HP Billiton has removed this effect in the February 2010 Technical Addendum and Close-Out Report and will not include it as an effect in the next EIR.
IEMA-12	Land	The removal of Leslie Lake from the mine plan is not a mitigative measure that was undertaken to reduce land disturbance as is reported in the 2009 EIR (Table 6.2-1).	BHP Billiton wishes to work with clear references and relevant performance examples. Since the reference to Leslie Lake is not material to the effects assessment or the general purpose of the EIR, BHP Billiton has removed this item in the February 2010 Technical Addendum and Close-Out Report. Additionally, BHP Billiton will critically review the examples of adaptive management and mitigative actions for the next EIR to ensure that each is clear and relevant.
IEMA-20	Land	The loss of vegetation cover should be rated higher than "minor".	The observed conditions and circumstances are the same as those that were anticipated during the 1995 EIS and it is appropriate, therefore, to maintain the same effect rating as was assigned in 1995.

Appendix A. Comments on the 2009 EIR

ID	Topic	Comment	Response
ENR-5	Wildlife	Wolverine study results do not implicate mining activities as causing the observed trends but the study does not conclude that mining activities have had no role in the trend.	BHP Billiton accepts ENR's statement and agrees that the information to be collected during the DNA program at EKATI this winter (April 2010) will be relevant to advancing the study's conclusions. BHP Billiton has amended the reference in Table 6.1-2 in the February 2010 Technical Addendum as suggested by ENR.
ENR-6	Wildlife	There were at least 3 documented wolverine mortalities prior to 2006.	BHP Billiton accepts ENR's statement and has amended the reference in Table 6.1-2 in the February 2010 Technical Addendum to read "There were three documented wolverine mortalities in total prior to 2006".
ENR-7	Wildlife	Are raptors increasing or decreasing or the same over time and is it possible to rank the significance in comparison to nesting outside of the mine area?	The raptor surveys are primarily observational and do not provide a population count that would support conclusions on population trends. Similarly, a population-based comparison with nesting outside of the mine area is not feasible.
ENR-8	Wildlife	Effect rating for nesting habitat on pit walls should be "positive".	In Table 6.1-2 of the Technical Report, this effect is titled "Nesting on mine infrastructure and pit walls by birds" and is rated as "negligible" regarding nesting on mine infrastructure and "positive" regarding nesting on pit walls. Page 7-2 of the Technical Report conservatively lists the combined effect as "negligible". The Summary Report shows only the aspect of nesting on pit walls and correctly reports this as "positive". BHP Billiton apologizes for any confusion that this may have caused. BHP Billiton agrees with the comment from ENR in support of the positive nature of nesting on pit walls. The reporting of the two aspects of this effect has been amended in the February 2010 Technical Addendum and Close-Out Report to list each separately.
IEMA-3	Wildlife	Effects on caribou is one of the primary effects of the mine and should have a higher effect rating.	BHP Billiton has reviewed its decision-making for the three effects related to caribou a second time and believes that its ratings (two "negligible" and one "minor") are appropriate. The February 2010 Technical Addendum provides a more in-depth description of the general methodology used for rating effects and of the specific re-assessment of this effect. BHP Billiton recognizes that there are substantive concerns about caribou on a regional basis; however, the EIR is focused on potential effects related to activities at EKATI. BHP Billiton is improving its caribou monitoring program through a collaborative approach with others.
IEMA-5	Wildlife	Caribou avoidance of the mine site was not predicted in the 1995 EIS as is reported in the EIR.	BHP Billiton believes that caribou avoidance is discussed in the 1995 EIS in Section 3.3.1, including stating "if caribou do encounter the project development during migration they will circumvent it".

Appendix A. Comments on the 2009 EIR

ID	Topic	Comment	Response
IEMA-8	Wildlife	There is inadequate monitoring data to support the conclusion that grizzly bears are not affected by mine activities.	BHP Billiton agrees that the grizzly bear monitoring program can be improved and is working collaboratively on improvements. Nonetheless, BHP Billiton also feels that providing an effect rating based on the information at hand, while recognizing the limitations and uncertainties in the data, is appropriate. For added clarity the February 2010 Technical Addendum and Close-Out Report will document that the available data includes higher than desired uncertainties and that, as a result, the monitoring methodology is in the process of being improved for 2010.
IEMA-14	Wildlife	The 2006 to 2008 aerial surveys for caribou were not conducted collaboratively with the Diavik mine as is stated in the 2009 EIR (pg 4-32).	BHP Billiton accepts IEMA's correction in part. Some of the 2006 aerial survey was done collaboratively with the Diavik mine. BHP Billiton has amended the reference in the February 2010 Technical Addendum to read "It covers a total area of 6,300 km2 and was conducted in collaboration with Diavik Diamond Mines Inc. for part of 2006".
IEMA-15	Wildlife	The reference to consistency with Boulanger et al (2004) is not clear (pg 5-129).	BHP Billiton accepts IEMA's correction and has amended this into the February 2010 Technical Addendum.
IEMA-16	Wildlife	The reference to a loon mortality in 2008 should be 2007 (pg 5-152).	BHP Billiton accepts IEMA's correction and has amended this into the February 2010 Technical Addendum.
IEMA-17	Wildlife	There is no evidence to support decreasing the effect rating for caribou movement patterns from "moderate" in the 2006 EIR to "minor" in the 2009 EIR.	Refer to Response to Comment IEMA-3. Additionally, BHP Billiton feels that the rating applied in 2006 was overstated and that the monitoring information is consistent across an extended time period.
INAC-1 ENR-1 IEMA-1	Process	There was no consultation on the EIR as required under the Environmental Agreement.	BHP Billiton has held or been involved in various meetings and initiatives on the major monitoring programs (WEMP, AQMP, ICRP-land and others) that provide information to the EIR. The Company feels that these initiatives have generally been positive. For the EIR specifically, BHP Billiton provides high-quality reports that require adequate research and preparation time; time that needs to take into account the receipt and analysis of the previous year's monitoring results. BHP Billiton has proposed a process for the next (2012) EIR, as attached, that should provide research and preparation time plus additional meetings prior to finalization of the report. It is BHP Billiton's understanding, based on the December 2009 EIR meeting, that this proposed approach is generally acceptable to the parties to the Environmental Agreement.
ENR-3	Process	Results of studies that have not yet been reported should be reported annually as they become available.	BHP Billiton agrees and will circulate such results as they become available.
YKDFN-1	Process	Most effects ratings are too low.	BHP Billiton has reviewed its decision-making for a number of effects as documented in this table and in the February 2010 Technical Addendum. The Technical Addendum will also provide a more in-depth description of the general methodology used for rating effects that maintains necessary consistency with the methodology used in the 1995 EIS.

Appendix A. Comments on the 2009 EIR

ID	Topic	Comment	Response
YKDFN-2	Process	Monitoring programs should focus on collecting appropriate and useful data.	BHP Billiton agrees with this statement and will continue to pursue opportunities such as the current collaborative process for improvements to the WEMP.
YKDFN-3	Process	Combined/cumulative effects are not taken into account even though it is mentioned in the 1995 EIS.	BHP Billiton gathers and assesses monitoring information according to the monitoring plans that are approved for the EKATI mine. The Company has worked and will continue to work with government agencies who assemble regional cumulative effects monitoring frameworks into which mine-specific data can be introduced. In some instances, such as aerial caribou surveys, BHP Billiton has worked collaboratively with the Diavik mine to conduct both programs in an efficient manner and to reduce potential effects to the herd from monitoring activities (i.e., multiple fly-overs). Air quality modeling in 2006 (CALPUFF) included aspects of cumulative effects by incorporating estimated emissions from both the Diavik and EKATI mines.
IEMA-4	Process	Adaptive Management is not appropriately defined and not all of the reported examples are “adaptive management”.	BHP Billiton wishes to work with clear references and relevant performance examples. BHP Billiton will critically review the examples of adaptive management for the next EIR to ensure that each is clear and relevant.
IEMA-9	Process	The 2009 EIR does not recognize the geographical extent of “ecozone”, “ecoregion” and “ecosection” that were provided during the 1995 EIS as additional information to the panel, and this affects the significance criteria.	BHP Billiton has attempted to fairly bring forward the effects ratings and criteria from the 1995 EIS in a manner consistent with previous EIRs. The February 2010 Technical Addendum provides a more in-depth description of the general methodology used for rating effects that includes discussion of these spatial boundaries.
IEMA-10	Process	“It would be far more appropriate to indicate that the residual effects are uncertain or unknown until appropriate studies and research are concluded.” IEMA also provides specific examples of caribou avoidance of the mine site, caribou behaviour, carnivore habitat and wolverine track surveys.	BHP Billiton disagrees with IEMA’s statement. The collection of monitoring information is a progressive process that evolves as information is gathered and understood. The point at which the information is adequate to enable an effect assessment is a subjective determination that could effectively defer an effect assessment indefinitely. BHP Billiton feels that it is important to conduct periodic effect assessments (such as the 2009 EIR) based on the information at hand and to document the information and uncertainties involved. These periodic assessments then help to grow the monitoring programs in appropriate and focussed directions. The current process for revisions to the WEMP is an example of this. For added clarity the February 2010 Technical Addendum and Close-Out Report document where that the available data contains higher than normal uncertainty.
IEMA-13	Process	Better explanation of the use of Traditional Knowledge in monitoring programs should be provided.	BHP Billiton works hard to solicit and use TK in the monitoring programs and wishes to provide clear explanations and descriptions of its work. BHP Billiton will review these descriptions to increase the clarity in future reports.

Appendix B

EIR Process Meeting Presentation and Notes

2012 Environmental Impact Report- Process Workshop

Chateau Nova meeting room – 4401 50th Ave Yellowknife NT
December 8, 2011

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SPACER

- SPACER is a tool to facilitate a good start to all meetings.

S afety

P urpose

A genda

C ode of Conduct (Ground Rules)

E xpectations

R oles and responsibilities

Purpose

- Meaningful Process
- Satisfactory Environmental Impact Report (EIR)

Discussion Topics

- Environmental Agreement (EA) Requirements Fulfilled
- Report Outline
- Consultation Process
- Schedule

Meeting Agenda

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Time	Topic
8:30am	Coffee
9:00am	**Environmental Agreement Requirements of the EIR**
9:30am	IEMA Discussion Paper – Building Consensus: Toward a Shared Understanding of the EKATI Environmental Impact Report • Review of Recommendations
10:00am	Report Outline (Preliminary)
10:30am	Break
10:45am	Schedule of EIR Process
11:00am	Discussion Topics
12:00pm	Lunch provided

Environmental Agreement

- Ensure that BHP Billiton follows through with commitments to environmental monitoring, reclamation and reporting that BHP Billiton made in its 1995 EIS
- Designed as an integrated and innovative approach to monitoring and adaptive management of the mine's environmental effects

ENVIRONMENTAL AGREEMENT

DATED AS OF JANUARY 6, 1997

BETWEEN

HER MAJESTY THE QUEEN IN RIGHT OF CANADA
as represented by the Minister of Indian Affairs
and Northern Development

AND

THE GOVERNMENT OF THE NORTHWEST TERRITORIES
as represented by the Minister
of Resources,
Wildlife and Economic Development

AND

BHP DIAMONDS INC.
a body corporate, incorporated pursuant to the laws of
Canada and having its place of business in the City
of Yellowknife, in the Northwest Territories on behalf
of itself and its joint venture partner, the Blackwater Group

Environmental Agreement

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"BHP shall:

- prepare and submit to the Minister, the GNWT, the Monitoring Agency and the Aboriginal Peoples a comprehensive report (the "Environmental Impact Report") on April 30, 2000 and on each third April 30 thereafter until full and final reclamation of the Project site has been completed in accordance with the requirements of all Regulatory Instruments and the terms of this Agreement.
- Each Environmental Impact Report
  - shall be accompanied by a plain English summary prepared by BHP and
  - shall report on longer term effects of the Project and
  - the results of environmental monitoring programs and
  - the actual performance of the Project in comparison to the results predicted in the Impact Statement
  - and to evaluate how BHP's adaptive environmental management has performed to the date of such report."

Environmental Agreement

- Each Environmental Impact Report shall, inter alia, include:
  1. a summary of operational activities during the reporting period;
  2. actions taken or planned to address impacts or compliance programs which are set out in the Environmental Impact Report;
  3. a summary of operational activities for the next reporting period; and
  4. list and abstracts of all Environmental Plans and Programs.

Environmental Agreement

BHP

- "shall consult with representatives of the Minister, the GNWT and the Monitoring Agency as BHP compiles the information and data to be included in such Environmental Impact Report
- Within forty-five (45) days of the receipt by the GNWT, the Monitoring Agency and the Aboriginal Peoples of the Environmental Impact Report, the GNWT, the Monitoring Agency and the Aboriginal Peoples may advise the Minister whether such Environmental Impact Report is unsatisfactory;
  - including whether the information provided is adequate as well as whether or not remedial actions taken or proposed in respect of impact or compliance problems are satisfactory"

Environmental Agreement

- “Within ninety (90) days of the receipt of the Environmental Impact Report, the Minister may advise BHP whether the report is satisfactory or whether the Minister has determined (including based on reports from the GNWT, the Monitoring Agency and/or the Aboriginal Peoples and including whether the information provided is adequate as well as whether or not remedial actions taken or proposed in respect of impact or compliance problems are satisfactory) the Environmental Impact Report to be deficient. In the event that the Minister has determined an Environmental Impact Report is deficient, the Minister shall provide BHP with a Minister's Report.”

Environmental Agreement

- In relation to matters substantially within the jurisdiction of the GNWT, the Minister shall provide BHP with a Minister's Report pursuant to Section 5.2(d) when the Minister receives advice from the GNWT pursuant to Section 5.2(c) that the Environmental Impact Report is unsatisfactory and the GNWT advice shall be included in such Minister's Report.
- Within sixty (60) days of the receipt by BHP of the Minister's Report, BHP shall reply to the Minister's Report and provide the Minister with a revised Environmental Impact Report which addresses satisfactorily the deficiencies described in the Minister's Report.
- The Minister may, after consultation with the GNWT, provide BHP with an extension of time for delivery of an Environmental Impact Report where BHP is bona fide delayed in completing an Environmental Impact Report.
- The Minister may, after Consultation with the GNWT and the Monitoring Agency, increase the time between the Environmental Impact Reports.

Environmental Agreement

BHP shall

- "make each Annual Report and each Environmental Impact Report available to the public and shall arrange for public meetings to review and discuss each Annual Report or Environmental Impact Report, as the case may be."

Meeting Agenda

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Time	Topic
8:30am	Coffee
9:00am	Environmental Agreement Requirements of the EIR
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IEMA Discussion Paper

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Building Consensus: Towards a Shared Understanding on the EKATI Environmental Impact Report

Recommendations based on experience with EIRs:

- Consultation prior to submission of final report
- Submission of final report and summary plain language report (reflect entire contents of the technical report) on time and at the same time
- Should have a consistent process for soliciting comments on the EIR
- Should have a systematic tracking of EIR comments, responses and Minister's decisions.

IEMA Discussion Paper

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Recommendations based on focus and content:

- Focus
  - The Agency suggests the following focus for the 2012 EIR, in order of priority
    1. longer term effects;
    2. an evaluation of BHPB's adaptive management systems;
    3. results of monitoring programs; and
    4. actual vs. predicted effects.

- Adaptive Management:
  - Adaptive Management versus Best Practices
  - Evaluate Adaptive Management

IEMA Discussion Paper

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Recommendations based on focus and content:

- Effects Significance
  - Define 1995 Methodology
  - Document limitations and uncertainty (identify where further research is underway)
  - Based on trends
  - Include unpredicted effects

Meeting Agenda

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Time	Topic
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Report Outline (Preliminary)

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Chapter 1- Introduction

- Report objectives as outlined in the Environmental Agreement

Chapter 2- Background

- General information on the mine, environment and nearby communities
- The Mine Plan
- Overview of the mining process
- Mine operations
  - 1997 to 2008
  - 2009 to 2011
  - 2012 to 2014

- EA Report Components:
  - plain English summary
  - longer term effects of the Project
  - results of environmental monitoring programs
  - actual performance compared to predicted results
  - evaluate adaptive environmental management
  - ✓ operational activities during the reporting period and for next reporting period
  - planned actions to address impacts or compliance programs
  - abstracts of all Environmental Plans and Programs.

Report Outline (Preliminary)

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Chapter 3- Environmental Management

- BHP Billiton Charter guidance
- Environmental management framework
  - Environmental Agreement
  - Water Licences
  - Fisheries Act Authorizations
- Health, Safety, Environment and Community
  - Audits, unauthorized discharge management and solid waste management
- Adaptive Management approach

- EA Report Components:
  - plain English summary
  - longer term effects of the Project
  - results of environmental monitoring programs
  - actual performance compared to predicted results
  - evaluate adaptive environmental management
  - ✓ operational activities during the reporting period and for next reporting period
  - ✓ planned actions to address impacts or compliance programs
  - abstracts of all Environmental Plans and Programs.

Report Outline (Preliminary)

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Chapter 4- Assessment Methodology

- Provided in the 2009 Technical Addendum and Close-Out Report

- Significance ratings for the Residual effects
    - Predicted and unpredicted effects
    - Compare to 1995 EIS predictions
    - Summarize in a ‘report card’

Report Outline (Preliminary)

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Chapter 5, 6, 7, 8- Air, Land, Wildlife, Water and Fish

- Summary of monitoring programs
- Inclusion of Traditional Knowledge
- Impact assessment
  - Predicted effects, unpredicted effects and observed effects (historical and present)
  - Residual effect rating
  - Uncertainties
- Adaptive management and best practices
- Long-term predictions (where possible)- trend descriptions and identification of risks

- EA Report Components:
  - plain English summary
  - ✓ longer term effects of the Project
  - ✓ results of environmental monitoring programs
  - ✓ actual performance compared to predicted results
  - ✓ evaluate adaptive environmental management
  - ✓ operational activities during the reporting period and for next reporting period
  - ✓ planned actions to address impacts or compliance programs
  - abstracts of all Environmental Plans and Programs.

Report Outline (Preliminary)

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Chapter 9- Summary of Effects

- Number and magnitude of residual effects
- Summary table (include uncertainty and risks)

Appendix A- Acronyms, Glossary and Abbreviations

Appendix B- Annotated Bibliography (April 2009 to March 2012)

Appendix C- Independent Scientific Research at EKATI, 2009 to 2012

Appendix D- Construction Activities 2009 to 2012

- EA Report Components:
  - plain English summary
  - ✓ longer term effects of the Project
  - ✓ results of environmental monitoring programs
  - ✓ actual performance compared to predicted results
  - ✓ evaluate adaptive environmental management
  - ✓ operational activities during the reporting period and for next reporting period
  - ✓ planned actions to address impacts or compliance programs
  - ✓ abstracts of all Environmental Plans and Programs.

Meeting Agenda

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Time	Topic
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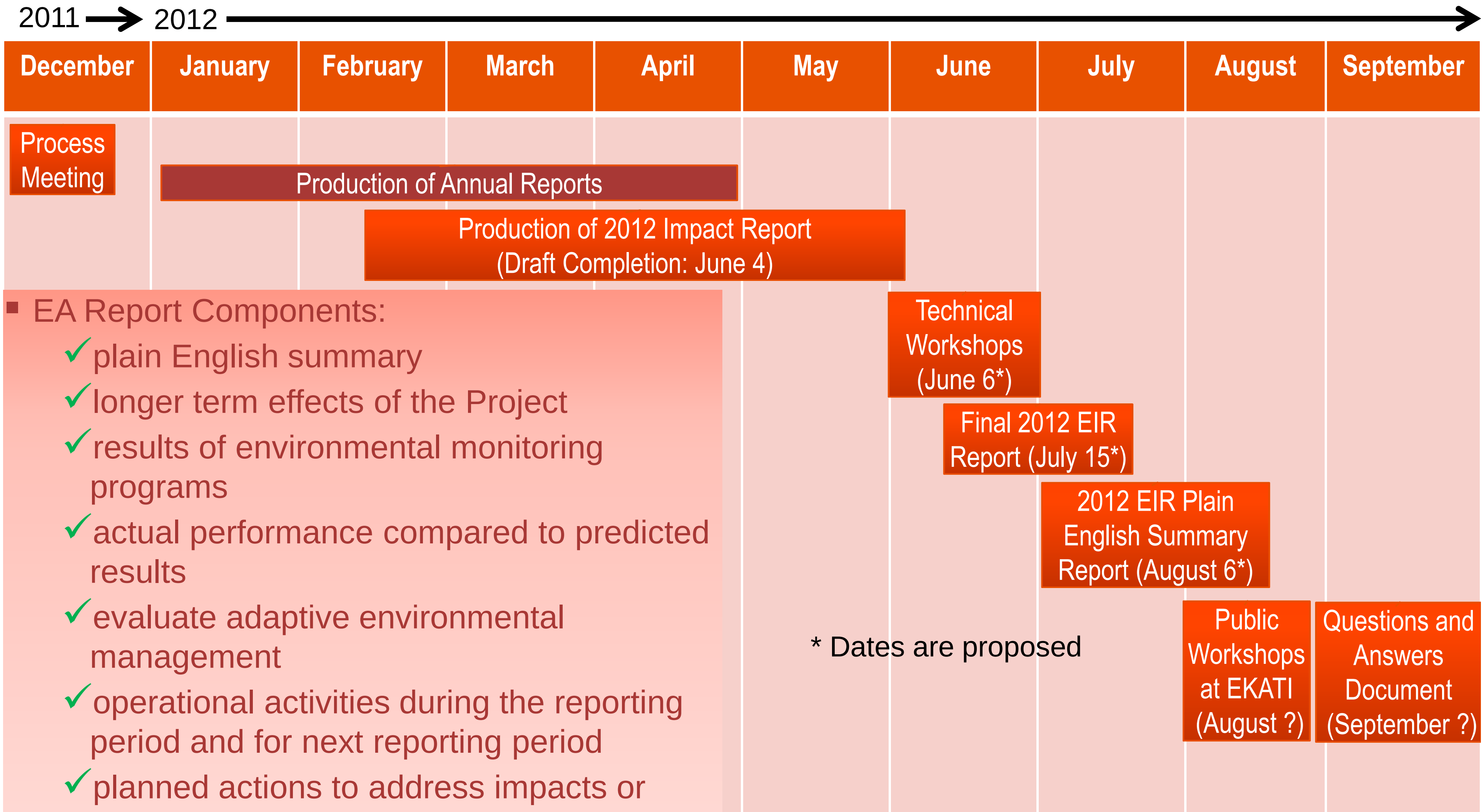
Proposed Report Schedule



- EA Report Components:
  - ✓ plain English summary
  - ✓ longer term effects of the Project
  - ✓ results of environmental monitoring programs
  - ✓ actual performance compared to predicted results
  - ✓ evaluate adaptive environmental management
  - ✓ operational activities during the reporting period and for next reporting period
  - ✓ planned actions to address impacts or compliance programs
  - ✓ abstracts of all Environmental Plans and Programs.

Discussion Topics (1 Hour)

- EA Requirements Fulfilled
- Report Outline
- Consultation Process
- Schedule
- Other

Required Components- Reporting

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- Plain English summary
- Longer term effects of the Project
- Results of environmental monitoring programs
- Actual performance compared to predicted results
- Evaluate adaptive environmental management
- Operational activities during the reporting period and for next reporting period
- Planned actions to address impacts or compliance programs
- Abstracts of all Environmental Plans and Programs.

Required Components- Process

- Consultation
- Upon receipt (within 45 days) GNWT, IEMA and Aboriginal Peoples of the EIR may advise the Minister
- The Minister may advise (within 90 days) whether report is satisfactory based on reports from IEMA and Aboriginal Peoples of the EIR
  - if unsatisfactory the Minister shall provide BHP Billiton with a Minister's Report
- Reply to Minister's report within 60 days
- Minister may provide an extension of time for EIR delivery
- Minister may increase time between EIRs
- Make each Annual Report and each Environmental Impact Report available to the public and shall arrange for public meetings

Environmental Management Framework- Monitoring Programs

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Environmental Impact Report- 3 Years

Water Licence

- Aquatic Baseline and Monitoring
- Surveillance Network Monitoring (SNP)
- Waste Rock and WRSA Seepage Monitoring
- Aquatic Effects Monitoring (AEMP)

Environmental Agreement

- Air Quality Monitoring (AQMP)
- Land Use Monitoring- Reclamation
- Land Use Monitoring- Archaeology
- Wildlife Effects Monitoring (WEMP)
- Traditional Knowledge Monitoring
- Environmental Baseline Monitoring

Fisheries Act Authorizations

- Panda Diversion Channel (PDC) Monitoring
- Nero-Nema Monitoring

Environmental Management Framework- Management Plans

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Environmental Impact Report- 3 Years

Water Licence

- Interim Closure and Reclamation Plan
- Reclamation Research
- Hydrocarbon Contaminated Materials Management Plan
- Spill Contingency Plan
- Drawdown Plans
- Wastewater and Processed Kimberlite Management Plan
- ML/ARD and Geochemical Characterization Plan
- Waste Rock and Ore Storage Management Plan

Environmental Agreement

- Air Quality Management and Monitoring Plan
- Materials Management Plan
- Wildlife Management Plan
- Traffic Management Plan
- Aquatic Life Management Plan
- Waste Management Plan
- Adaptive Management Plan
- Quarry Management Plan
- Closure and Reclamation Plan
- Archaeology Management Plan
- Environmental Awareness Plan
- Construction Phase Management Plan
- Operating Environmental Management Plan

Fisheries Act Authorizations

- Sable, Pigeon and Beartooth Compensation Plan
- Desperation Carrie Compensation Plan
- Nero-Nema Compensation Plan
- King Pond Compensation Plan
- Panda, Koala, Misery, Fox 1, Alexis and Leslie Compensation Plan

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Environmental Impact Report (EIR) Process Meeting

December 9, 2011
Yellowknife, NT

PARTICIPANTS:

Name	Group
Krystal Thompson	Aboriginal Affairs and Northern Development Canada (AANDC)
Karl Schubert	BHP Billiton Canada (BHPB)
Charles Klengenberg	BHPB
Keith McLean	BHPB
Jamie Steele	BHPB
Charity Clarkin	BHPB
Helen Butler	BHPB
Eric Denholm	BHPB
Gavin More	Environment and Natural Resources (ENR)
Andrea Patenaude	ENR
Lisa Lowman	Environment Canada (EC)
Sarah-Lacey McMillan	EC
Bruce Hanna	Fisheries and Oceans Canada
Kevin OReilly	Independent Environmental Monitoring Agency (IEMA)
Laura Johnston	IEMA
Bill Ross	IEMA
Tony Peause	IEMA
Tim Byers	IEMA
Sheryl Grieve	IEMA
Kim Poole	IEMA
Anut Pidieefin	Kitikmeot Inuit Association
Barbara Adjun	Kugluktuk Hunters and Trappers
Mike Tollis	Lutsel K’e
Marc Wen	Rescan
Tonia Robb	Rescan
Ginger Gibson	Tlicho

The following notes represent the discussions during the EIR Process Meeting as part of the consultation process for the 2012 EIR. This is not a transcript of the meeting.

Discussion Topic:

[Karl Schubert]: What do you consider consultation?

Responses:

[Bill Ross]: We believe the intent of this meeting is for stakeholders to contribute to the content of the EIR and if it should be adjusted

[Gavin More]: Provide comments during the draft of the report to avoid a final report with additional reports

Discussion Topic:
[Gavin More]: Suggest that the during the year of the EIR, the annual reports be included (avoid multiple reports for review)

Responses:
[Kim Poole]: Will the late delivery of the EIR affect the annual reports submission?
[Bill Ross]: Annual report should be the same time as the EIR? April or August?
[Eric Denholm]: There are 2 annual reports- one required by Water Licence (WL) and one by the Environmental Agreement (EA).
[Gavin More]: Having the Annual Report in the EIR causes confusion for some reviewers because there is a regulatory gap under EA should be separate
[Bill Ross]: Integration is preferred

Discussion Topic:
[Kevin OReilly]: Comments on the EIR and responses should be tracked through time. Currently there is not tracking system and it is difficult to find previous comments on earlier versions of the EIR.

Responses:
[Bruce Hanna]: If the EIR is submitted with Annual Report on the Water Board website then tracking is included
[Eric Denholm]: It is possible that the Water Board could track for BHPB.
ACTION ITEM: Eric Denholm will discuss with the Water Board the possibility of submitting the EIR on their website and allow tracking of the comments.
[Kevin OReilly]: The agency could upload on their site but too slow. We suggest BHPB should have own site with posts worthy of discussion.
[Krystal Thompson]: I will take these suggestions to the minister and get back to you on this topic.

Discussion Topic:
[Keith McLean]: Regarding IEMA's Discussion paper- What should be the focus of the EIR

Responses:
[Bill Ross]: We feel the focus of the EIR is one of the more important recommendations put forward by the discussion paper. Issues today need to be put forward as the main focus of the report (prominently covered); actual vs predicted are often a non-issue and don't need to be discussed. In addition adaptive management must be distinguished from best practices.

In addition BHPB should be careful when indicating a positive effect. Historical EIRs noted positive effects when they were not and these should not be brought forward in the 2012 EIR.

[Sheryl Grieve]: Will community input be solicited for input on the ratings?

[Eric Denholm]: There is still some importance to comparing to 1995 predictions

[Bill Ross]: I agree but continuing to use unacceptable indicators is not suitable

[Karl Schubert]: The Technical Workshops (scheduled upon completion of the Draft 2012 EIR) will allow BHPB to provide the ratings and allow agency and others to request removal or changes or review

<u>Discussion Topic:</u>

[Marc Wen]: What level of detail is required for reports on monitoring programs?

<u>Responses:</u>

[Tim Byers]: No methodology but highlighting major results.

[Bill Ross]: Should be more high level but also include more important results especially if they are related to the long term and things that matter

[Kim Poole]: It is fine to reference reports but need to provide long term trend if not presented explicitly in other reports

[Laura Johnston]: A synthesis and interpretation of what it means
[Kim Poole]: It should include results that go further back than the last 3 years. There should be more of a description of trends.
[Gavin More]: I agree that should be more than the last 3 years; long term predictions can also be included as well as changes to the monitoring programs or mine practices as well as importance

[Sheryl Grieve]: The Technical Workshops will be a good place to decide importance and include Traditional Knowledge

[Tim Byers]: The glossary should avoid using technical terms to describe another term

[Tony Peause]: The summary of effects should be a discussion with lessons learned and what monitoring programs should focus on in the future
[Kevin OReilly]: Abstracts should include a table of management plans and the last update or they should be provided in a new appendix

<u>Discussion Topic:</u>

[Keith McLean]: Are there any comments on the 2012 EIR reporting schedule

<u>Responses:</u>
[Bill Ross]: General flow is good; but review of the draft needs to be at least one week
[Sheryl Grieve]: There might be more time required for review by communities
[Bill Ross]: It is not necessary to change the EA to release the report in August rather than April

[Eric Denholm]: If no objections are made on the summary notes of the meeting, then the dates proposed should be sufficient.

[Kevin Oreilly]: Suggest BHPB should write a letter to GNWT Minister with intentions of the EIR schedule. [Eric Denholm] agrees that a letter to the Minister is necessary however the letter content should be reviewed
[Sheryl Grieve]: Should communities be involved in the decision?

[Laura Johnston]: According to the EA the date of the EIR submission should be discussed only with the GNWT

[Krystal Thompson]: I will confer with my team on what is required in the letter to the Minister regarding the EIR reporting schedule.

ACTION ITEM: Krystal Thompson will provide what is required in the letter to the Minister regarding the EIR reporting schedule.

<u>Discussion Topic:</u>

[Marc Wen]: We will not be able to provide everyone with a complete draft EIR report prior to the Technical Workshops. What are your expectations of the draft submitted prior to the workshops?

<u>Response:</u>

[Bill Ross]: Will require sufficient text to have understanding of the key messages (i.e., could be in bullet form). The report does not need to be the final draft.

<u>Discussion Topic:</u>

[Keith McLean]: The two previous EIRs included the Annual Report (required by the Environmental Agreement and Water Licences). Is there a preference for it to be included in the 2012 EIR?

<u>Responses:</u>

[Bill Ross]: It should be made available in April each year and not a part of the EIR
[Gavin More]: If included in the EIR, it will not be reviewed by us but the decisions will made on the EIR
[Eric Denholm]: Will the ministers report be on both reports?
[Charity Clarkin]: By inclusion of the report could there be a single review period?
[Krystal Thompson]: These questions will require consultation with our legal team.

<u>Discussion Topic:</u>

[Keith McLean]: Where will past EIR reports and comments be posted?

<u>Responses:</u>

[Bill Ross]: This should be done; one option is for the agency to do this but will require cooperation with the company for historical documents

[Karl Schubert]: BHPB’s website cannot provide all reports
[Krystal Thompson]: The comment tracking should also be set-up when this is completed

[Kevin Oreilly]: This could be further discussed in separate meeting with BHPB
[Eric Denholm]: Tracking of comments could also be completed by the Water Board document tracking

Discussion Topic:

[Marc Wen]: What is your expectation of how we should discuss 'going forward'

Responses:

[Gavin More]: The EIR provides a place for those issues not covered by the Water Board
[Charity Clarkin]: The AEMP will continue on its cycle of review as defined by the Water Licence. However review and improvements to the air and wildlife monitoring components could be included in the EIR

[Laura Johnston]: The Technical Workshops should concentrate on synthesis, significance, adaptive management and looking forwards

Discussion Topic:

[Marc Wen]: It might be possible to get away from the rating system (e.g., minor versus moderate impact) and instead just compare to what was stated in the Environmental Impact Statetment as a narrative instead of a single grade.

Responses:

[Laura Johnston]: This could be possible as long as the 'so what' question is still incorporated i.e., why are these results important and if necessary what is BHPB doing to manage effects.

[Helen Butler]: The rating does provide a discussion point and is useful for the purpose of the EIR

[Tim Byers]: The discussion should build more on the meaning of the results and not focus on the comparison to 1995

[Kevin Oreilly]: The agency feels most of the significant trends in the 2009 weren't rated properly. It would be better to correct the rating system

[Bill Ross]: If this could be complete, we would be open to discussing the details of the narrative and rating system

Appendix C

Annotated Bibliography (April 2009 to April 2012)

Appendix C. Annotated Bibliography (April 2009 to April 2012)

The following is a list of 60 technical reports published by BHP Billiton and prepared by BHP Billiton or their consultants between April 2009 and April 2012. The reports are presented chronologically by year and month or report issuance and by subject area.

2009 REPORTS

2009 Aquatics Monitoring

1.
Title: EKATI Diamond Mine: 2008 Aquatic Effects Monitoring Program. Summary Report, Appendix A: Evaluation of Effects, Appendix B: Data Report, Appendix C: Statistical Results.

Prepared by: Rescan Environmental Services

Date: April 2009

Description: The Aquatic Effects Monitoring Program (AEMP) at EKATI is a requirement specified in both of BHP Billiton Diamond Inc.'s Class A Water Licences. The program is designed to detect changes in the aquatic ecosystem that may be caused by mining activities. 2008 was the 11th consecutive year of post-baseline monitoring within the Koala Watershed and Lac de Gras, and the eighth consecutive year of post-baseline monitoring within the King-Cujo Watershed and Lac du Sauvage.

The 2008 AEMP report contains the following documents:

- The Summary Report that provides an overview of the aquatic monitoring program and consolidated findings.
- Appendix A: Evaluation of Effects, that describes the methods used to assess change in the aquatic environment and summarizes the results of the assessment. It compares data collected from potentially affected (monitored) lakes and streams with data collected from reference lakes and streams.
- Appendix B: Data Report, that describes the 2008 AEMP field methodology and includes both the raw and summarized data collected during the 2008 sampling period (October 2007 to September 2008).
- Appendix C: Statistical Report, that provides the detailed results of the statistical analyses reported in Appendix A.

2.
Title: EKATI Diamond Mine: Panda Diversion Channel Monitoring Program 2008 Volume I – Technical Report.

Prepared by: Rescan Environmental Services

Date: April 2009

Description: This report describes the results from the tenth and final year of the fish monitoring program of the Panda Diversion Channel (PDC) established at the EKATI. The PDC was constructed in 1997 as compensation for loss of stream habitat during development of EKATI. Monitoring of the PDC began in 1999 and 2008 was the tenth year of the monitoring program. The principal objective of the monitoring program was to assess the effectiveness of the PDC in providing productive fish habitat. This was done, in part, by comparing productivity of the PDC with the productivity of two nearby natural streams, Pigeon and Polar-Vulture. Results from the tenth and final year of monitoring the PDC demonstrated that it continued to be effective in providing fish habitat. It is inhabited by six fish species and provides effective rearing, spawning and feeding habitat as well as a migration corridor between Kodiak Lake and North Panda Lake.

3.
Title: EKATI Diamond Mine: Critical Effect Size Scoping Document for the Aquatic Effects Monitoring Program.

Prepared by: Rescan Environmental Services

Date: May 2009

Description: This document outlines BHP Billiton's approach to defining Critical Effect Size (CES) and providing interested stakeholders the opportunity to participate in a discussion of CES for the EKATI AEMP. It also reviews the link between the Minimum Detectable Difference (MDD) already included in the AEMP and the CES.

4.
Title: EKATI Diamond Mine: LLCF Water Quality Investigation, 2007 - 2008

Prepared by: Rescan Environmental Services

Date: June 2009

Description: The Long Lake Containment Facility (LLCF) is the processed Kimberlite management facility for the EKATI Diamond Mine. Since September 2004, a comprehensive water sampling program has been conducted to measure the seasonal and yearly variations in water quality within the LLCF. The results of the 2007/08 program are presented in this report and are discussed in comparison to results from previous years.

5.
Title: EKATI Diamond Mine: Work Plan for the 2009 Phase II Long Lake Containment Facility Nitrate *In Situ* Treatment Test

Prepared by: Rescan Environmental Services

◎ Table of Contents

Date: June 2009

Description: The Long Lake Containment Facility (LLCF) has increased steadily since the facility was commissioned. The nitrate originates mainly from residual blasting agents containing ammonium nitrate. The objective of the proposed work is to reduce nitrate concentrations by 25% to 50% in the epilimnion (surface layer) of Cell D of the LLCF.

6.
Title: EKATI Diamond Mine: A Study of Fish in Cell E of the Long Lake Containment Facility.

Prepared by: Rescan Environmental Services

Date: November 2009

Description: Results of data collected for the 2007 Aquatic Effects Monitoring Program (AEMP) indicated that fish communities downstream of the Long Lake Containment Facility (LLCF) were being affected by mine activities. There was, however, some uncertainty associated with these conclusions. This report summarizes the 2008 study, which attempted to answer whether the changes observed were associated with mine effects, and if so, to identify the specific stressors responsible for these effects.

2009 Wildlife

7.
Title: EKATI Diamond Mine: 2008 Wildlife Effects Monitoring Program.

Prepared by: Rescan Environmental Services

Date: March 2009

Description: This report presents the results of the 2008 Wildlife Effects Monitoring Program (WEMP) conducted at the EKATI Diamond Mine (EKATI). The WEMP monitors wildlife and documents any wildlife effects resulting from mining activities and associated development at EKATI. The WEMP also assesses the effectiveness of wildlife mitigation and management efforts. The program focuses on animal species identified as species of greatest concern, termed Valued Ecosystem Component or VEC.

2009 Other

8.
Title: Thermal Evaluation of Filling Pit with Mine Water EKATI Diamond Mine, NT.

Prepared by: EBA Engineering Consultants Ltd.

Date: April 2009

Description: In 2009, open-pit mining in Beartooth Pit at the EKATI Diamond Mine, NT, was scheduled to finish. Underground mining in the Beartooth kimberlite pipe was not planned and consideration was being given to pump mine water into Beartooth Pit as part of the mine water management system. This would take place simultaneously with ongoing mining in the Panda/Kola underground. Underground operations are planned to operate until 2020. All pits at EKATI, including Beartooth Pit, are required to be filled with water as a part of the long-term closure and reclamation efforts. This report assesses the short-term effects to ground temperature due to pumping mine water into Beartooth pit during the period of underground mine operations.

9.
Title: EKATI Diamond Mine: Environmental Impact Report 2009.

Prepared by: Rescan Environmental Services

Date: April 2009

Description: The comparison of results from environmental monitoring activities from 2006 to 2008 to the predictions of the 1995 *Environmental Impact Statement,* were outlined in this report. Background descriptions of EKATI's environment and mine operations, as well as descriptions of the environmental management policies (i.e. traditional knowledge), were provided in this report. The primary objectives of this report were to report the results of the monitoring valued ecosystems components from 2006 to 2008, compare the enduring effects of the mine against the 1995 predictions, and asses the mitigation and adaptive management actions. Approximately 89% of the 46 residual effects were listed as negligible –to-minor, negligible, or positive in significance. It was determined the mine has left a manageable and reversible footprint on a portion (0.77%) of the current EKATI claim block.

2010 REPORTS

2010 Aquatics Monitoring

10.
Title: EKATI Diamond Mine: 2009 Aquatic Effects Monitoring Program Re-Evaluation.

Prepared by: Rescan Environmental Services

Date: January 2010

Description: The AEMP is re-evaluated every three years allowing new information to be reviewed by BHP Billiton and other stakeholders, thus providing for a more in depth review of the program. The 2009 re-evaluation report addresses comments provided by reviewer on recent AEMP reports, as well as from the previous AEMP re-evaluation. Multivariate statistical techniques were used to explore patterns in the data that may otherwise not be identified in the annual program. Effect sizes are discussed, and the concept of Minimum Detectable Differences is explained to in relation to the AEMP. The overall sampling design and annual statistical evaluation is reviewed to identify additional variables that should be incorporated into the annual evaluation. The AEMP re-evaluation provided a total of 33 recommendations to improve and refine the quality of collected data and their analysis under the 2010-2012 AEMP Plan for EKATI.

11.
Title: EKATI Diamond Mine: 10-year Panda Diversion Channel Monitoring Program.

Prepared by: Rescan Environmental Services

Date: March 2010

Description: BHP Billiton established a ten-year monitoring program from 1999 to 2008 to assess the effectiveness of the Panda Diversion Chanel in providing productive fish habitat. The principal focus was Arctic grayling because it is the predominant fish species in the PDC. Following completion of the ten-year monitoring program, BHP Billiton reduced the program to focus monitoring efforts on Arctic grayling spawners and their use of the PDC. This report contains the results from the 12th year of fish monitoring in the PDC. Results from the 12th year of monitoring the PDC demonstrated it to be effective in providing fish habitat. It is inhabited by seven fish species and provides valuable spawning and feeding habitat, as well serving as a migration corridor between Kodiak Lake and North Panda Lake.

12.
Title: EKATI Diamond Mine: 2008/2009 Long Lake Containment Facility Nitrate *in situ* Treatment Test.

Prepared by: Rescan Environmental Services

Date: April 2010

Description: The Long Lake Containment Facility (LLCF) is the primary mine wastewater and processed kimberlite management facility for EKATI. Levels of nitrate have increased in the LLCF in recent years. Ammonium-nitrate blasting agents are believed to be the main source of nitrate to the LLCF. EKATI's water licence does not include a discharge criterion for nitrate; however, rising nitrate concentrations are a concern because of the potential toxicity to downstream aquatic organisms.

Phase I, undertaken during the summer of 2008, consisted of a mesoscale demonstration that phytoplankton in the LLCF are phosphorus-limited and that the enrichment of surface waters with phosphate could be an effective way to reduce nitrate levels. Building on the results of Phase I, Phase II consisted of a larger-scale addition of phosphate to the waters of Cell D, the largest containment cell (by area and volume) in the LLCF. Phase II was undertaken during the ice-free season of 2009. Conditions were monitored closely in the adjacent downstream pond, Cell E, for any chemical or biological response to the experiment being undertaken in Cell D. There was no observed increase in total phosphorus or phytoplankton biomass in Cell E, confirming that the Phase II experiment was contained within Cell D.

13.
Title: EKATI Diamond Mine: 2009 Aquatic Effects Monitoring Program. Summary Report, Appendix A: Evaluation of Effects, Appendix B: Data Report, Appendix C: Statistical Results.

Prepared by: Rescan Environmental Services

Date: April 2010

Description: The Aquatic Effects Monitoring Program (AEMP) at EKATI is a requirement specified in BHP Billiton Canada Inc.'s (BHP Billiton) Class A Water Licence. Sampling conducted for the 2009 AEMP was permitted through the Aurora Research Institute (ARI) Scientific Research Licence issued for EKATI for the collection of samples from April 1 to December 31, 2009.

The 2009 AEMP report consists of the following documents:

- the Summary Report (this report), which provides an overview of the aquatic monitoring program and consolidated findings;
- Appendix A: Evaluation of Effects, which describes the methods used to assess change in the aquatic environment and summarizes the results of these assessments;
- Appendix B: Data Report, which describes the 2009 AEMP field methodology and includes both the raw and summarized data collected during the 2009 sampling period (October 2008 to September 2009); and

- o Appendix C: Statistical Results, which provides the detailed results of the statistical analyses reported in Appendix A.

The year 2009 was the 12th consecutive year of post-baseline monitoring within the Koala Watershed and Lac de Gras, and the ninth consecutive year of post-baseline monitoring within the King-Cujo Watershed and Lac du Sauvage.

14.
Title: EKATI Diamond Mine: 2009 Panda Diversion Channel Monitoring Program.

Prepared by: Rescan Environmental Services

Date: April 2010

Description: The Panda Diversion Channel (PDC) was constructed in 1997 as compensation for the loss of stream habitat during the development of EKATI Diamond Mine in accordance with an agreement with the Fisheries and Oceans Canada. Under this agreement, BHP Billiton Canada Inc. established a ten-year monitoring program from 1999 to 2008 to assess the effectiveness of the PDC.

The principal objective of the ten-year monitoring program was to assess the effectiveness of the PDC in providing productive fish habitat, focusing predominantly on Arctic grayling because of its prevalence in the PDC. 2008 was the last year of the ten-year monitoring program. Following completion of the ten-year monitoring program, BHP Billiton reduced the program to focus monitoring efforts on Arctic grayling site fidelity and spawner use of the PDC. This report contains the results from the eleventh year of fish monitoring in the PDC.

15.
Title: EKATI Diamond Mine: Pigeon Stream Diversion Monitoring Program 2009 Data Report.

Prepared by: Rescan Environmental Services

Date: April 2010

Description: This report describes the fifth year of pre-construction monitoring of the Pigeon Watershed. The baseline information will be used in the future for comparison of the Pigeon Stream Diversion with post-construction monitoring to determine whether the construction of the Pigeon Stream Diversion is successful in providing fish habitat.

16.
Title: EKATI Diamond Mine: Aquatic Effects Monitoring Program Plan for 2010 to 2012.

Prepared by: Rescan Environmental Services

Date: July 2010

Description: As a condition of BHP Billiton Water Licence W2009L2-0001, EKATI Aquatic Effects Monitoring Program requires re-evaluation every three years. The first re-evaluation in 2003 examined the performance of the AEMP between 1998 and 2002. The 2006 re-evaluation report covered the AEMP during the period of 2003 to 2006. A third re-evaluation was completed in January 2010 and reviewed the performance of the AEMP between 2007 and 2009. The 2009 re-evaluation report including a list of 33 recommendations was submitted to the Wek'èezhìi Land and Water Board (WLWB) and presented to stakeholders, at workshops in February 2010. Following the workshops, WLWB solicited written comments from stakeholders to consider and provided BHP Billiton recommendations to be incorporated into an AEMP design summary for 2010 to 2012. This AEMP plan presents the design summary for 2010–2012, incorporating each of the recommendations provided by the WLWB.

17.
Title: EKATI Diamond Mine: 2009 Waste Rock and Waste Rock Storage Area Seepage Survey Report.

Prepared by: SRK Consulting (Canada)

Date: August 2010

Description: BHP Billiton is required to monitor waste rock storage area seepage quality and characterize waste rock at the EKATI Diamond Mine. Findings of these monitoring programs are reported annually in the Waste Rock and Waste Rock Storage Area Seepage Survey reports. The 2009 survey did not lead to any new general water types as in previous years. Based on the 2009 seepage monitoring results, no revisions to the approved waste rock and ore storage management plan are required. All water quality parameters measured at seepages that drain to the receiving environment were within the acceptable ranges specified in Water Licence MV2009L2-0001.

18.
Title: EKATI Diamond Mine: 2010 Freshet Waste Rock Storage Area Seepage Survey Report.

Prepared by: SRK Consulting (Canada)

Date: August 2010

Description: Impact to runoff water quality was identified as a possible consequence of developing waste rock storage areas at EKATI through BHP Billiton's Environmental Impact Statement and the subsequent Environmental Assessment Review Process. This report documents the June 2010 results from the spring freshet seepage. To note, this report does not include detailed interpretation of the results.

19.
Title: EKATI Diamond Mine: 2008-2009 Fay Bay Monitoring Program.

Prepared by: Rescan Environmental Services

Date: September 2010

Description: In May 2008, a release of approximately 4,465 m^3 of processed kimberlite (PK) to the shore and ice of Fay Bay adjacent to Cell B of the LLCF was identified and reported. Clean up efforts occurred immediately following the release and resulted in the successful removal of 80% of the total PK volume of released. This report provides the results of the 2008 and 2009 monitoring programs conducted to assess any potential effects to the aquatic environment following the unplanned release of PK. Overall, the two year monitoring program conducted at Fay Bay and downstream environments following the unplanned PK release indicated short-term localized effects to both the physical and chemical nature of the aquatic environment. Given the inherent variability of aquatic biology in space and time, follow-up monitoring for water quality, primary and secondary producers is recommended for an additional year to provide additional insight and verification to these conclusions.

2010 Wildlife Monitoring

20.
Title: EKATI Diamond Mine: 2009 Wildlife Effects Monitoring Program (WEMP)

Prepared by: Rescan Environmental Services

Date: March 2010

Description: This report presents the results of the 2009 Wildlife Effects Monitoring Program (WEMP) conducted at the EKATI Diamond Mine (EKATI). The WEMP monitors wildlife and documents wildlife effects resulting from mining development and associated activities at EKATI. The WEMP also assesses the effectiveness of wildlife mitigation and management efforts. The program focuses on animal species identified as species of greatest concern, termed Valued Ecosystem Component or VEC.

21.
Title: EKATI Diamond Mine: 13-Year Breeding Bird Monitoring Program Summary

Prepared by: Rescan Environmental Services

Date: March 2010

Description: This report provides a summary of the results from the 13-year Breeding Bird Monitoring Program, conducted from 1996 to 2008 at the EKATI Diamond Mine, Northwest Territories. Tundra breeding birds considered in this study include shorebirds, waterfowl, passerines, ptarmigan, and short-eared owl (a ground nesting raptor). Some of the most common tundra breeding bird species occurring in the EKATI study area include small perching birds and shorebirds, such as the American tree sparrow, Harris's sparrow, Lapland longspur, savannah sparrow, least sandpiper, and stilt sandpiper. The goal of the breeding bird survey at EKATI was to document the presence of tundra breeding bird species on control plots (plots greater than 5 km from the mine) and mine plots (less than 1 km from the mine) in the EKATI study area, and to test the null hypothesis that the mine is not affecting tundra breeding bird species.

2010 Other

22.
Title: Pigeon Stream Diversion Construction Specifications – Issued for Review.

Prepared by: EBA Engineering Consultants Ltd.

Date: January 2010

Description: This study summarizes the specifications for the construction of the Pigeon Stream Diversion (PSD). The development of the Pigeon Kimberlite Pipe will interrupt the natural flow path of Pigeon Stream through Pigeon Pond therefore a stream diversion is required. It will direct flows from the stream, around the pit, and back into the stream downstream of Pigeon Pond. The report is broken into discusses the following components: Site Preparation and Clean Up, Water Control, Excavation and Foundation Preparation, Fill Materials, Fill Placement, Liner System, Insulation, Quality Assurance Testing, and a Maintenance Plan.

23.
Title: EKATI Diamond Mine: Environmental Impact Report 2009 – Technical Addendum.

Prepared by: Rescan Environmental Services

Date: February 2010

Description: This addendum to the 2009 Environmental Impact Report (EIR) compiles BHP Billiton's responses to feedback received following the May 2009 technical sessions and the community workshop in August 2009. The report also documents all of the resultant changes to the EIR based on the feedback. A detailed description of the methodology that was used both in the 1995 EIS and in the 2009 EIR to rate the significance of residual environmental effects is provided in this Technical Addendum. This report also provides the errata for the 2009 EIR as well as a re-calculation of the greenhouse gas emissions at the EKATI mine site.

24.
Title: EKATI Diamond Mine: Environmental Impact Report 2009 - Close-out Report.

Prepared by: Rescan Environmental Services

Date: February 2010

Description: The purpose of this report is to describe the work that has been completed for the purpose of the 2009 Environmental Impact Assessment for the EKATI Diamond Mine. The impact assessment takes place every three years and following the 2009 process a follow-up meeting was held in December 2009 for discussion to better the EIR process. The feedback and information provided by others was a very valuable contribution and set a direction for the next assessment in three years times. The Close-Out Report provides an updated summary of the 2009 assessment containing all of the final technical changes and it was written in a new report structure that better highlights the topics of primary interest.

25.
Title: Environmental Agreement and Water Licences Annual Report 2009.

Prepared by: EKATI Diamond Mine, BHP Billiton Canada Inc.

Date: April 2010

Description: The 2009 Annual Report for the EKATI Diamond Mine was prepared to meet the annual reporting obligations outlined in the Water Licence issued under the Northwest Territories Waters Act and the Mackenzie Valley Resources Management Act as currently administered by the Wek'eezhi Land and Water Board as well as the Environmental Agreement. The report summarizes the activities completed by BHP Billiton and its employees during the 2009 calendar year to meet and achieve the requirements of the water licence and Environmental Agreement. A summary of the annual use of water and deposition of waste generated at EKATI in 2009 is also provided.

26.
Title: EKATI Diamond Mine Revegetation Research Projects – 2009

Prepared by: Harvey Martens and Associates

Date: April 2010

Description: BHP Billiton Canada Inc. (BHP Billiton) has been conducting revegetation research at the EKATI Diamond Mine (EKATI) since 1995, in support of the reclamation goals outlined in the Interim Closure and Reclamation Plan for the mine. This report describes the application of recultivation treatments in the Rock Pad Reclamation Study. Construction of a rock pad reclamation study, to assess reclamation techniques for stabilizing camp pads and laydown sites, was completed in 2008. The study plots are located on the Panda/Koala/Beartooth Waste Rock Storage Area. The application of recultivation treatments continued in 2009 with the planting of 1000 seedlings of four indigenous tundra species and evaluation of initial results. This research will assist in determining how best to use the limited supply of growth materials (i.e., topsoil, glacial till, lake sediment) to reclaim rock pads, such as the Main Camp and laydown areas at the EKATI mine site. The study will assess methods and procedures that optimize benefits from the salvaged growth materials that include best equipment to use and placement techniques. The study goals are to assess the ability of different plant materials to establish and grow on different growth materials, applied as a top dressing or in pockets (1.5 m x 1.5 m x 0.5 m) in the rock pad, and to identify what revegetation techniques are most effective in promoting plant growth.

27.
Title: EKATI Diamond Mine: Review of Misery WRSA Performance.

Prepared by: SRK Consulting (Canada)

Date: October 2010

Description: This report evaluated the geochemical performance of the Misery Waste Rock Storage Area (WRSA) as part of the Selection Phase Study for the development of the Pigeon Pit. The Misery WRSA performance from both a thermal and chemical perspective was evaluated and as the Misery pipe represents the closest analog to the Pigeon pipe, it has the potential for acid generating metasediments/biotite schists. Evidence of warming and sulphide oxidation was found in the Misery WRSA, however, due to the pile's age and the low sulphide content, results suggests that exhaustion of sulphide may be occurring with little significant worsening of water quality. Short term predictions can be developed using the current Misery WRSA through observations for the Misery WRSA and Pigeon WRSA.

28.
Title: Panda Diversion Channel Stabilization, EKATI Diamond Mine Design Report.

Prepared by: EBA Engineering Consultants

Date: November 2010

Description: Monitoring has identified three areas that require slope modification to improve the long-term stability of the Panda Diversion Channel (PDC). This report provides the complete design for the long-term stabilization of a portion of the PDC at EKATI. The report summarizes design and construction requirements. In addition the construction drawings and specifications were prepared and are included in the report. As a result of the PDC being an environmentally sensitive area, all work within the channel was intended to be completed in the winter, when the channel is frozen to the bottom. A snow/ice pad will be constructed in the channel to catch any debris resulting from blasting and excavation operations. All debris and loose material will be removed from within the channel limits to prevent the introduction of sediment into the watercourse at freshet.

29.
Title: MGT-78 Vibration Wire Piezometer Installation: Field and Interpretive Report

Prepared by: Schlumberger Water Services (Canada) Inc

Date: December 2010

Description: In July 2010, Schlumberger Water Services (Canada) Inc was contracted by BHP Billiton to contribute to the hydrology and hydrogeology sections to the Misery Development Study – Feasibility. The report identified four principal hydrogeological uncertainties: depth of permafrost, *h*ydraulic connection between south-west extension and Mist Lake, hydraulic connection between Lac de Gras and Misery Pit Piezometric level in and around Misery Pit

2011 REPORTS

2011 Aquatics Monitoring

30.
Title: EKATI Diamond Mine: Nero-Nema Stream Monitoring Program 2010.

Prepared by: Rescan Environmental Services

Date: March 2011

Description: Nero-Nema Stream is a short, wide stream that flows from Nero Lake to Nema Lake in the Koala Watershed. During the winter of 2002 to 2003, an open-span bridge for the Fox Access Road was installed over Nero-Nema Stream. The construction of this bridge resulted in a loss of fish habitat, necessitating compensation for the lost habitat. Addition of gravel within the stream was chosen as the means to increase fish habitat quality – specifically spawning habitat for Arctic grayling. From 2005 to 2007, eight Gravel Enhancement Pads (GEPs) were installed upstream and downstream of the bridge. The general objective of the Nero-Nema Stream monitoring program was to evaluate the effectiveness and success of the GEPs as compensatory habitat. The *Fisheries Authorization* obtained for this site indicates that the habitat is considered successful when it is proven to be functioning physically and ecologically as it was designed to. This report provides data that demonstrates that the compensation habitat is functioning physically and ecologically. It summarizes results of Arctic grayling spawner, egg, and fry surveys for 2010 and compares results to data collected in the previous four years.

31.
Title: EKATI Diamond Mine: 2010 Waste Rock and Waste Rock Storage Area Seepage Survey Report.

Prepared by: SRK Consulting (Canada)

Date: March 2011

Description: This report summarizes the conditions listed under Part G, Item 4 of Water Licence W2009L2-0001, along with the activities undertaken in 2010 by BHP Billiton to comply with all conditions, and documents how each Water Licence condition has been satisfied. During 2010, routine monitoring of waste rock seepage was continued following established protocols. No waste rock sampling was carried out at any of the underground developments or the Fox pit in the 2010 reporting year, as per the updated Geochemical Characterization and Metal Leaching Management Plan approved by the Wek'èezhìi Land and Water Board. Eight samples of coarse kimberlite rejects were collected in 2010. In 2010, seepage monitoring at EKATI generally showed results comparable to previous years. Based on these results, no revisions to the approved waste rock and ore storage management plan are required.

32.
Title: EKATI Diamond Mine: 2010 Aquatic Effects Monitoring Program. Summary Report, Part 1: Evaluation of Effects, Part 2: Data Report, Part 3: Statistical Report.

Prepared by: Rescan Environmental Services

Date: April 2011

Description: The Aquatic Effects Monitoring Program (AEMP) at EKATI is a requirement specified in BHP Billiton Class A Water Licence. Sampling for the 2010 season occurred between January 1st and December 31st, 2010. The AEMP is designed to detect changes in the aquatic ecosystem resulting from mine activities. The 2010 AEMP plan was developed following a detailed review of 2007 to 2008 AEMP results and stakeholders comments. The AEMP report consists of three sections: Part 1 – Evaluation of Effects: provides the methods used to assess change in the aquatic environment and summarizes the results of the effects assessments; Part 2 - Data Report: provides the state of the aquatic environment at EKATI in 2010, including the field methodology and results for each of the aquatic environmental components (e.g., physical limnology); and Part 3 - Statistical Report: provides the detailed results of the statistical analyses reported in the evaluation of effects.

33.
Title: EKATI Diamond Mine: Site Specific Water Quality Objective for Molybdenum, 2011.

Prepared by: Rescan Environmental Services

Date: April 2011

Description: The AEMP has indicated that molybdenum concentrations in some lakes and streams of the Koala Watershed have changed over time, with total molybdenum concentrations increasing in water of Leslie lake and Moose lake downstream of the Long Lake Containment Facility (LLCF) in comparison to historical baseline levels. Molybdenum has also increased in Nema Lake and in a Moose-Nero stream downstream of the LLCF. Due to increasing molybdenum, BHP Billiton commissioned a Tier 1 aquatic Ecological Risk Assessment (ERA) in 2006, which determined short and long-term exposure water site specific water quality objectives (SSWQOs). Since 2006, numerous acute and chronic toxicity studies have been completed. Current molybdenum concentrations are approximately 100 times lower than the SSWQO and approximately 1000 times lower than the short-term SSWQO.

34.
Title: EKATI Diamond Mine: 2010 Panda Diversion Channel Monitoring Program.

Prepared by: Rescan Environmental Services

Date: February 2011

Description: The Panda Diversion Channel (PDC) was constructed in 1997 as compensation for the loss of stream habitat during the development of EKATI Diamond Mine in accordance with an agreement between BHP Billiton and Fisheries and Oceans Canada, which established a ten-year monitoring program from 1999 to 2008 to assess the effectiveness of the PDC in providing fish habitat. With the completion of the ten-year monitoring program, BHP Billiton reduced the monitoring efforts on Arctic grayling. Arctic grayling were the principal fish of focus as they are the predominant fish species in the PDC. This report contains the results of the 12th year of fish monitoring in the PDC. Results from the 12th year of monitoring the PDC demonstrate that it continues to be effective in providing fish habitat. It is inhabited by seven fish species and provides valuable spawning and feeding habitat, as well serving as a migration corridor between Kodiak Lake and North Panda Lake.

35.
Title: EKATI Diamond Mine: 2010 Fay Bay Monitoring Program.

Prepared by: Rescan Environmental Services

Date: August 2011

Description: In May 2008, BHP Billiton identified and reported a release of approximately 4,465 m^3 of fine processed kimberlite (PK) to the shore and ice of Fay Bay adjacent to Cell B of the Long Lake Containment Facility (LLCF). Clean up efforts occurred immediately following the results and resulted in the successful removal of approximately 80% of the total volume of released PK. This report provides the results of the 2012 monitoring program conducted to assess the recovery of the area disturbed by the temporary access road used to recover PK and the recovery of the aquatic environment. Overall, the three year monitoring program results indicated that the phytoplankton and zooplankton communities are recovering while the benthos community remains unaffected.

36.
Title: EKATI Diamond Mine: 2010 Long Lake Containment Facility Nitrate *in situ* Treatment Test.

Prepared by: Rescan Environmental Services

Date: August 2011

Description: The Long Lake Containment Facility (LLCF) is the primary mine wastewater and processed kimberlite management facility for the EKATI Diamond Mine operated by BHB Billiton Canada Inc. Levels of nitrate have increased in the LLCF in recent years. Ammonium-nitrate blasting agents are believed to be the main source of nitrate to the LLCF. EKATI's Water Licence does not include a discharge criterion for nitrate; however, rising nitrate concentrations are a concern because of the potential toxicity to downstream aquatic organisms.

A potential mitigation strategy to reduce the nitrate load in the LLCF is to stimulate the growth of phytoplankton and the biological uptake of nitrate by fertilizing the LLCF with phosphate. Rescan Environmental Services Ltd. undertook a two-phased approach to test the effectiveness of this nitrate-removal strategy. This was considered to be a potentially feasible approach warranting field experimentation based on the isolated location of Cell D, the known abundance of nitrate in Cell D waters, the known phosphorus-limitation of algal growth in freshwater systems, and the known ability of algae to take up nitrogen species (e.g., nitrate and ammonia) from the water column.

The goal of the 2010 program was to resume the weekly open-water season phosphorus amendments in Cell D that began in 2009, in order to achieve further reductions in the nitrate load of the LLCF.

37.
Title: Summary Evaluation and Proposed Work Plan for the Fish Component of the 2012 Aquatic Effects Monitoring Program.

Prepared by: Rescan Environmental Services

Date: December 2011

Description: In its evaluation of the 2009 AEMP re-evaluation completed by BHP Billiton issued on May 4, 2010, the Wek'èezhìi Land and Water Board (WLWB) required that BHPB submit to the WLWB a work plan for the fish sampling program before the end of December 2011. This report addresses the key issues brought up by the WLWB and other stakeholders during the 2009 AEMP re-evaluation and provides the details of the proposed scope of work for the 2012 fish sampling program. Addressed in this report are four main issues: (1) the continued use of gillnets to sample fish populations, (2) the potential to use non-lethal sampling for the collection of tissue for metal analysis, (3) the potential to use slimy sculpin as a sentinel species and (4) the continued evaluation of the presence of hydrocarbons in fish to address fish palatability, as well as an evaluation of the spatial extent of hydrocarbons in fish of AEMP lakes.

From an assessment of these four topics, a series of recommendations have been put forth to address these subjects. The first is that it is recommended that gillnets be the method of sampling for large bodied fish in AEMP lakes in 2012. Changing the sampling techniques (i.e., angling instead of gillnetting) would result in a catch-per-unit-effort (CPUE) that could not be compared to the CPUE of fish calculated in the past. There would therefore be no way to determine if there is an effect on the overall population size of fishes in the lakes sampled as part of the AEMP. Not only would the CPUE no longer be comparable between years, but other biological measures (e.g., length, weight, etc.) would also no longer be comparable.

2011 Wildlife

38.
Title: EKATI Diamond Mine: 2010 Wildlife Effects Monitoring Program.

Prepared by: Rescan Environmental Services

Date: April 2011

Description: This report presents the results of the 2010 Wildlife Effects Monitoring Program (WEMP) conducted at the EKATI Diamond Mine (EKATI). This program monitors the effects of mining development and associated activities at EKATI upon wildlife, as well as assessing the effectiveness of wildlife mitigation and management efforts. The program focuses on wildlife species identified as species of greatest interest, termed Valued Ecosystem Components or VECs.

39.
Title: EKATI Diamond Mine: 2012 WEMP Work Plan.

Prepared by: Rescan Environmental Services

Date: December 2011

Description: The Wildlife Effects Monitoring Program (WEMP) is a monitoring requirement of BHP Billiton's Environmental Agreement and the Wildlife Effects Monitoring Plan. The WEMP has been conducted since 1997. The WEMP was developed through extensive consultation with stakeholders, including regulators, scientists, and Aboriginal people. The WEMP focuses on wildlife species and habitats that were identified during the Environmental Assessment Review Process (EARP) (the regulatory regime that preceded *The MacKenzie Valley Resource Management Act* of 1998) as being of social or economic importance or of particular ecological or conservation concern (i.e., Valued Ecosystem Components [VECs]).This document (the Plan) is an update to the February 2000 WEMP Plan, and outlines the objectives and methodologies for monitoring and mitigation activities at EKATI. The Plan is a living document that will be reviewed in conjunction with the Environmental Impact Review every three years, and updated as needed.

2011 Other

40.
Title: Environmental Agreement and Water Licences Annual Report 2010.

Prepared by: EKATI Diamond Mine, BHP Billiton Canada Inc.

Date: April 2011

Description: The 2010 Annual Report for the EKATI Diamond Mine was prepared to meet the annual reporting obligations outlined in the Water Licence issued under the Northwest Territories Waters Act and the Mackenzie Valley Resources Management Act as currently administered by the Wek'eezhi Land and Water Board as well as the Environmental Agreement. The report summarizes the activities completed by BHP Billiton and its employees during the 2010 calendar year to meet and achieve the requirements of the water licence and Environmental Agreement. A summary of the annual use of water and deposition of waste generated at EKATI in 2010 is also provided.

41.
Title: EKATI Diamond Mine Revegetation Research Project – 2010

Prepared by: Harvey Martens and Associates

Date: March 2011

Description: BHP Billiton Canada Inc. (BHP Billiton) has been conducting revegetation research at the EKATI Diamond Mine (EKATI) since 1995, in support of the reclamation goals outlined in the Interim Closure and Reclamation Plan (ICRP) for the mine. This report describes 1) the results of the assessment of vegetation cover and soil characteristics at several progressive reclamation sites, and 2) the planting of seedling stock in the Rock Pad Reclamation Study and the results of the initial assessment.

42.
Title: PSD Temporary Diversion Concept Evaluation.

Prepared by: EBA Engineering Consultants Ltd.

Date: July 2011

Description: This report highlights the design efforts and evaluation for the Pigeon Pit littoral zone. EBA completed in 2007 a detailed design for a permanent diversion around the Pigeon Pit, which was later updated to include aquatic habitat features in 2010. New regulatory requirements to develop aquatic habitat within the pit footprint at closure may however impede the requirement for a permanent diversion structure with habitat features. Therefore, EBA will evaluate options for a temporary diversion with the intent of providing a more cost effective solution that meets the standards to divert stream flow around mining operations on request of BHP Billiton. In conjunction with Rescan Environmental Services Ltd, a preliminary design for the Pigeon Pit littoral zone was completed by EBA as part of a joint littoral zone evaluation.

43.
Title: EKATI Diamond Mine: 2008 Air Quality Monitoring Program (AQMP).

Prepared by: Rescan Environmental Services

Date: July 2011

Description: THE AQMP at EKATI is a requirement under Section VII of the Environmental Agreement to which the signatories are BHP Billiton, the Government of Canada and the Government of the Northwest Territories. In accordance with that agreement and commitments made in the 1995 Environmental Impact Statement, BHP Billiton initiated an AQMP in 1998 to support the management of air quality throughout the life of EKATI mining operations. Summary results of the AQMP are reported each year in the Annual Environmental Agreement and Water License Report. Every three years in concert with an extended sampling program, a separate AQMP report is prepared that presents and interprets AQMP results in more detail. This current report provides and assesses results for the period from 2006 to 2008. The AQMP consists of meteorological monitoring, air emissions and greenhouse gas calculations, ambient air quality monitoring including high volume air sampling and continuous air monitoring, dustfall monitorin, snow chemistry monitoring, and lichen tissue monitoring. Results from the 2006 to 2008 AQMP suggest that management measures implemented at EKATI are effective at mitigating the effects of the mine on air quality.

44.
Title: EKATI Diamond Mine: Interim Closure and Reclamation Plan.

Prepared by: Rescan Environmental Services

Date: August 2011

Description: BHP Billiton is required to have in place an approved Interim Closure and Reclamation Plan (ICRP) for EKATI during active mining operations, and to update that plan on a regular basis, and when there is significant change to the Life of Mine Plan. The purpose of this ICRP document is to satisfy both BHP Billiton's Closure Plan framework used throughout the company and the ICRP Terms of Reference. The ICRP is based on the EKATI Diamond Mine 2005 Life of Mine (LOM) Plan, which anticipates active mining operations until 2020. This interim plan will be updated throughout mining operations and a final closure plan will be prepared and submitted at least 2 years before end of active mining. The current reclamation and closure schedule anticipates final ICRP implementation and post-closure monitoring to be complete in approximately 2060.

45.
Title: Wastewater and Processed Kimberlite Management Plan Version 2.0.

Prepared by: BHP Billiton

Date: October 2011

Description: This document is an update to "Wastewater and Processed Kimberlite Management Plan, August 2010". The two primary changes were updated to the FPK deposition strategy that: (1)Further defers and possibly eliminates the use of Cell D for FPK deposition; and (2) Builds on and refines the established deposition plan. The revised strategy continues with the established approach for FPK deposition in Cell A, B, C, while incorporating new deposition areas in Beartooth Pit, Cell C West, and Cell A South.

46.
Title: EKATI Diamond Mine –Waste Rock and Ore Storage Management Plan: Version 3.

Prepared by: BHP Billiton

Date: October 2011

Description: This report includes both an updated Waste Rock and Ore Storage Management Plan and an updated Geochemical Characterization and Metal Leaching Management Plan to address the terms of Part G.2 and G.3 of Water Licence W2009L2-0001 related to disposal of mine wastes at EKATI. The report presents information on the current conditions at EKATI including geology, production history including tonnages, and descriptions of the existing waste storage facilities. In addition the existing geochemical characterization of waste rock and coarse kimberlite rejects including acid/alkaline drainage potential are presented. The current temperature trends in waste rock storage areas are provided as well as the existing drainage management, seepage monitoring methods, and predictions of drainage quality and metal leaching potential based on the seepage monitoring database.

2012 REPORTS

2012 Aquatics Monitoring

47.
Title: EKATI Diamond Mine: Site-specific Water Quality Objective for Molybdenum, 2011

Prepared by: Rescan Environmental Services

Date: February 2012

Description: The AEMP at EKATI is a requirement specified in BHP Billiton's Class A Water Licence (W2009L2-0001). The Water Licence lists effluent quality criteria for some substances; however, no criterion is listed for molybdenum. As an increasing trend for molybdenum in the Koala Watershed was seen, BHP Billiton commissioned a Tier I aquatic Ecological Risk Assessment (ERA) in 2006. This ERA included the derivation of short-term (acute) and long-term exposure (chronic) site specific water quality objectives (SSWQOs) for molybdenum. The short-term exposure SSWQO was 20 mg/L, and the long-term exposure SSWQO was 16 mg/L. Since 2006, there have been numerous acute and chronic toxicity studies reported, along with several SSWQOs for molybdenum. BHP Billiton therefore commissioned an update of the 2006 SSWQOs for molybdenum. This report derives updated SSWQOs for molybdenum following 2007 CCME guidance that was not available when the 2006 SSWQOs were derived.

48.
Title: EKATI Diamond Mine: 2011 Waste Rock and Waste Rock Storage Area Seepage Survey Report.

Prepared by: SRK Consulting (Canada)

Date: March 2012

Description: This report summarizes the conditions listed under Part G, Item 4 of Water Licence W2009L2-0001, along with the activities undertaken in 2010 by BHP Billiton to comply with all conditions, and documents how each Water Licence condition has been satisfied. During 2011, routine monitoring of waste rock seepage during freshet and fall was continued following established protocols. No waste rock sampling was carried out at any of the underground developments or the Fox pit in the

2011 reporting year, as per the approved Geochemical Characterization and Metal Leaching Management Plan (SRK 2007). Sampling of Misery waste rock following commencement of the Misery Pit push back in late 2011 will be conducted annually as per Version 3 of the Waste Rock and Ore Storage Management Plan (BHP Billiton 2011). Seven samples of coarse kimberlite rejects (CKR) were collected in 2011.

49.
Title: EKATI Diamond Mine: 2011 Long Lake Containment Facility Nitrate in Situ Treatment Test

Prepared by: Rescan Environmental Services

Date: April 2012

Description: The Long Lake Containment Facility (LLCF) is the primary mine wastewater and processed kimberlite management facility for the EKATI Diamond Mine (EKATI) operated by BHP Billiton Canada Inc. Levels of nitrate have increased in the LLCF throughout most of the last decade. Ammonium-nitrate blasting agents are believed to be the main source of nitrate to the LLCF. EKATI's Water Licence (WL2009L2-0001) does not include a discharge criterion for nitrate; however, rising nitrate concentrations are a concern because of the potential toxicity to downstream aquatic organisms.

A potential mitigation strategy to reduce the nitrate load in the LLCF is to stimulate the growth of phytoplankton and the biological uptake of nitrate by fertilizing the LLCF with phosphate. Rescan Environmental Services Ltd. undertook a multi-phased approach to test the effectiveness of this nitrate-removal strategy in Cell D of the LLCF. This was considered to be a potentially feasible approach warranting field experimentation based on the isolated location of Cell D, the known abundance of nitrate in Cell D waters, the known phosphorus-limitation of algal growth in freshwater systems, and the known ability of algae to take up nitrogen species (e.g., nitrate and ammonium) from the water column.

50.
Title: EKATI Diamond Mine: PDC Monitoring Report

Prepared by: Rescan Environmental Services

Date: March 2012

Description: The Panda Diversion Channel (PDC) was constructed in 1997 as compensation for the loss of stream habitat during the development of the EKATI Diamond Mine in accordance with an agreement between BHP Billiton Canada Inc. (BHP Billiton) and Fisheries and Oceans Canada (DFO). Under this agreement, BHP Billiton established a ten-year monitoring program from 1999 to 2008 to assess the effectiveness of the PDC in providing productive fish habitat. The principal focus was placed on monitoring Arctic grayling because it is the predominant fish species inhabiting the PDC. Following completion of the ten-year monitoring program, BHP Billiton reduced the program in 2009 and 2010, focussing the monitoring on Arctic grayling spawners and their use of the PDC. A ten-year summary report of all monitoring aspects was prepared in 2010, covering years 1999 to 2008. External reviews of this report by DFO and IEMA (Independent Environmental Monitoring Agency) raised questions, highlighting the need for additional data acquisition. Therefore, the goal of the 2011 field season was to collect data to address the questions put forth by the reviewers, and to continue monitoring the few key variables specific to Arctic grayling spawners in the PDC and reference streams. This 2011 report, presenting the 13th and final year of monitoring under the compensation agreement, is to be considered a stand-alone report that complements the ten-year summary report. Its purpose is to provide closure to the PDC monitoring program by presenting both new (2011) and previously reported data not included in the ten-year summary report, in order to address questions put forward during the review process.

51.

Title: EKATI Diamond Mine: Site-specific Water Quality Modelling of the Koala Watershed

Prepared by: Rescan Environmental Services

Date: April 2012

Description: The Long Lake Containment Facility (LLCF) is the Process Kimberlite Containment Area (PKCA) for the EKATI Diamond Mine (EKATI). A water quality prediction model for the LLCF was originally developed in 2004 and has been used to identify potential water quality concerns and to evaluate water management options for the EKATI site.

This report presents the results of a comprehensive update of the existing model of the LLCF that includes;

- analysis of observed data from EKATI mine (flow and water quality data) up to at least the end of 2010 and in some cases to include data from 2011;
- a method of modelling future Process Plant Discharge (PPD) quality for 30 water quality parameters;
- a model of the chain of lakes lying downstream of the LLCF;
- the current preferred water and Fine Processed Kimberlite (FPK) management option including Beartooth pit; and
- development of Water Quality Benchmarks for 30 parameters.

52.

Title: EKATI Diamond Mine: Site-specific Water Quality Objective for Potassium

Prepared by: Rescan Environmental Services

Date: April 2012

Description: Site specific water quality objectives (SSWQOs) were developed for potassium based on short-term (acute) and long-term (chronic) toxicity test data that were available in the literature, as well as data obtained from reference toxicant tests that were conducted by laboratories using potassium chloride (KCl) as a reference toxicant.

53.

Title: EKATI Diamond Mine: Site-specific Water Quality Objective for Nitrate, 2012

Prepared by: Rescan Environmental Services

Date: April 2012

Description: A site specific water quality objective (SSWQO) was developed for nitrate based on chronic toxicity test data that were available in the literature and from a recent investigation conducted by Nautilus Environmental (2011a and 2011b) on the effect that water hardness has on the toxicity of nitrate.

Acceptable toxicity data were available for: one green algal species (*Pseudokirchneriella subcapitata*); four invertebrates, including two zooplankton (*Ceriodaphnia dubia* and *Daphnia magna*), one epibenthic amphipod (*Hyalella azteca*), and one benthic midge larva (*Chironomus dilutus*); and four fish, two salmonids (*Oncorhynchus mykiss* and *Salvelinus namaycush*), and two non-salmonids (*Pimephales promelas* and *Notropis topeka*). These data met the CCME requirements for establishing a Type A water quality guideline using a Species Sensitivity Distribution (SSD).

54.
Title: EKATI Diamond Mine: Site-specific Water Quality Objective for Sulphate

Prepared by: Rescan Environmental Services

Date: April 2012

Description: Proposed short-term and long-term site specific water quality objectives (SSWQOs) were developed for sulphate based on acute and chronic toxicity test data that were available in the literature.

55.
Title: EKATI Diamond Mine: Site-specific Water Quality Objective for Vanadium

Prepared by: Rescan Environmental Services

Date: April 2012

Description: Site specific water quality objectives (SSWQOs) were developed for vanadium based on short-term (acute) and long-term (chronic) toxicity test data that were available in the literature, as well as data obtained from tests conducted specifically for this purpose.

For short-term exposure, acceptable toxicity data were available for four species of fish, including two salmonids (*Oncorhynchus mykiss* and *Salvelinus fontinalis*) and two non-salmonids (*Gasterosteus aculeatus* and *Brachydanio rerio*), as well as three invertebrates, including two planktonic species (*Ceriodaphnia dubia* and *Daphnia magna*) and one epibenthic amphipod (*Hyalella azteca*).

Acceptable data for long-term exposures were available for three species of fish, including two salmonids (*O. mykiss* and *S. fontinalis*) and one non-salmonid (*Carassius auratus*); three invertebrates, including two planktonic crustaceans (*C. dubia* and *D. magna)* and one epibenthic amphipod (*H. azteca*), as well as three primary producers, including a green alga *(Ankistrodesmus falcatus),* a diatom *(Diatoma elongatum)* and a blue-green alga *(Anabaena flos-aquae)*.

56.
Title: EKATI Diamond Mine: 2011 Aquatic Effects Monitoring Program. Summary Report, Part 1: Evaluation of Effects, Part 2: Data Report, Part 3: Statistical Report.

Prepared by: Rescan Environmental Services

Date: April 2012

Description: The Aquatic Effects Monitoring Program (AEMP) at EKATI is a requirement specified in BHP Billiton Class A Water Licence. Sampling for the 2011 season occurred between January 1st and December 31st, 2010. The AEMP is designed to detect changes in the aquatic ecosystem resulting from mine activities. The 2010 AEMP plan was developed following a detailed review of 2007 to 2008 AEMP results and stakeholders comments. The AEMP report consists of three sections: Part 1 – Evaluation of Effects: provides the methods used to assess change in the aquatic environment and summarizes the results of the effects assessments; Part 2 - Data Report: provides the state of the aquatic environment at EKATI in 2011, including the field methodology and results for each of the aquatic environmental components (e.g., physical limnology); and Part 3 - Statistical Report: provides the detailed results of the statistical analyses reported in the evaluation of effects.

2012 Wildlife

57.
Title: EKATI Diamond Mine: 2011 Wildlife Monitoring Program

Prepared by: Rescan Environmental Services

Date: April 2012

Description: This report presents the results of the 2011 Wildlife Effects Monitoring Program (WEMP) conducted at the EKATI Diamond Mine (EKATI) to meet the requirements of the Environmental Agreement (Article V.1(a) and Article VII). The WEMP monitors wildlife and documents wildlife effects resulting from mining development and associated activities at EKATI. The WEMP also assesses the effectiveness of wildlife mitigation and management efforts. The program focuses on animal species identified as species of greatest concern, termed Valued Ecosystem Component or VEC (e.g., caribou, grizzly bear, wolf, and wolverine). This report covers the period from October 1, 2010 to December 31, 2011.

2012 Other

58.
Title: EKATI Diamond Mine: Revegetation Research Projects 2011

Prepared by: Harvey Martens & Associates Inc.

Date: February 2012

Description: BHP Billiton Canada Inc. (BHP Billiton) has been conducting revegetation research at the EKATI Diamond Mine (EKATI) since 1995, in support of the reclamation goals outlined in the Interim Closure and Reclamation Plan (ICRP) for the mine. This report describes 1) the results of the assessment of vegetation cover and soil characteristics at several progressive reclamation sites, and 2) the results of the assessment of the planting of seedling stock in the Rock Pad Reclamation Study.

59.
Title: Environmental Agreement and Water Licences Annual Report 2011.

Prepared by: EKATI Diamond Mine, BHP Billiton Canada Inc.

Date: April 2012

Description: The 2011 Annual Report for the EKATI Diamond Mine was prepared to meet the annual reporting obligations outlined in the Water Licence issued under the Northwest Territories Waters Act and the Mackenzie Valley Resources Management Act as currently administered by the Wek'eezhi Land and Water Board as well as the Environmental Agreement. The report summarizes the activities completed by BHP Billiton and its employees during the 2011 calendar year to meet and achieve the requirements of the water licence and Environmental Agreement. A summary of the annual use of water and deposition of waste generated at EKATI in 2011 is also provided.

◎ Table of Contents

60.
Title: EKATI Diamond Mine: 2011 AQMP Report

Prepared by: Rescan Environmental Services

Date: May 2012

Description: Summary results of the AQMP are reported each year in the Annual Environmental Agreement and Water License Report. Every three years in concert with an extended sampling program, a separate AQMP report is prepared that presents and interprets AQMP results in more detail. The following report provides and assesses results for the period from 2009 to 2011. The AQMP consists of six components: Meteorological monitoring; Air emissions and greenhouse gas (GHG) calculations; Ambient air quality monitoring: high volume air sampling (HVAS) and continuous air monitoring (CAM); Dustfall monitoring; Snow chemistry monitoring; and Lichen tissue monitoring.

Appendix D

Independent Scientific Research at EKATI (April 2009 to April 2012)

Appendix D. Independent Scientific Research at EKATI (April 2009 to April 2012)

The following are independent research projects conducted by University-based scientist at the EKATI Diamond Mine between the years 2009 and 2012.

1.
Title: Chronic Toxicity of Chloride to Freshwater Species: Effects of Hardness and Implication for Water Quality Guidelines

Project Scientist: Elphick, J. (Nautilus Environmental), Bergh, K. (Rescan Environmental), and Bailey, H. (Nautilis Environmental)

Date: January 2010

Description: Toxicity tests using nine freshwater species (*Ceriodaphnia dubia, Daphnia magna, Oncorhynchus mykiss, Pimephales promelas, Lumbriculus variegatus, Tubifex tubifex, Chironomus dilutus, Hyallela azteca, and Brachionus calyciflorus*) were conducted to evaluate their sensitivity to chloride. The present study was designed to provide information necessary to establish safe levels of chloride in the receiving environment at EKATI. However, the results of the testing conducted are broadly applicable.

Elphick, J., Bergh, K., and Bailey, H. 2010. Chronic Toxicity of Chloride to Freshwater Species: Effects of Hardness and Implication for Water Quality Guidelines. *Environmental Toxicology and Chemistry 30* (1): 239 – 246.

2.
Title: Peer Review of: 10-Year Panda Diversion Channel Monitoring Program Summary

Project Scientist: William M. Tonn (University of Alberta, Edmonton, AB)

Date: June 2010

Description: This report provides a response to 22 "key findings" of the 10-year PDC Monitoring Program in relation to study design, methods, and analyses. Also, three questions were addressed: (1) Is the PDC functioning properly and well? (2) Is further monitoring required (3) If so, what should be monitored?

Tonn, W. 2010. Peer Review of: 10-Year Panda Diversion Channel Monitoring Program Summary. University of Alberta, Edmonton, Alberta.

3.

Title: The EKATI Long Lake Containment Facility: History & Future of Processed Kimberlite Disposal.

Project Scientists: McKenzie, I. (BHP Billiton), McLean, K. (BHP Billiton), Koop, G. (EBA), and Caldwell, J. (Roberston GeoConsultants).

Date: November 2011

Description: This report describes the design of the LLCF, which consists of five cells separated by permeable dikes with deposition into three of cells. The additional two cells are used for water quality "polishing" in compliance of discharge criteria. Additionally, this paper describes the nature of the processed kimberlite (tailings) as it has been deposited over the past ten years. Finally, this report describes a major evaluation of alternative for expanding the LLCF and the potential to use mined out open pits to augment capacity.

McKenzie, I., McLean, K., Koop, G., and Caldwell, J. 2011. The EKATI Long Lake Containment Facility: History & Future of Processed Kimberlite Disposal. *Proceedings Tailings and Mine Waste*: 1-9.

4.
Title: Metal Leaching in a Neutral pH Environment: EKATI Diamond Mine, NT, Canada

Project Scientists: Ketchum, K. (SRK Consulting Canada), Day, S. (SRK Consulting Canada), Lee, C. (BHP Billiton), and McLean, K. (BHP Billiton)

Date: December 2011

Description: This paper reviews chemistry data for selected seeps in the Panda-Koala and Misery areas, with many years of data, which illustrate the range of waters observed from EKATI WRSA's. Major and trace element concentrations in the seeps can be related to the distinctive mineralogy of the waste rock and allow different water sources to be recognized. A key indicator of differences in seepage chemistry is the magnesium-nickel ratio (Mg/Ni). This study has implications for future WRSA design and allows for more informed adaptive management practices.

Ketchum, K., Day, S., Lee, C., and McLean, K. 2012. Metal Leaching in a Neutral pH Environment: EKATI Diamond Mine, NT, Canada. Submitted to the International Conference on Acid Rock Drainage (ICARD), Ottawa, On.

◎ Table of Contents

Appendix E
Construction Activities 2009 to 2011

Appendix E. Construction Activities 2009 to 2011

2009 OVERVIEW

- Commissioning of the new incinerator building was ongoing;
- Construction of the new Cell A high road was completed and the high road discharge line was operating on Aug 10, 2009;
- A complete process plant shutdown was initiated for 12 hours every 3 weeks, and a four day shutdown was carried out for annual maintenance and project work;
- Commissioning continued on the glycol heat recovery line to heat underground mine air from waste heat generated by the powerhouse;
- Construction of an impervious dam between Cell B and Fay Lake as an operational risk mitigation measure;
- Installation of heat trace in Dyke B culvert as an operational risk mitigation measure; Commissioning of the new incinerator building;
- Between February and May 2010 the Pigeon Test Pit was constructed in the Pigeon Watershed and the resulting overburden was piled immediately adjacent to the pit, kimberlite ore was transported to the process plant;
- Misery Camp was not in operation in 2009; no operations occurred in Misery Pit in 2009.

Underground operations:

- Kimberlite ore from both Panda and Koala Underground was transported to the process plant;
- Waste rock from the underground was transported to the Panda/Koala Waste Rock Storage Area;

Fox Pit:

- Kimberlite ore was transported to the process plant;
- Waste rock was transported to the Fox Waste Rock Storage Area;

Beartooth Pit:

- Kimberlite ore was transported to the Process Plant;
- Waste rock was transported to the Panda/Koala Waste Rock Storage Area;
- Open pit mining of the Beartooth kimberlite pipe was completed in April 2009. Since that time, the pit has been integrated into the mine water management system as a mine water retention pond.
- Construction of Beartooth Pipeline to (optionally) divert underground mine water from the LLCF to Beartooth Pit containment facility, per the approved Wastewater and Processed Kimberlite Management Plan;

- Kimberlite coarse ore rejects continued to be placed in the coarse kimberlite rejects area of the Panda/Koala Waste Rock Storage Area;
- Fine processed kimberlite, mine sump water and treated effluent from the sewage plant continued to be deposited into the LLCF;
- Water from Cell E of the LLCF was discharged into Leslie Lake from October 1, 2008 (ongoing from August 2008) to December 16, 2008; and from July 21, 2009 to September 30, 2009 at which point it was still ongoing.

2010 OVERVIEW

- Commissioning of the mechanical upgrades to the incinerator building were ongoing;
- The Dyke C was raised to increase the holding capacity (volume) of Cell C, construction began in July 2010 and was completed in September 2010;
- The airstrip was resurfaced during July and August of 2010;
- The electric fence that formerly surrounded the airport and airstrip was replaced with a plastic mesh barrier fence in September of 2010;
- The Pigeon test pit was fenced with plastic mesh barrier fence in September 2010; and jetty was constructed in Cell B at A11 in September 2010;
- The Ammonium Nitrate Building was renovated to control erosion and contain fugitive ammonium nitrate emissions;
- Yearly spring maintenance was conducted on the Panda Diversion Channel following the clearing of snow in preparation for spring freshet. In addition, snow was cleared away from the entrances of the culverts, and the culvert covers were removed.
- Misery Camp was not in operation in 2010
- Misery Pit was partially dewatered into King Pond Settling Facility (KPSF) in August and September 2010.

Underground:

- Kimberlite ore from both Panda and Koala was transported to the Process Plant;
- Panda Pit was decommissioned June 29, 2010
- Waste rock was transported to Panda/Koala Waste Rock Storage Area or used for landfill containment

Fox Pit:

- Kimberlite ore was transported to the process plant;
- Waste rock was transported to the Fox Waste Rock Storage Area; and
- Kimberlite coarse ore rejects were placed in the coarse kimberlite rejects area of the Panda/Koala Waste Rock Storage Area and used to cap landfill waste.

Beartooth Pit:

- No mining of Beartooth Pit occurred.

- Beartooth Pit was used as a waste water containment facility throughout 2010.
- Kimberlite coarse ore rejects continued to be placed in the Coarse Kimberlite Rejects Area of the Panda/Koala Waste Rock Storage Area
- A distribution pipeline was designed and constructed, and became fully operational in 2010.
- Fine processed kimberlite, mine sump water, treated sewage, and plant effluent continued to report to Cells A, B and C of the LLCF.

Panda Pit:

- Kimberlite ore from underground was transported to the process plant;
- Waste rock and kimberlite coarse ore rejects from underground were transported to the Panda/Koala Waste Rock Storage Area;
- Mining of Panda Pit was completed in June of 2010; and de-commissioning of Panda Pit was on-going.

Koala North Pit:

- Kimberlite ore from underground was transported to the process plant; and
- Waste rock and kimberlite coarse ore rejects from the underground were transported to the Panda/Koala Waste Rock Storage Area.

Koala Pit:

- Kimberlite ore from underground was transported to the process plant; and
- Waste rock and kimberlite coarse ore rejects from the underground were transported to the Panda/Koala Waste Rock Storage Area.

2011 OVERVIEW

- Phase 1 of the PDC Slope Enhancement Project took place from January to May of 2011. During this time a 450 m section of the banks of the PDC were modified to prevent any future spalling/erosion of material from the banks into the channel;
- A jetty 240 m in length was constructed at the A11 spigot on the Cell B west tailings line between August and October 2011; a pipeline runs along the jetty and contains 5 spigot points;
- The construction of the Cell B West Road began in August of 2011 (approximately 450 m of the total was completed);
- A pipeline with 5 additional spigot points was installed on the Cell B jetty to better use available storage space in cell B;
- The B7 spigot point at the top end of Cell C was shifted so that it could be reactivated to better fill void space in Cell C.
- A total surface area of 9 m2 of coarse gravel was added to gravel enhancement pads (GEP) A, B and F at the Nero-Nema crossing;
- Beginning in September of 2011 various structural and mechanical changes were made to the incinerator building to improve the operation and safety of the system.

Fox Pit:

- Kimberlite ore was transported to the process plant;
- Waste rock was transported to the Fox Waste Rock Storage Area; and
- Kimberlite coarse ore rejects were placed in the coarse kimberlite rejects area of the Panda/Koala Waste Rock Storage Area.

Beartooth Pit:

- No mining of Beartooth Pit occurred.

Panda Pit:

- De-commissioning of Panda Pit was on-going.

Koala North Pit:

- Kimberlite ore from underground was transported to the process plant; and
- Waste rock and kimberlite coarse ore rejects from the underground were transported to the Panda/Koala Waste Rock Storage Area.

Koala Pit:

- Kimberlite ore from underground was transported to the process plant; and
- Waste rock and kimberlite coarse ore rejects from the underground were transported to the Panda/Koala Waste Rock Storage Area.

Incinerator

Work was restarted in September 2011 to bring the new incinerator building to working status. Activities included:

- Upgrades to the ventilation system;
- Repairs to the fire suppression system;
- Repairs to ram feeder;
- Installation of backup power supply;
- Installation of fuel supply for generator and burners;
- Modifications to the Induced Draft Fan to ensure negative pressure in the primary chamber; and
- Upgrade to fire alarm system.

Misery Camp

Construction of the Misery Camp occurred thorough 2011. Activities included:

- Construction of a 115 person accommodations facility;
- Truck shop maintenance facilities;
- Construction of Utilities Services building;

- Increase in Misery Pad footprint to accommodate powerhouse upgrade; and
- Chain link perimeter fence.

◎ Table of Contents

Appendix F
EKATI Traditional Knowledge Strategy

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EKATI Traditional Knowledge Strategy

Version:	1.0
Replaces:	None
Creation Date:	2011-04-30
Scheduled Review Date:	2012-06-30
Review Date:	
Document Owner:	Superintendent-Traditional Knowledge & Permitting
Document Approver:	Head-HSEC
Related Documents:	Community Development Management Plan Stakeholder Engagement Management Plan
Key Contacts:	Environment Advisor-Traditional Knowledge
Change Requests:	Environment Advisor-Traditional Knowledge
Brief Description:	The Strategy for Traditional Knowledge Programs with the EKATI Diamond Mine

Table of Contents

1.0 Where We Are

Traditional Knowledge work at EKATI over the past 15 years has provided a solid base upon which BHP Billiton and Aboriginal groups can continue a long term and productive relationship.

The Environmental Assessment process and the subsequent Environmental Agreement document BHP Billiton's commitment to continue work on traditional knowledge projects and to incorporate traditional knowledge into environmental management. The Environmental Agreement states that "BHP shall incorporate all available traditional knowledge in the Environmental Plans and Programs and shall give all available traditional knowledge full consideration along with other scientific knowledge as the Environmental Plans and Programs are developed and revised" (Article X1, Item 11.3).

During the course of mine operations, BHP Billiton has initiated and successfully completed a number of traditional knowledge projects. However, not all projects were completed (e.g. development of a GIS database in Lutsel K'e and the development of a traditional history of the Metis in the EKATI area). To increase the focus on this important area, BHP Billiton talked with communities in 2008 and 2009 to reassess ideas on how BHP Billiton can assist in developing new projects, or renew past initiatives. The critical focus is on projects that will provide long-term benefit to the communities.

In 2010, the three diamond mines held a *Diamond Mines Wildlife Monitoring Programs-Community Workshop*. The objectives for the workshop were:

(1) Discuss the use of traditional knowledge in monitoring wildlife and determine how it can be incorporated into the wildlife monitoring programs currently in place; and,

(2) Gather ideas on how the mines can conduct and improve their wildlife monitoring programs by incorporating community perspectives from traditional knowledge holders.

The workshop provided the community representatives and Traditional Knowledge holders a forum to voice recommendations. BHP Billiton agreed to review the recommendations to determine how best to incorporate into its existing monitoring programs.

In 2011, the position of Environment Advisor-Traditional Knowledge was created and staffed. The mandate was to implement the EKATI Diamond Mine Traditional Knowledge Strategy. The advisor is to consult with the Impact Benefit Agreement communities (IBA), Traditional Knowledge stakeholders, and local community governments to plan and implement community orientated traditional knowledge projects. In addition, the Environment Advisor-Traditional Knowledge is to execute site-based projects, and reclamation research, that advance the use of traditional knowledge in environmental monitoring programs and closure planning.

BHP Billiton considers the need to integrate Traditional Knowledge into its environmental monitoring programs as important today as when the EKATI mine first began operations. This strategy defines *"Where We Want To Go* and *How We Are Going To Get There"*.

2.0 Where We Want To Go

For 2011 to 2014

2.1 Vision

The Vision of the Traditional Knowledge program at EKATI is to build and sustain a meaningful, healthy and interactive relationship with the aboriginal people of the north, with a common goal of preserving, sharing and the promotion of northern aboriginal Traditional Knowledge.

2.2 Mission

BHP Billiton will continue its history of developing meaningful, lasting and mutually beneficial Traditional Knowledge relationships with the Impact Benefit Agreement communities, with the underlying objective of benefiting the communities and the environment at the EKATI mine.

BHP Billiton will work directly with community representatives to identify, develop, and implement ideas for Traditional Knowledge initiatives, in accordance with the Traditional Knowledge Strategy.

BHP Billiton will identify, develop and implement ideas for Traditional Knowledge incorporation into environmental monitoring and reclamation programs.

BHP Billiton will travel to communities and invite aboriginal people to EKATI, with the goal of fostering open and productive dialogue, demonstrating the principles of sustainable development and providing face-to-face interactions.

2.3 Guiding Principles

The guiding principles for this plan were developed from the BHP Billiton Charter, the BHP Billiton Sustainable Development Policy, and the recognition of aboriginal culture. These principles are the basis for decision-making regarding Traditional Knowledge relationships and Traditional Knowledge projects.

Guiding Principles that govern the EKATI Traditional Knowledge Strategy Plan:

Investment

BHP Billiton views Traditional Knowledge relationships as an investment in the aboriginal people of the North and values the use of Traditional Knowledge to develop best practices in mining and environmental monitoring.

Inclusion

BHP Billiton seeks to develop strategic relationship with all IBA communities for inclusion in Traditional Knowledge Projects, and looks for opportunities to strategically partner with other mining companies, government agencies, and other project partners.

Incorporation

BHP Billiton will assist aboriginal communities in advancing Traditional Knowledge within their community and look for ways to incorporate Traditional Knowledge into environmental monitoring programs and reclamation activities at the EKATI Diamond Mine.

Respect

BHP Billiton respects the rights of aboriginal peoples and values their cultural heritage. BHP Billiton acknowledges and fully respects that aboriginal peoples own and control their Traditional Knowledge, and will only utilize Traditional Knowledge that is communicated for the benefit of the EKATI Diamond Mine.

Fairness

BHP Billiton will treat each aboriginal community with fairness, and seeks to develop long-lasting, mutually beneficial partnerships.

2.4 Goals

Over the next 3 years, we specifically wish to:

- Increase Traditional Knowledge inclusion into site based monitoring programs. This will be accomplished through increased community participation and meaningful incorporation of Traditional Knowledge.
- Have discussions with each Impact Benefit Community to identify and prioritize Traditional Knowledge Projects. We want to complete community projects currently underway, and initiate new projects.
- Enhance feedback to communities on Traditional Knowledge initiatives. This will be accomplished by making community visits by inviting community members to the EKATI Diamond Mine, and providing summary reports on site visits.
- Provide Traditional Knowledge input to Community Development Projects.
- Provide Traditional Knowledge input to Reclamation Planning.

3.0 How We Are Going To Get There

BHP Billiton will continue to strengthen the relationships established with the Impact Benefit Agreement communities by actively seeking and engaging community participants in site based monitoring programs to incorporate and give full consideration for Traditional Knowledge in the further enhancement of the EKATI Diamond Mine's environmental management and reclamation and programs.

BHP Billiton will continue to solicit community based Traditional Knowledge project proposals that will provide sustainable long-term benefits through the preservation, sharing and the promotion of northern aboriginal Traditional Knowledge.

BHP Billiton will liaise with other mines, agencies, and governments for the advancement of northern aboriginal Traditional Knowledge.

3.1 Priorities

Priorities for the 2011 to 2014 EKATI Traditional Knowledge Strategy Plan:

Ideas

BHP Billiton will continue to facilitate discussions and lead processes that will generate forward-looking *ideas*.

Implement

BHP Billiton will assist the communities to *implement* the best ideas as well-planned projects.

BHP Billiton will *implement* with the communities participation in site-based programs.

Sustainability

BHP Billiton will support the on-going *sustainability* of Traditional Knowledge initiatives and completed projects.

3.2 Community Contacts

BHP Billiton's Community Contact List (Appendix # 2):

- Kitikmeot Inuit Association/Hamlet of Kugluktuk
- Lutsel K'e Dene First Nation
- North Slave Metis Alliance
- Tlicho Government
- Yellowknives Dene First Nation

3.3 Community Orientated Projects

Community Oriented Projects are those that are developed in cooperation with BHP Billiton and typically have community orientated objectives. These community-based projects may not have a direct link to environmental management at EKATI, however are developed based on the priorities and focus areas identified through community engagement.

These projects are focused on the preservation, sharing and advancement (promotion) of traditional knowledge within the community.

In 2008 and 2009, BHP Billiton invited each of the IBA communities to take part in a process to develop ideas for traditional knowledge projects in their communities, and to work with BHP Billiton to develop project implementation plans. The on-going strategy is to continue to engage each community to focus on projects of most immediate interest/value to them, and then to assist with development, implementation, and funding plans. In some cases BHP Billiton may fund the project and in other cases additional partners may also support the project.

Using the traditional knowledge proposal submissions, BHP Billiton will work with the communities to develop detailed project plans for the community. Working together, we will develop plans of action, milestones, roles and responsibilities, and deliverables. Each project will have its own schedule, reports and outputs, developed by and with the community.

3.4 EKATI Orientated Projects

EKATI Oriented Projects are projects initiated by or within BHP Billiton that relate directly to enhancing environmental management or monitoring at EKATI. The goal of these projects is to advance the development of EKATI-specific traditional knowledge and to use that knowledge in improving and modifying the environmental management and monitoring programs.

This approach will be to focus on:

- Talking with Traditional Knowledge Holders,
- Bringing Traditional Knowledge Holders to EKATI,
- Listening to their ideas, knowledge and concerns,
- Sharing our ideas, results and issues,
- Providing feedback to the communities.

Reports will be sent to the communities after each session, summarizing the traditional knowledge information gathered during site visits and participant interviews. This may include stories and personal reflections not directly related to the environmental monitoring and management programs, but reflect the values and traditions of the traditional knowledge stakeholder.

Individual EKATI monitoring and reclamation reports will document the use of Traditional Knowledge for that program.

Table of Contents

3.5 Reclamation Planning

The incorporation of community input into closure planning for EKATI is outlined in GLD.035 which requires the asset to "Develop a community and external relations plan for closure throughout the operating life of the Asset and into closure".

Reclamation planning for EKATI is formalized in the current Interim Closure and Reclamation Plan (ICRP), and the Final Closure and Reclamation Plan to be submitted to the Wek'eezhii Land and Water Board 2 years prior to cessation on mine operations. The current ICRP includes approximately 40 reclamation research and engineering studies that will address uncertainties in how mine components will be reclaimed. Community input and Traditional Knowledge will be valuable in assisting BHP Billiton to meet its reclamation goals. BHP Billiton will plan for inclusion of Traditional Knowledge.

3.6 Partnerships

For the overall benefit to the communities, BHP Billiton will reach out to other mines, agencies, and governments to create partnerships. This is important because it will support the communities in planning and implementing community orientated traditional knowledge projects, site based projects, and to advance the use of traditional knowledge in environmental, reclamation and management programs.

3.7 Update of the Traditional Knowledge Strategy

This strategy will be reviewed every year by BHP Billiton and updated where needed. The Head of HSEC and the Superintendent of Traditional Knowledge & Permitting will approve each update for the EKATI Diamond Mine. The Strategy will also be endorsed by the Superintendent-Environmental Operations and Superintendent-Community and External Affairs. Any change requests can be submitted to the Environment Advisor-Traditional Knowledge.

3.8 Approvals/Endorsements

APPROVAL SIGNATURES RECORD			
REVIEWER ROLE	**NAME**	**SIGNATURE**	**DATE**
Approval: Head – HSEC	Karl Schubert	[signature]	20 July 2011
Approval: Superintendent – Traditional Knowledge and Permitting	Eric Denholm	[signature]	20 July 2011
Endorsement: Superintendent-Community and External Affairs	Deana Twissell	[signature]	20 July 2011
Endorsement: Superintendent–Environment Operations	Keith Mclean	[signature]	28 July 2011
PREPARED BY: Environment Advisor-Traditional Knowledge	Charles Klengenberg	[signature]	20 July 2011

4.0 Appendices

Appendix 1.0 History of Traditional Knowledge Projects at EKATI

Background of Traditional Knowledge at EKATI

The Environmental Assessment Review Panel (EARP) charged BHP Billiton in the1996 Environmental Assessment of the EKATI Diamond Mine to give Aboriginal Traditional Knowledge full and equal consideration with engineering and scientific knowledge. This led to the proposal for Phase I and Phase II Studies. Phase I related to work that was incorporated in the EIS. Phase II were studies negotiated with the Aboriginal groups following the EARP process to contribute to the ongoing use of TK by BHP Billiton.

Phase I Studies

To include TK into the 1995 EIS, BHP Billiton conducted a Phase I TK Study. The study consisted of defining the roles of participating parties and initiating consultation/workshops in the communities to document the environmental and socioeconomic concerns that Aboriginal people might have with respect to the EKATI Mine Project. Traditional ecological knowledge was collected in the process, and BHP Billiton provided people with information on the mine and listened to their comments on what they thought the effects from the project might be. The information was collected through a series of structured interviews with traditional users using an interview guide designed by BHP Billiton's consultants. The information collected during Phase I from the three groups which participated was integrated throughout the EIS, with the primary purpose of highlighting concerns and addressing them in accordance with the EIS guidelines.

The Inuit, and the Metis, and NWT Diamonds Project employees participated directly in the Phase 1 Study. BHP Billiton contracted Inuit and Metis interviewers for those projects and had one of its own Traditional Knowledge consultants conduct the interviews with the employees. The Tlicho conducted its own study, and the Yellowknives Dene and Lutsel K'e Dene declined to participate, but later took part in the water licence public hearings on the subject.

Environmental Agreement

The Environmental Agreement was signed January 1997 between the Minister of Indian Affairs and Northern Development, the Government of the Northwest Territories and BHP Billiton. An ongoing role for traditional Aboriginal knowledge was established in the environmental management of the EKATI Diamond Mine.

Article XI of the Environmental Agreement states that:

11.1. Phase II Traditional Knowledge Study. In order to effectively incorporate the traditional knowledge of Aboriginal Peoples in its Environmental Plans and Programs, BHP shall complete the study (the Phase II Traditional Knowledge Study) BHP has agreed to carry out in order to identify categories of the traditional knowledge of Aboriginal Peoples to be incorporated into the Environmental Plans and Programs.

11.2. Principles. The following principles shall be incorporated in the Phase II Traditional Knowledge Study and into any agreement entered into between BHP and Aboriginal Peoples with respect to the Phase II Traditional Knowledge Study:

(a) it shall, to the greatest extent possible, be designed and carried out in partnership with the Aboriginal Peoples or if not possible be designed in Consultation with the Aboriginal Peoples;
(b) the traditional knowledge shall remain the property of the Aboriginal Peoples and no proprietary information shall be disclosed by BHP to parties other than employees of BHP directly involved in the Phase II Traditional Knowledge Study without the express prior consent of the affected Aboriginal Peoples; and
(c) each Aboriginal group shall determine the extent of its own participation in the Phase II Traditional Knowledge Study and the inclusion of its own expertise and knowledge.

11.3. Incorporation of Traditional Knowledge. Subject to Section 11.2(b), BHP shall incorporate all available traditional knowledge in the Environmental Plans and Programs and shall give all available traditional knowledge full consideration along with other scientific knowledge as the Environmental Plans and Programs are developed and revised.

Phase II Studies

The Phase II Study was originally part of the multi-party agreement signed in early 1995 between BHP Billiton, then Dogrib Treaty 11, Akaitcho Treaty 8, the Inuit of Kugluktuk (as represented by the Hunters and Trappers Association) and the NWT Metis Nation (later North Slave Metis). This study was intended to assist Aboriginal groups in preparation of a baseline of TK, and in turn assist BHP Billiton in environmental and socioeconomic monitoring of impacts. The Phase II was to be designed jointly by Aboriginal organizations and BHP Billiton to broaden the information collected during the Phase I Study. All proprietary information obtained by the groups during this phase of the program was to be kept confidential and would not be disclosed to each other or to third parties during or after the program, unless the group who supplied the information to the program agreed to disclose its portion of the study. Therefore, each group would determine the extent of its future participation and the inclusion of its own expertise and knowledge. The TK Projects would be jointly sponsored by BHP Billiton and the Aboriginal groups, to provide the groups the opportunity to bring relevant TK to EKATI's environmental management process.

Update of Traditional Knowledge Projects at EKATI

To date as part of the Phase II Studies BHP Billiton has provided funding to the Tlicho, Yellowknives Dene, North Slave Metis, Lutsel K'e Dene and the Kitikmeot Hunters and Trappers Association (and later the Kitikmeot Inuit Association) for TK projects.

Tlicho (Dogrib Treaty 11)

Funding was provided to the T'licho to develop a report on Tlicho traditional land use. In August 2000 "A T'licho Perspective On Biodiversity" was completed and provided to BHP Billiton. This study provided a brief overview of land use around the EKATI Lease Area and documented the various types of habitats and the vegetation found there.

Yellowknives Dene

The 'Weledeh Yellowknives Dene, A Traditional Knowledge Study of Ek'ati' was prepared and approved in 1997 by the Yellowknives Dene First Nation Elders Advisory Council. Funding for the project was provided by BHP Billiton, and this was the first of all the Phase II studies to be completed. The study looked at the historical land use of the Yellowknives Dene throughout the Weledeh and EKATI Mine site Lands, and provided recommendations on the use of the EKATI and Lac de Gras area for mining. Detail is provided on the patterns of life on the land prior to non-indigenous influence, and changes to the culture and settlement areas affected by the trapping industry through to mining. Maps have been included to show established Weledeh Yellowknives Dene routes in the tree line and the barrens, by people and wildlife, and discussion on camp sites and burial sites (Yellowknives Dene First Nation Elders Advisory Council, 1997).

NSMA

An historical study was initiated but not completed and reported.

Lutsel K'e Dene

A comprehensive Geographic Information Systems (GIS) based traditional land use database was developed between 2000 and 2005 in Lutsel K'e that was used as a tool by the Lutsel K'e Wildlife, Land and Environment Committee. The information was reported in the West Kitikmeot Slave Study (WKSS) reports. BHP Billiton's support was considered as matching WKSS funds. The GIS technician position in Lutsel K'e was funded by BHP Billiton.

Kugluktuk Inuit

Two TK projects have been developed in partnership between the Inuit of Kugluktuk and BHP Billiton. These are the Naonaiyaotit Traditional Knowledge Project (NTKP) and the Caribou and Roads project.

The original TK project agreement for the NTKP for the Copper Inuit was made between BHP Billiton and the Kitikmeot Hunters and Trappers Association. In 2006 the Kitikmeot Inuit Association (KIA) took over full responsibility of the NTKP, and are currently the overseers of the NTKP. BHP Billiton also has the use of the study for our ongoing environmental programs at EKATI.

Naonaiyaotit Traditional Knowledge Project (NTKP)

The (NTKP) was initiated in 1996 and the initial scope was completed in 2006. It covers a study area of 720,000 km^2, and ranges from the western boundary of Nunavut near Bluenose Lake, to Perry River in the east, north to include Holman and half of Victoria Island, and south to the base of the hunting overlap of the Inuit and the Dene in the Northwest Territories. The study collected information on regional movements of species such as caribou, bears and waterfowl over a span of time that covers decades and provides regional understanding of migratory paths. Although a direct translation is difficult, “Naonaiyaotit”, means “seeking knowledge” or “attempting to understand”. The English name for the project is “Walking in the Path of the Caribou”. The NTKP is a long-term project that was initiated during the environmental assessment for EKATI in 1996. From that initial impetus, the NTKP developed into a land-use planning tool that provides the Inuit with a means of responding to land-use applications and integrating TK into environmental assessments throughout their area of historical and current use, including EKATI. The project is ongoing, in that there has been an ongoing dialogue between Inuit and industry about the appropriate application of traditional Inuit cultural and natural history knowledge to environmental assessment and management. The level of biological detail in the NTKP will permit the information to be useful in minesite management. The first product of the NTKP, the Placenames Atlas, was released early in 2004. A series of reports in English on land use and wildlife was compiled and printed in 2006, and a GIS database was transferred to the KIA by BHP Billiton in 2006 with the intention to continue training and building capacity within the community to use and apply the database. In 2006 BHP Billiton and the KIA signed an Asset Purchase and Transfer Agreement. This agreement ensures that the NTKP is transferred to the KIA and that BHP Billiton provides financial assistance for 2 years to cover staff costs for use of the NTKP database, as well as training for that position. In 2007 the KIA created a full time GIS position in Kugluktuk with the purpose of maintaining and updating the GIS database. .

Caribou and Roads Traditional Project.

The Caribou and Roads Traditional Knowledge Project was initiated in 2002. The objective of the project was to review and address current issues with caribou on roads and near pits at EKATI. The project resulted in the formation of an Inuit "Elder's Advisory Group". Examples of the types of recommendations the Elder's Group made include:

- The use of inokhok at the mine site to deter caribou during spring migration.
- The use of gates across roads in specific areas such as on the Sable Road near the Beartooth Pit,
- The construction of a temporary fence at Beartooth Pit to protect caribou
- Improving existing caribou crossings,
- New caribou road crossings where needed on the Misery, Fox and Sable Roads,
- Removing road berms where less obstructive solutions would meet mine safety requirements,
- Constructing berms to act as barriers where caribou needed to be deterred, and
- Continuing to use people on the ground to divert caribou when necessary.

BHP Billiton and the Elder's Advisory committee met once a year in Kugluktuk to review the previous year's work projects at the mine, and discuss upcoming projects. Reports were produced each year. The project is being integrated into new strategies for using TK in environmental monitoring.

Appendix 2.0 BHP Billiton TK Community Contact List

Kugluktuk:

Kitikmeot Inuit Association

P.O. Box 360

Kugluktuk, Nunavut X0E 0E0

Canada

Phone: (867) 982-3310

Fax: (867) 982-3311

-Geoffrey Clark-Director of Lands, Environment and Resources

-Luigi Torretti-Senior Environment Officer

-Wynter Koluktana-Environment Technician

Hamlet of Kugluktuk

P.O. Box 271

Kugluktuk, Nunavut X0B 0E0

Canada

Phone: (867) 982-6505

Fax: (867) 982-3060

-Donald LeBlanc- Senior Administrative Officer

Lutsel K'e:

Lutsel K'e Dene First Nation

P.O. Box 28

Lutsel K'e, Northwest Territories X0E 1A0

Canada

Phone: (867) 370-7004

Fax: (867) 370-3010

-Ray Griffith-Senior Administrative Officer

-Tsatsiye Catholique-Director, Wildlife, Lands & Environment

-Sonja Almond- Administration Assistant-Wildlife, Lands & Environment

North Slave Metis Alliance:

North Slave Metis Alliance

32 Melville Drive

P.O. Box 2301

Yellowknife, Northwest Territories X1A 2P7

Canada

Phone: (867) 873-6762

Fax: (867) 669-7442

-Sheryl Grieve- Environment and Resource Manager

Tlicho Government:

Kwe Beh Working Group

Tlicho Government

P.O. Box 412

Betchoko NT. X1A 3T1

Canada

Phone: Betchoko (867) 392-6381

Yellowknife (867) 766-3391

Fax: (867) 766-3441

-Laura Duncan- Executive Officer-Tlicho Knowledge Research Division

-John B. Zoe-Senior Community Director

-Marjorie Matheson-Maund- Implementation Facilitator

-Allise Legat-Traditional Knowledge Facilitator

Yellowknives Dene First Nation:

Yellowknives Dene First Nation

P.O. Box 2514

Yellowknife, Northwest Territories X1A 2P8

Canada

Phone: Dettah (867) 873-4307

Ndilo (867) 873-8951

Fax: Dettah (867) 873-5969

Ndilo (867) 873-8545

-Kelly Cumming-Executive Assistant-Chief Dettah

-Randy Freeman-Director, Lands Management

Appendix G
Comments and Responses on 2012 EIR Technical Sessions

The following persons were present at the 2012 Environmental Impact Report Technical sessions:

Name	Organization
Charlotte Henry	Aboriginal Affairs and Northern Development Canada (AANDC)
Bruce Hanna	Fisheries and Oceans Canada (DFO)
Lisa Lowman	Environment Canada (EC)
Aileen Stevens	Environment and Natural Resources (ENR)
Sarah True	Environment and Natural Resources (ENR)
Loretta Ransom	Government of Northwest Territories (GNWT)
Bill Ross	Independent Environmental Monitoring Agency (IEMA)
Tim Byers	Independent Environmental Monitoring Agency (IEMA)
Kevin O'Reilly	Independent Environmental Monitoring Agency (IEMA)
Allison Anderson	Independent Environmental Monitoring Agency (IEMA)
Mike Tollis	Lutsel'Ke Dene First Nation (LKDN)
Stephanie Poole	Lutsel'Ke Dene First Nation (LKDN)
Ginger Gibson	TliCho
Brett Whelar	Wek'èezhìi Land and Water Board (WLWB)
Todd Slack	Yellowknives Dene First Nation (YKDN)

The following persons provided technical support or were presenters:

Name	Organization
Rob Maclean (Head of HSEC)	BHP Billiton Canada Inc.
Claudine Lee (Superintendent, Environment Operations)	BHP Billiton Canada Inc.
Erin Forster (Environmental Advisor, Fisheries and Aquatics)	BHP Billiton Canada Inc.
Jamie Steele (Environmental Advisor, Compliance)	BHP Billiton Canada Inc.
Harry O'Keefe (Environmental Advisor, Wildlife)	BHP Billiton Canada Inc.
Eric Denholm (Superintendent, Traditional Knowledge and Permitting)	BHP Billiton Canada Inc.
Kate Shea	BHP Billiton Canada Inc.
Brian Milakovic (Wildlife Biologist)	Rescan Environmental Services
Derek Shaw (Atmospheric)	Rescan Environmental Services
Tonia Robb (Aquatic Biologist)	Rescan Environmental Services
Kirsty Ketchum (Senior Consultant-Geochemistry)	SRK Consulting
Gary Koop	EBA

2012 Environmental Impact Report– Air

Claudine Lee
Superintendent- Environmental Operations
July 10, 2012

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resourcing the future

Contents

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resourcing the future

Name, Position, Department, Month Date, Year Slide 2

Air- Summary of Monitoring Programs

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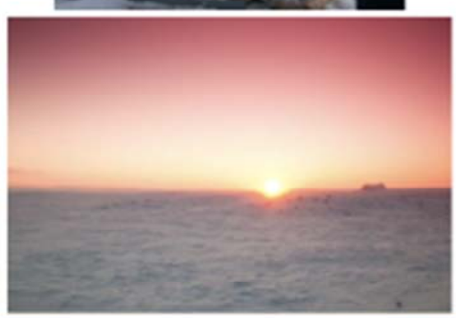
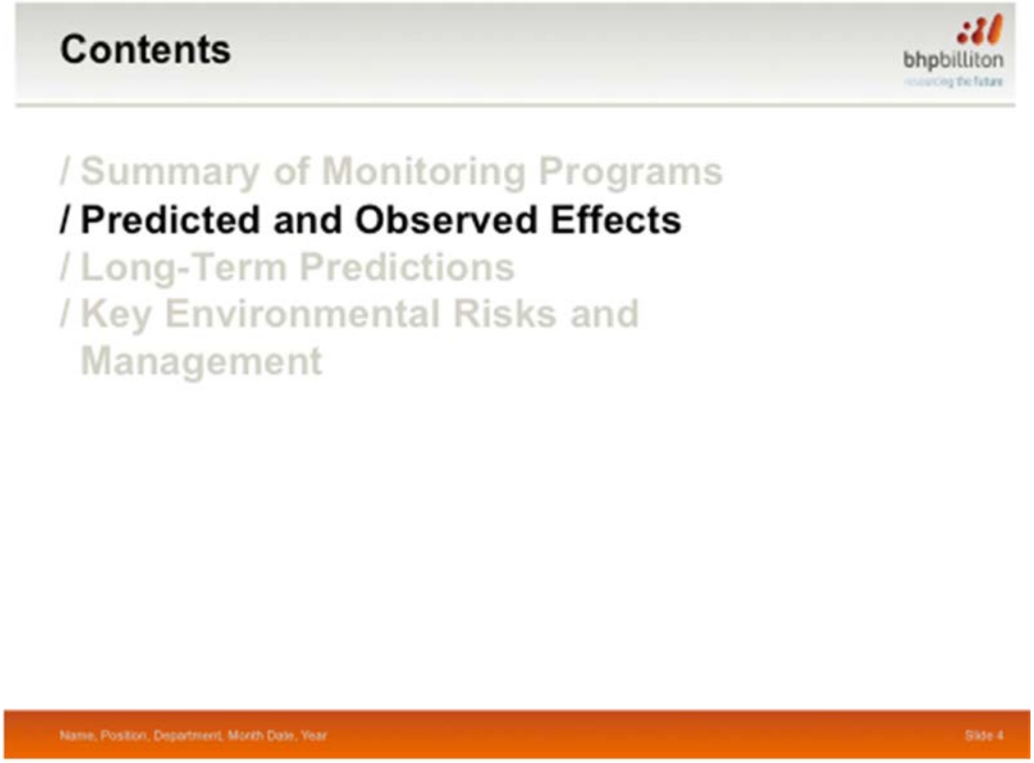
resourcing the future

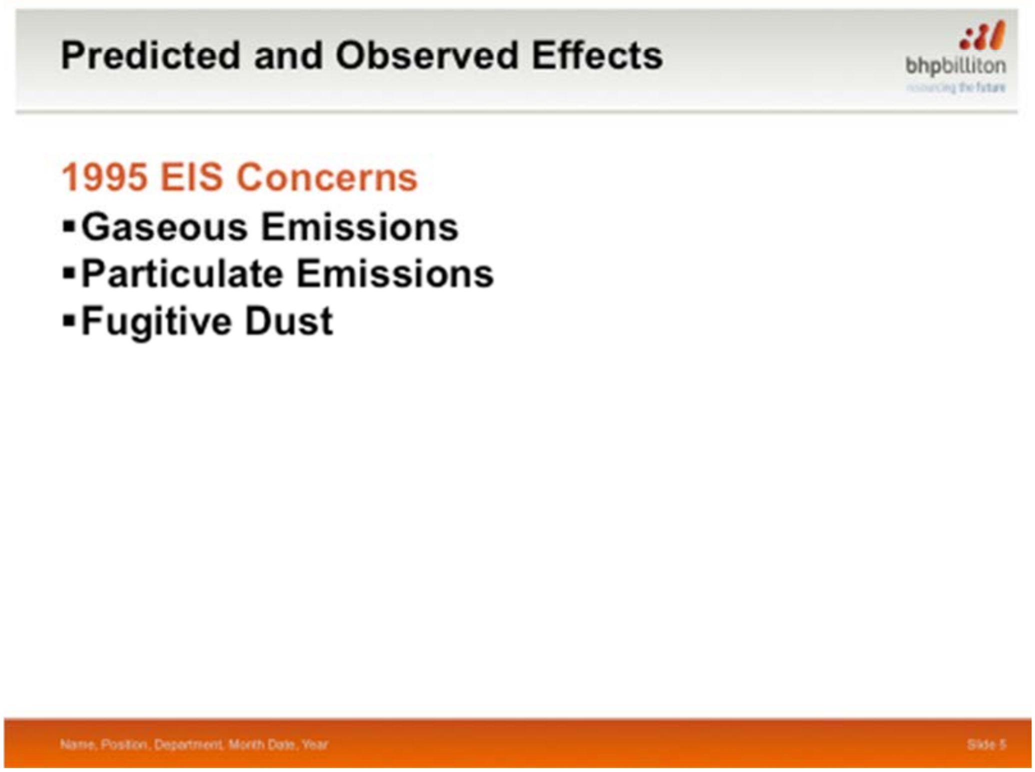
Section 5 of Material Provided

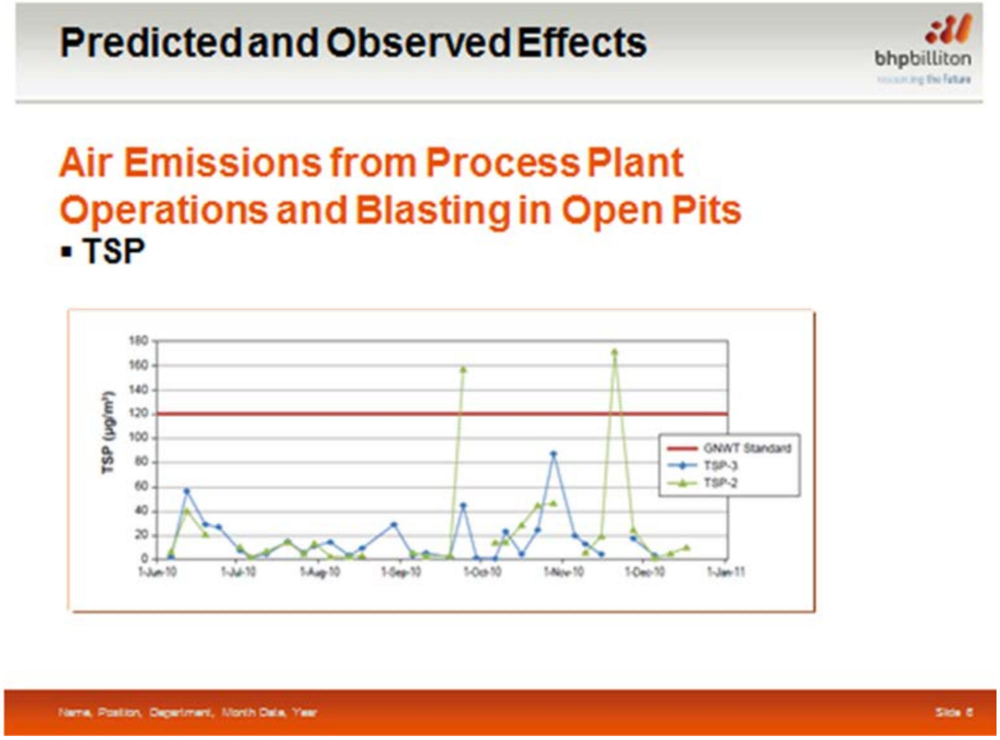
- Local Climate
- Air Quality Monitoring Program



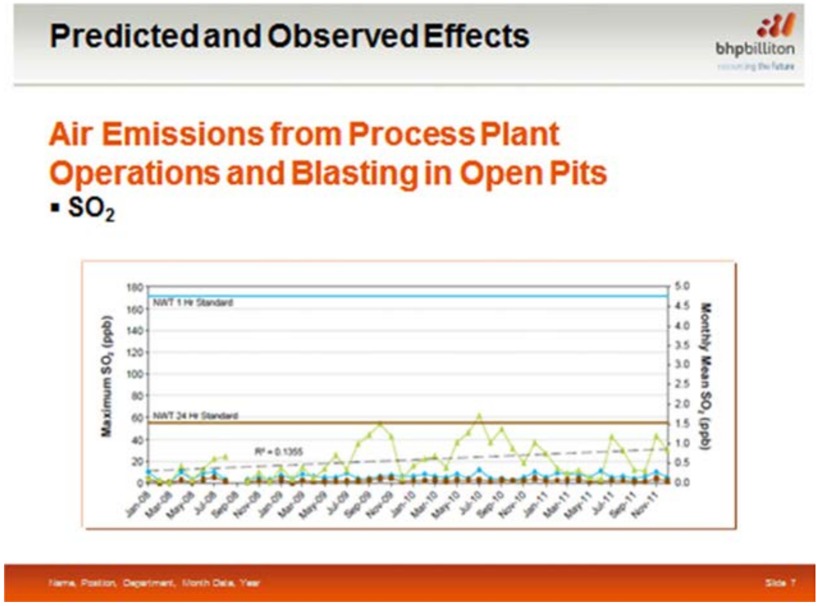
Name, Position, Department, Month Date, Year Slide 3


Contents
bhpbilliton
/ Summary of Monitoring Programs
/ Predicted and Observed Effects
/ Long-Term Predictions
/ Key Environmental Risks and Management
Name, Position, Department, Month Date, Year
Slide 4


Predicted and Observed Effects
bhpbilliton
1995 EIS Concerns
▪Gaseous Emissions
▪Particulate Emissions
▪Fugitive Dust
Name, Position, Department, Month Date, Year
Slide 5



Name (Organization)	Comment(s)	Response(s)
Bill (IEMA):	1a) Reference to at or beyond claim block is interesting since claim block is so large and the largest concern for IEMA is dustfall and suspended particulates, especially how it might affect caribou, this should be made explicit. 1b) Be careful using the claim block since effects might be felt outside of it (especially with caribou)	**Jamie:** Model prediction would say that BHP is not having an affect outside of claim block, goal is trying to maintain CAQ objectives
	2) Large amounts of the air quality data might be useless so making conclusions is potentially dangerous so use caution when writing the EIR since the draft looks like results are being tried to cover up.	**Rescan:** We do have lots of good data (lichen) to show trends, while there are issues with CAM data, on the whole the measurement should be good
	3a) IEMA's focus is TSP and this data seems to be lacking, and this is why care should be exercised when writing report 3b) Yes, and do not draw conclusions that are based on flawed data. More care needed to collect GOOD data and draw the correct conclusions from that.	**Jamie:** So, when writing report, we should also include statement of uncertainty?



Name (Organization)	Comment(s)	Response(s)
Todd (YK Dene FN):	1a) Has trend been extrapolated into the future? How close would the mean trend bring you to exceedances in a few years?	**Rescan (1a):** Graph is misleading, actual results are way below exceedances limits
Bill (IEMA):	1b) Was equally confused, so make graphics clearer.	**Jamie (1b):** Agreed.
Aileen Stevens (ENR) **Bill (IEMA)**	2a) Will QAQC and calibration procedures be covered? This data is important in order to understand data and make accurate data assessments 2b) Was calibration being done in accordance with national standards? 2c) Is calibration and maintenance not working then? If 75% of data is no good, then the checks in place need improvement. Ongoing QAQC evaluation needed to catch bad data earlier and steps taken to fix the problem	**Jamie (2a):** For purposes of discussion, QAQC will be discussed re: risk, but actual number crunching is outside scope of meeting **Jamie (2b):** We do have a maintenance schedule and quarterly and as needed contracting for calibration **Jamie (2c):** Agrees, ideas are being discussed to improve
Aileen Stevens (ENR)	3a) Is 75% data capture accurate?	**Rescan (3a)**: SO_x was bad, but other metrics were much better
	3b) Seeing these numbers would be very helpful	
Stephanie (Lutsel K'e Dene FN)	4a) Why is a contractor necessary for calibration?	**Jamie (4a):** We need to bring in outside expertise since its very technical **Rescan (4a):** Agrees; years of training necessary since equipment is sophisticated.
	4b) Hasn't mine had enough time to train an employee well?	**Jamie/Rescan (4b):** People have full time jobs doing mine circuit calibrating these machines.

◎ **Table of Contents**

Predicted and Observed Effects

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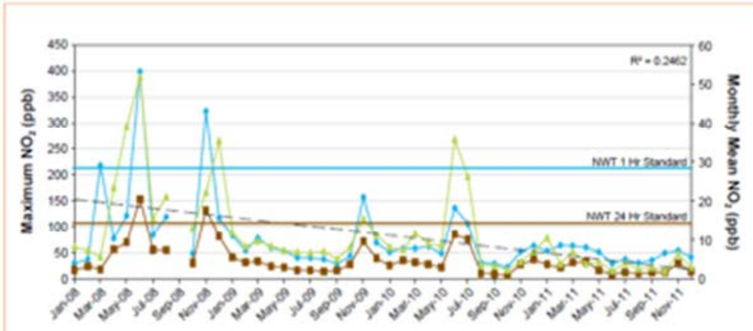
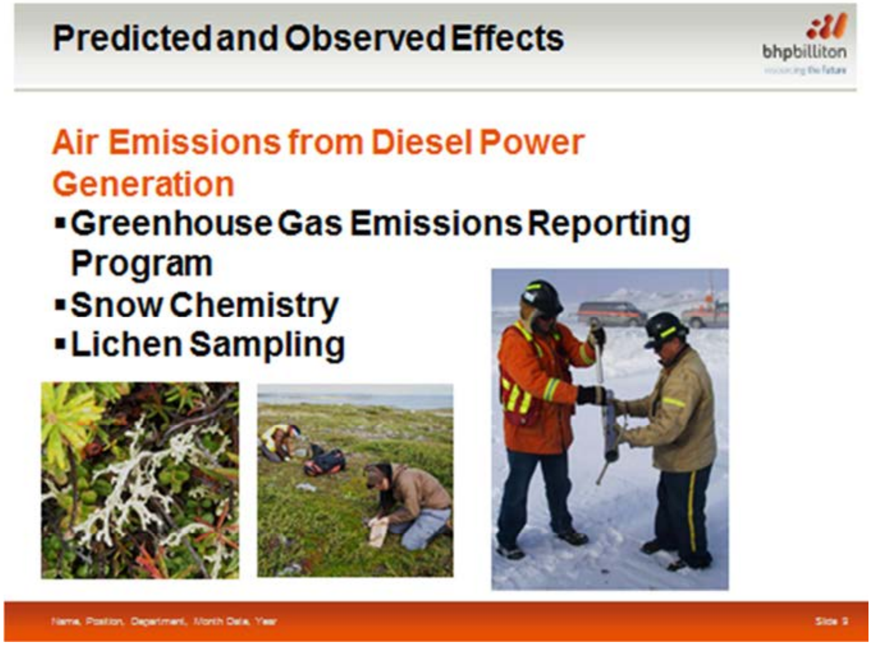
Air Emissions from Process Plant Operations and Blasting in Open Pits

▪ NO_2



Name, Position, Department, Month Date, Year

Slide 6



Name (Organization)	Comment(s)	Response(s)
Mike (Lutsel K'e Dene FN)	1a) How big is Zone of Influence?	**Jamie (1a):** ~45 km
	1b) Is this the same for dustfall?	**Jamie (1b):** Dustfalls measure road dust, so farthest station is 1km. Lichen and snow measurements are better for really fine particulate and so have a much further range. **Rescan (1b)**: Baseline dustfalls are also farther from the mine

Predicted and Observed Effects

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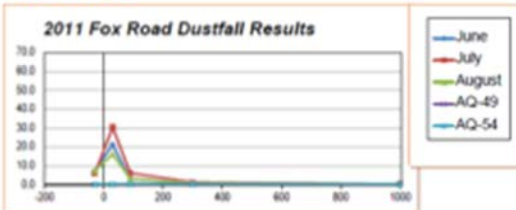
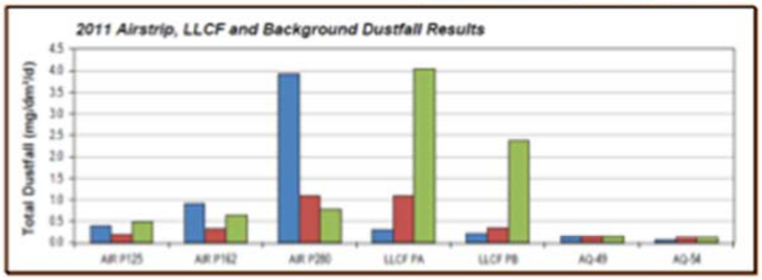
Roads and Road Traffic Create Fugitive Dust





Name, Position, Department, Month Date, Year   Slide 10

Contents

bhpbilliton

/ Summary of Monitoring Programs
/ Predicted and Observed Effects
/ Long-Term Predictions
/ Key Environmental Risks and Management

Name, Position, Department, Month Date, Year   Slide 11

Long-Term Predictions

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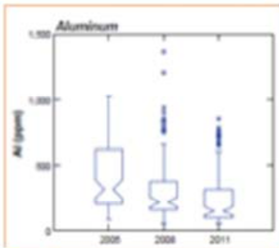
Long-Term Datasets
CALPUFF Air Dispersion
Development of Pigeon Pit



Lichen Tissue Concentrations

Name, Position, Department, Month Date, Year — Slide 12

Contents

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Name, Position, Department, Month Date, Year — Slide 13

Key Environmental Risks and Management

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resourcing the future

Ability to Detect Changes in Air Quality

- Management
- Residual Risk
- Future Actions

Name (Organization)	Comment(s)	Response(s)
Stephanie (Lutsel K'e Dene FN)	1a) Will Air Quality Management Plan be included in EIR?	**Jamie (1a):** Not sure if it's there now. **Rescan (1b):** selection process was based on list relevant to reporting period but yes, it can be included as an abstract or appendix in EIR

Name (Organization)	Comment(s)	Response(s)
Tim (IEMA):	1a) Thanks BHP for recognizing dustfall as potential aquatic impact; IEMA wasn't necessarily concerned about direct impacts of dustfall on aquatic, but rather the integrity of AEMP's reference lakes specifically vulture (since it is close to the mine as well); this consideration should be made.	**Jamie (1a):** Agrees; this concern will be addressed in re-evaluation of future AEMP

Name (Organization)	Comment(s)	Response(s)
Stephanie (Lutsel K'e Dene FN)	1a) Clarification; monitoring is taking place around Fox or around all WR storage areas? When will monitoring begin around all WR piles?	**Jamie (1a):** Currently looking for indication before future plans are made for increased monitoring
Kevin O'Reilly (IEMA)	1b) Wasn't Misery also to be included in WR monitoring? 1c) How was decision made regarding where to put dustfall monitoring stations? Are you trying to measure effects from new material dumping? Or to just understand latent dust coming from waste fall piles? Upwind? Downwind? Distance? How was the project designed and what were the objectives? 1d) Is objective to see what's happening with end dumping on an active WR pile? Or more general observations?	**Claudine (1b):** Right now just Fox. **Rescan (1c):** UP and Down covered; gradient also included (100, 300 and 1km) **Erin (1c):** Fox was chosen as pilot since it's the closest WR pile to water bodies **Claudine (1d):** Fox is not very active, so it's more latent observations.
Stephanie (Lutsel K'e Dene FN)	1e) How can you tell if its WR pile or general mine ops?	**Claudine (1e):** Distance from fox to main site, and proximity of monitoring stations to WR pile
Aileen Stevens (ENR)	2a) Problems with snow chemistry, SO_x, acid deposition, all above reference values. Lichen samples also showed elevated sulphate levels. Are these changes due to changes in fuel? What could be causing these changes?	**Jamie (2a):** No change in fuel, but this is an issue that needs to be looked at in future AQMP reports.
	3a) SO_x and NO_x are monitored because of their contribution to acid deposition, which is especially important in nutrient poor barrenlands and, so, very Important! Where were emissions from new incinerator accounted for, especially dioxins and	**Jamie (3a):** Agrees. Actual discharge from New Incinerator isn't accounted for, but emissions will be measured through stack testing and ambient data measurement.

	furans? This should be included in report.	
	4a) Seems that recent data capture has improved; this should be discussed in report. Sampling methods for snow sampling; did not change from 2008 despite potential nitrate losses? 4b) Were findings reported? 4c) Brief write-up of findings and procedures should be included in report.	**Jamie (4a):** In house comparison study and consultations with ALS, Rescan, Env Can led us to keep old protocol **Rescan (4b):** No, just statement that results did not differ **Harry (4b):** Also, replication was difficult since program was discontinued around AN building.
Eric Denholm (BHPB)	5a) Does GNWT have data capture rate with CAM building?	**Eileen (5a): :** Canada-wide standards require minimum 75% data capture on quarterly basis for all reporting. We aim for 85% but achieve this at only two of four stations due to limited expertise, long turn around times, etc. But this is why contract with Maxxam is so important.
	5b) Is that 75% for each instrument? Or collectively?	**Eileen (5b):** 75% for ozone and PM 2.5 alone. 85% for instrument by instrument basis otherwise.
Stephanie (Lustel K'e Dene FN)	6a) We are worried about increasing levels of mercury in lake trout; statements such as "we're not monitoring emissions from the incinerator" are unacceptable since these contaminants directly affect our health. Could dust entering PDC when frozen also be affecting fish size? Large industrial activities taking place in GNWT directly affect the people living here and all efforts should be made to ensure that best practices are in place to protect people and environment.	
Bill (IEMA)	7a) More detail re: new incinerator is needed for future plans discussion	**Jamie (7b):** Clarification; more inspections.
Kevin (IEMA)	8a) What have you learned about dust suppression on roads? Is suppression based on monitoring of AQ in CAM building? Does RW directly affect TSP measurements in the area? Have these lessons been used to change practices? What about changing from CaCl to DL-10? 8b) Mine inspector's visits are a requirement of water license. One lesson is re: lowering traffic speeds below 20 km/hr. But what's the point of dustfall monitoring if you're not going to learn from it?	**Jamie (8a):** Dust is suppressed as much as possible since it's a health and safety hazard, so no lessons learned from minimum requirements. **Claudine (8a):** Key trigger is visual rather than based on measurements of AQ. **Eric (8a):** RW is a very short term thing; short section of road, short time span. DL-10 is effective as longer term solution; we have 30m buffer for this compound around creeks and water bodies. Subsequent considerations re: mine inspector observing application of dust suppressant which is fine, but also means more red tape as we meet this requirement.
Stephanie (Lustel K'e Dene FN)	9a) Why and how was DL 10 selected as dust suppressant?	**Jamie (9a):** DL-10 is approved in GNWT guidelines, among others. To use any

	9b) What about EK-35? This is what we use in Lutselk'e. 9c) How did you come to this conclusion? 9d) Monitoring program ran for one year?	non-approved substance is very difficult and requires significant research investment **Aileen (ENR) (9b):** Guidelines are from 1998, need updating. If a new substance is to be used, it requires proof of non-harm. And ultimate approval comes from GNWT **Jamie (9b):** EK-35 is put on airport and current understanding is that effects from DL-10 are minimal **Jamie (9c):** No current monitoring programs in place **Rob (9c):** DL-10 was selected since at the time was one of the best approved substances. EK-35 was selected for the airstrip since it was compatible with jet aircraft. When DL-10 was initially applied, we had a monitoring program in place including water sampling and runoff sampling which showed no appreciable results on water bodies and so we kept using DL-10 (published). To date, that's why we still use it. **Rob (9d):** Believes program ran for 2-3 years as part of regular seasonal sampling program. **Claudine to follow up on results from DL-10 report for Stephanie Poole (Lutselk'e Dene FN)**

2012 Environmental Impact Report– Land

Claudine Lee
Superintendent- Environmental Operations
July 10, 2012

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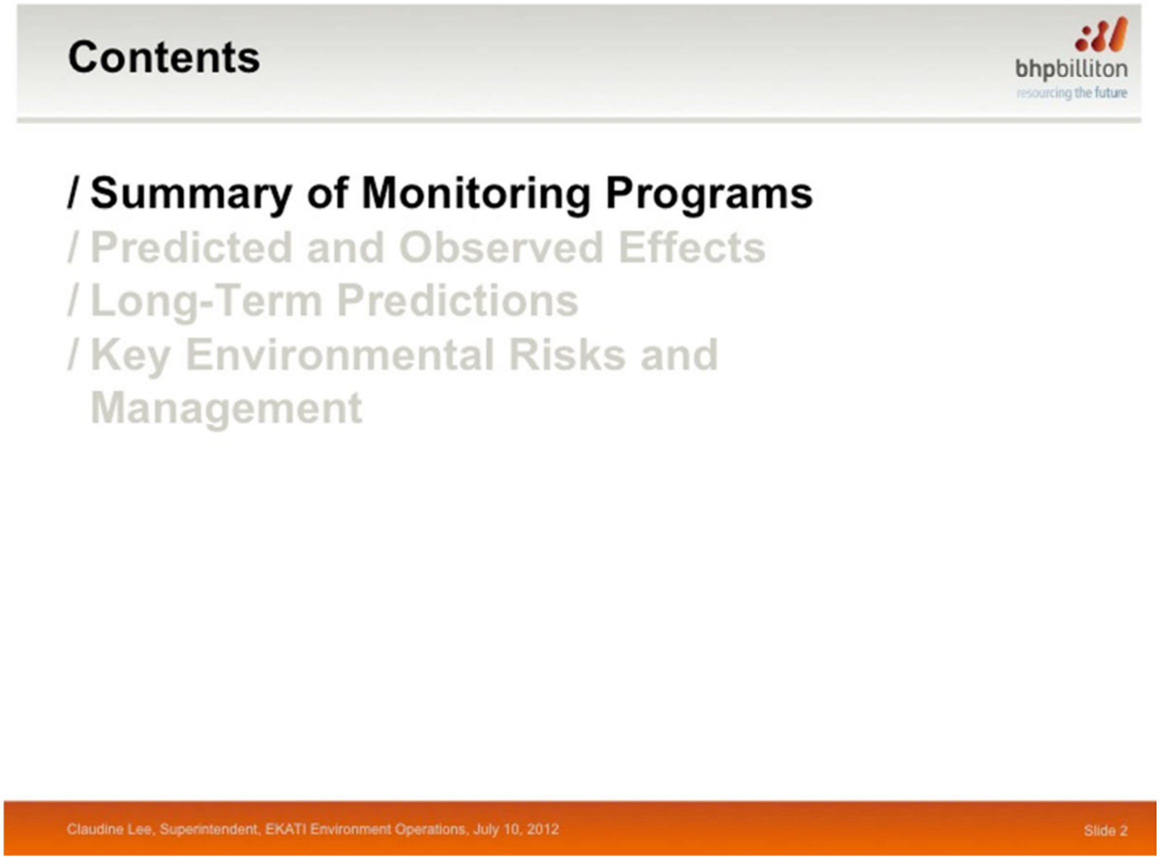
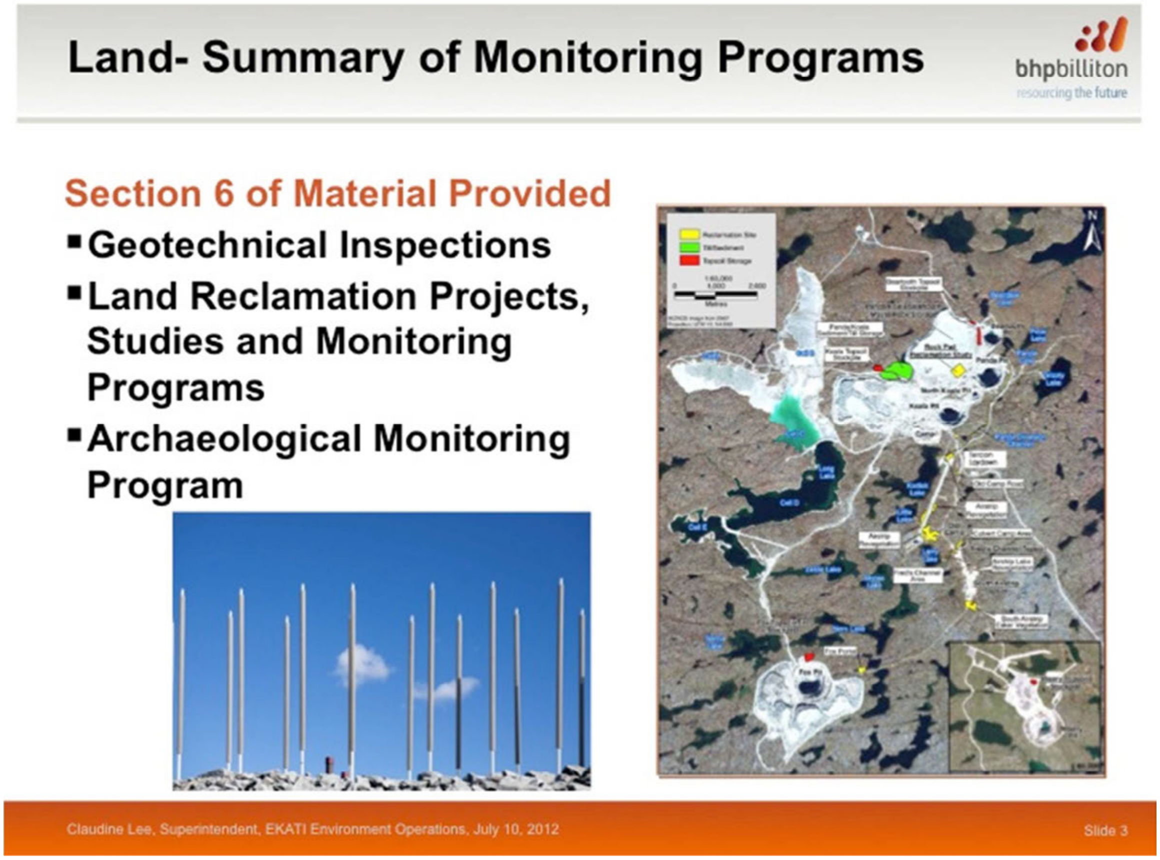

Contents
bhpbilliton
resourcing the future
/ Summary of Monitoring Programs
/ Predicted and Observed Effects
/ Long-Term Predictions
/ Key Environmental Risks and Management
Claudine Lee, Superintendent, EKATI Environment Operations, July 10, 2012
Slide 2



Name (Organization)	Comment(s)	Response(s)
Todd (YK Dene FN):	1) Clarification that archaeology will not be included since no new information	**Tonia:** Yes, will be mentioned but not in detail
Stephanie (Lutsel K'e)	2) Re: future actions for disturbance of archaeological sites and no new investigations for Pigeon	**Claudine:** Pigeon area and all other areas expected to be affected in next three years have already been assessed.
Bill (IEMA)	3a) Clarify that no new land disturbances in next three years? If any expectations are present, these should be included in 6-3 of report. 3b) Pigeon will be disturbed. Any other land disturbances planned?	**Claudine 3a):** Future expected losses will be discussed in following section and will be continually reevaluated as mine ops clarifies projections **Claudine 3b):** LLCF W. road will have deposition of PK. Misery WR (both have already been approved)
Stephanie (Lutsel K'e)	4a) Fay Bay leak; is LLCF freezing as predicted? Is this an issue regarding permafrost? Is there an increased risk of future spills from facility? Why is this not mentioned in the EIR?	**Claudine 4b):** LLCF is not supposed to be frozen
Bill (IEMA)	5) lack of freezing refers to waste rock, etc. not LLCF	**Stephanie 5) I**ssue will be discussed later.

Contents

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Predicted and Observed Effects

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Four VECs

- Permafrost
- Physical/Terrestrial Environment
- Groundwater
- Archaeology

Predicted and Observed Effects

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Permafrost

- 1995 EIS- local disturbance
- Geotechnical Inspections

Predicted and Observed Effects

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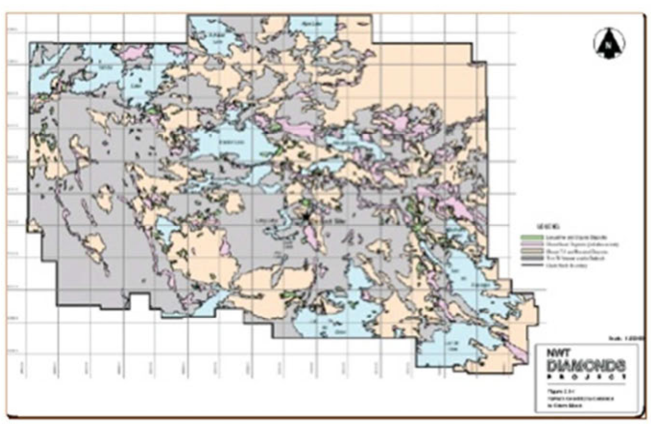
Physical/Terrestrial Environment- Land Disturbance and Loss of Vegetation Cover

- 1995 EIS- unavoidable effects on landscape
- 2011- 3,002 ha



Predicted and Observed Effects

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Physical/Terrestrial Environment- Land Area Disturbed by Temporary Roadbed

- Removal of temporary Fay Bay access Road

Predicted and Observed Effects

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Groundwater
-Alteration of Groundwater Flow
-Alteration of Water Table
-Mixing of Groundwater Extracted from Underground Mines with LLCF Water

Predicted and Observed Effects

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Archaeology (Heritage Sites)

- 2008: 200 archaeological sites
- 2009-2011: no proposed exploration drill sites or land developments

Summary of Effects

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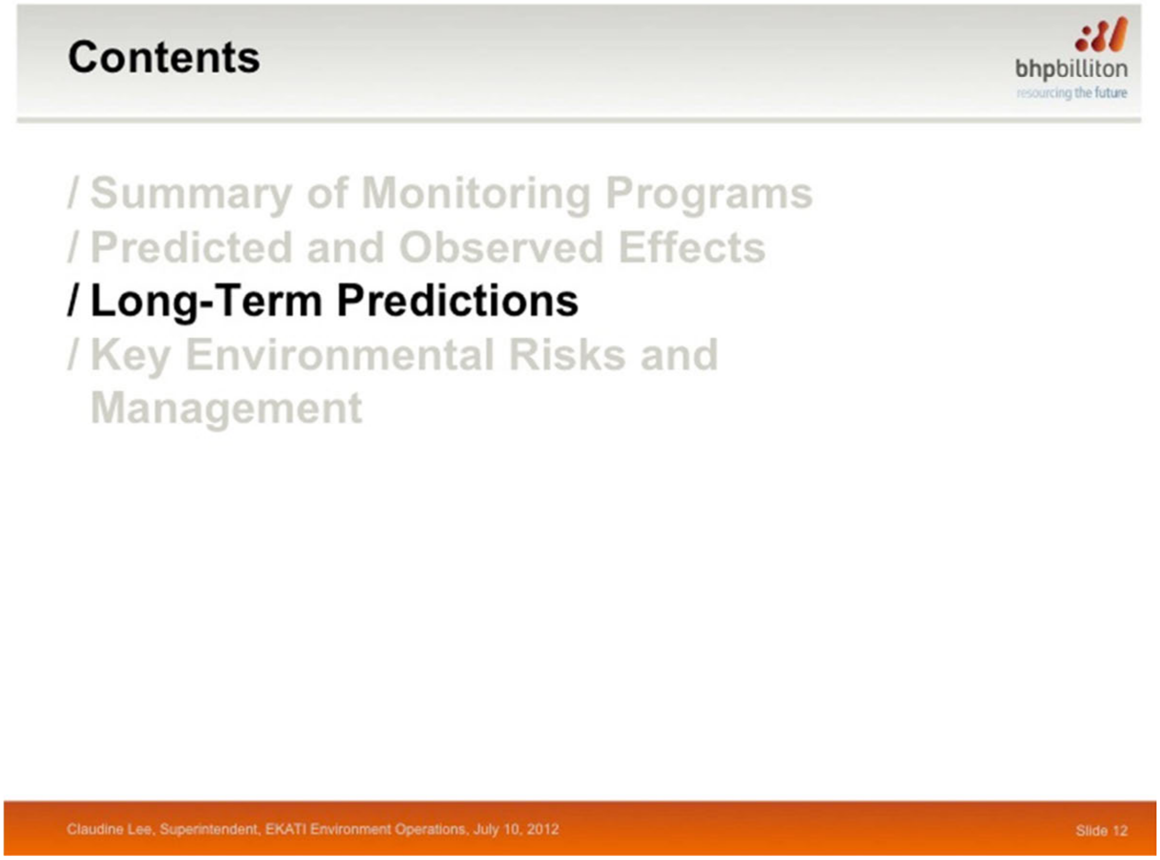
Permafrost

Physical/Terrestrial Environment- Land Disturbance and Loss of Vegetation Cover

Physical/Terrestrial Environment- Land Area Disturbed by Temporary Roadbed

Groundwater
-Alteration of Groundwater Flow
-Alteration of Water Table
-Mixing of Groundwater Extracted from Underground Mines with LLCF Water

Archaeology (Heritage Sites)


Contents
bhpbilliton
resourcing the future
/ Summary of Monitoring Programs
/ Predicted and Observed Effects
/ Long-Term Predictions
/ Key Environmental Risks and Management
Claudine Lee, Superintendent, EKATI Environment Operations, July 10, 2012
Slide 12

Long-Term Predictions

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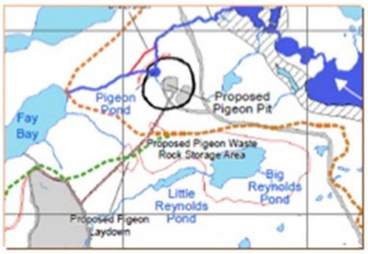
Development of Pigeon Pit Reclamation Research



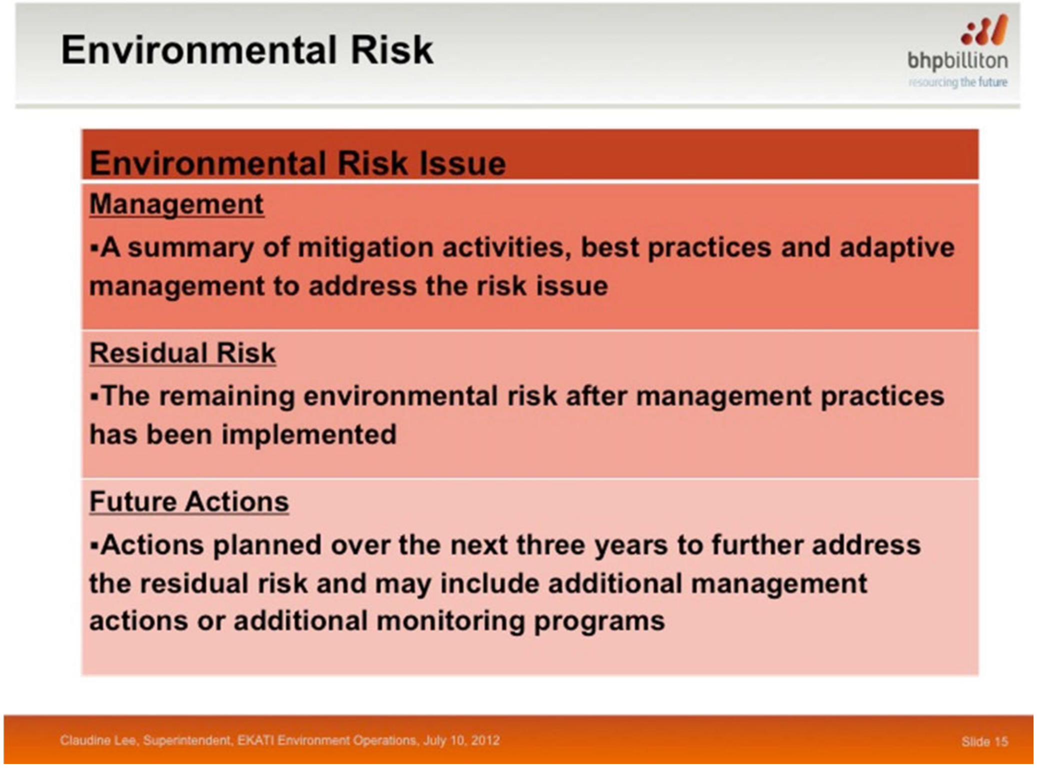
Claudine Lee, Superintendent, EKATI Environment Operations, July 10, 2012 — Slide 13

Contents

bhpbilliton
resourcing the future

/ Summary of Monitoring Programs
/ Predicted and Observed Effects
/ Long-Term Predictions
/ Key Environmental Risks and Management

Claudine Lee, Superintendent, EKATI Environment Operations, July 10, 2012 — Slide 14


Environmental Risk
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Environmental Risk Issue
Management
▪A summary of mitigation activities, best practices and adaptive management to address the risk issue
Residual Risk
▪The remaining environmental risk after management practices has been implemented
Future Actions
▪Actions planned over the next three years to further address the residual risk and may include additional management actions or additional monitoring programs
Claudine Lee, Superintendent, EKATI Environment Operations, July 10, 2012
Slide 15

Key Environmental Risks and Management

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Permafrost Exposure

- Management
- Residual Risk
- Future Actions

Claudine Lee, Superintendent, EKATI Environment Operations, July 10, 2012 Slide 16

Name (Organization)	Comment(s)	Response(s)
Kevin (IEMA):	1a) Seepage reports including thermistor readings from WR piles, which indicates that parts of Misery and Fox WR piles are not freezing; this matters since some components of WR pile can't be exposed to air/water. What is BHP doing about this, and why isn't this identified as a residual risk? Were more thermistors installed as per previous discussion? This needs to be included in EIR. If WR piles DON'T freeze, what is the contingency plan to address indirect affects? (also included in EIR) 1b) Needs to do more reading, but wants to make sure it's covered somewhere.	**Claudine 1):** Permafrost integrity related to containment of seepage; looks for feedback on where best to include (seepage or permafrost section?)
Bill (IEMA):	2) Key is that readers don't get impression that permafrost degradation in rock piles is uniform and consistent. There are reasons why permafrost is aggrading more	**Gary (EBA) 2):** The parts of the pile that aren't freezing are treending towards cooling, certain reasons for this exist. Closure plan includes procedures to deal with this issue long

	slowly in some places than others, and these need to be included in the report.	term.
Eric (BHP):	3a) Is additional risk item re: RP freezing needed in report?	**Kevin (IEMA) 3a):** Up to BHP to determine best fit, but it needs to be addressed somewhere, including what you plan to do about addressing the risk. **Claudine 3b):** Risk is seepage, so we can discuss this further in seepage section.

Key Environmental Risks and Management

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Changes to the Physical/Terrestrial Environment

- Management
- Residual Risk
- Future Actions

Claudine Lee, Superintendent, EKATI Environment Operations, July 10, 2012 Slide 17

Name (Organization)	Comment(s)	Response(s)
Bill (IEMA):	1a) List of items to minimize mine footprint; ISO-140001 is not an example of minimizing footprint expansion and should probably not be listed as such in a general way (cite specifics if necessary) 1b) Progressive re-vegetation has been construed as reclamation and so needs to be explicitly defined. What has been the progressive reclamation activities in the last 3 years? What do they amount to? (Need to include). 1c) Should be “clear and unequivocal” re: what the 3-yr period has accomplished.	**Eric 1b):** No issues what suggestion; will be addressed. **Eric 1c):** Agreed.

Key Environmental Risks and Management

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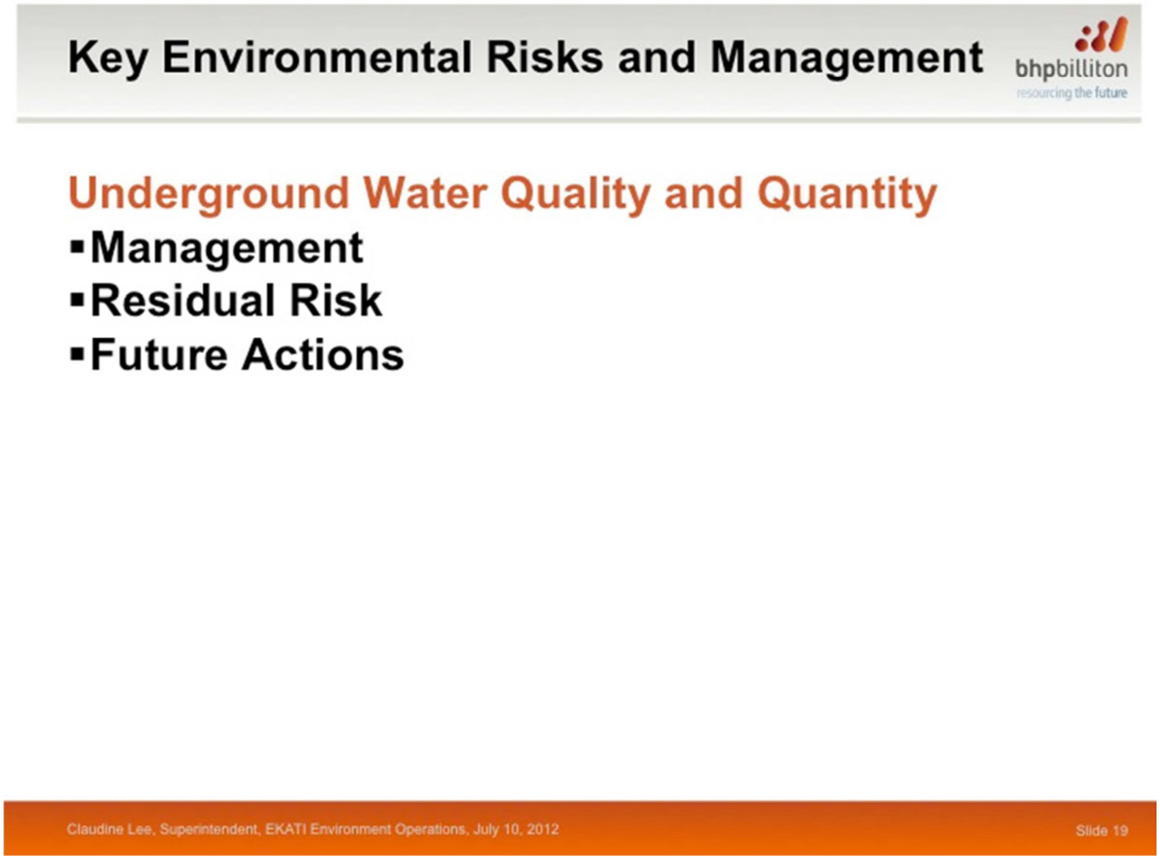
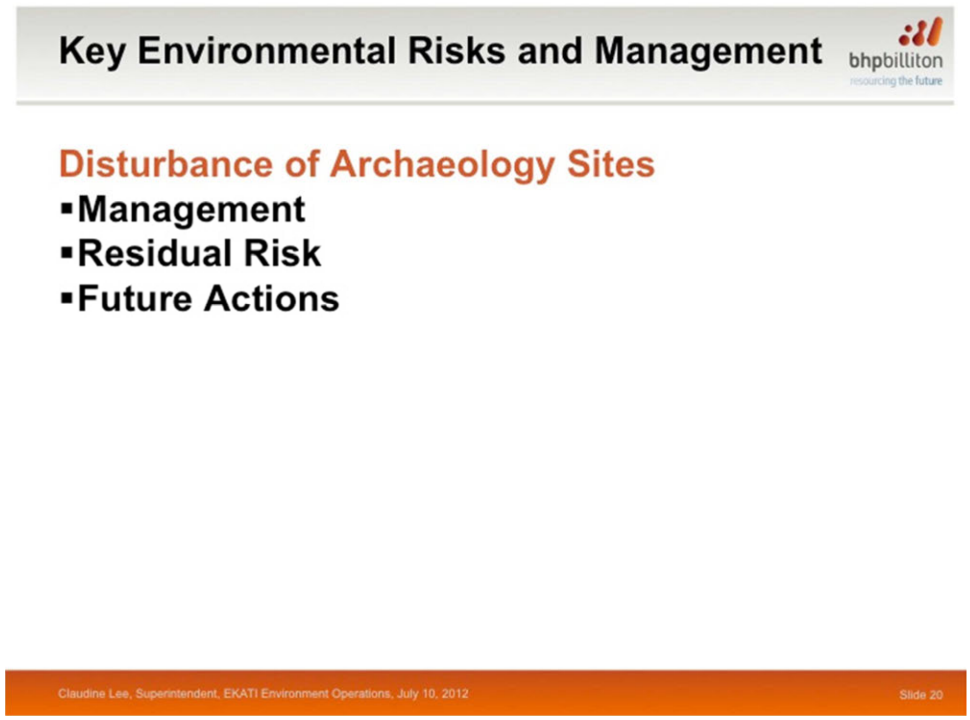
Groundwater Mixing with LLCF Water

- Management
- Residual Risk
- Future Actions

Claudine Lee, Superintendent, EKATI Environment Operations, July 10, 2012 — Slide 18



Name (Organization)	Comment(s)	Response(s)
Bill (IEMA):	1) Can you do WQ monitoring within Beartooth pit?	**Eric 1):** Getting into the pit is one issue (safety concern). Monitoring of Beartooth Pit water is in water license already, current models include runoff, input water chemistry, etc. Ongoing discussion with geotechs re: when we can safely access water for explicit testing.
Kevin (IEMA):	2) Pit water quality modelling; next stages? Is that report coming? Does that differ from what was submitted for water license?	**Eric 2): Y**es. Water license submission included LLCF model. Pit lake modelling is included in long term closure plan report; that report is almost complete but should be out in next few months.



Name (Organization)	Comment(s)	Response(s)
Todd (YK Dene FN):	1a) Is there an acknowledgement that arch. Work must be completed in summer time? 1b) Wishes to see summer sampling acknowledged.	**Rob 1a):** Studies have always been done and will continue to be completed in the summer. Brings up issue that there are no plans to impact any areas that have not already been assessed, and if anything new comes up it will be preceded by arch. **Rob 1b):** Agreed.
Tim (IEMA):	2a) Have any artefacts come up in the process of past mine construction? If so, what is the protocol for addressing any new artefacts identified? 2b): Accepts.	**Rob 2a):** No recollection of materials found that prevented development or exploration. Esker near L. du Sauvage yielded some artefacts but nothing required reworking of mine development **Eric 2b):** Procedure is that if anything was identified, work stops until assessment is done.
Kevin (IEMA):	3) Report includes mention of 5-year closure performance report but even more interesting is that annual report on closure performance is necessary for AANDC guidelines	

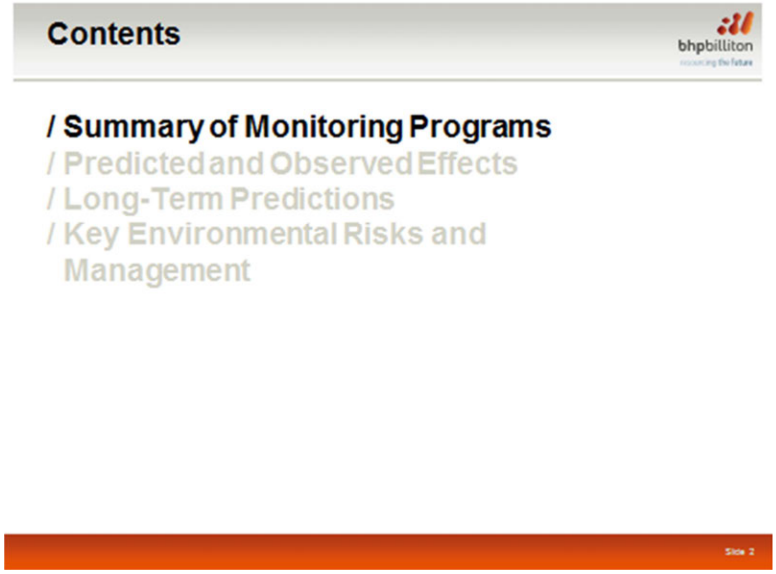
Bill (IEMA):	4) Water license requires annual report of closure performance and this should be identified.	**Eric/Claudine 4)** Agreed.

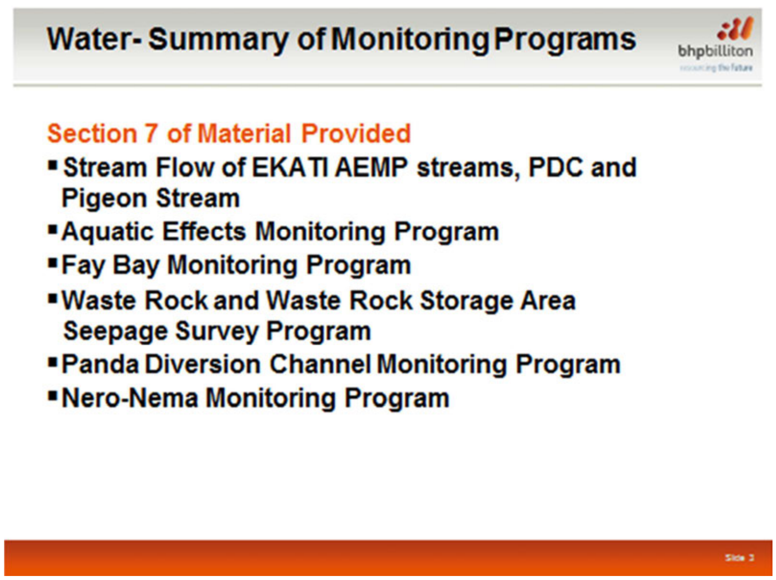
2012 Environmental Impact Report– Water

Claudine Lee
Superintendent- Environmental Operations
July 10, 2012

bhpbilliton
resourcing the future

◎ **Table of Contents**





Contents

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Slide 4

Predicted and Observed Effects

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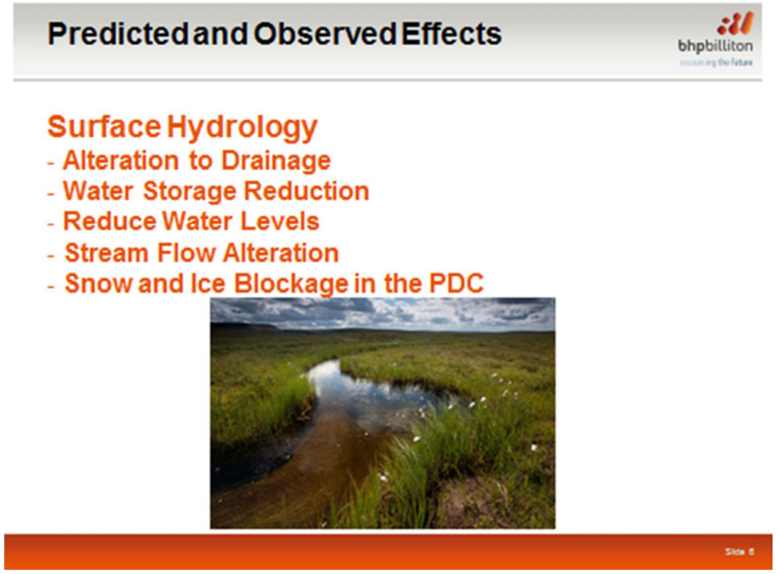
Three VECs

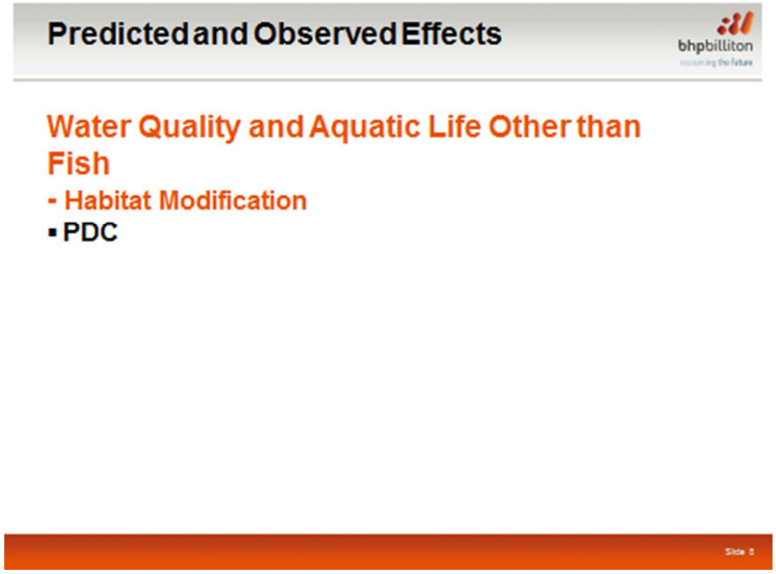
- Surface Hydrology
- Water Quality and Aquatic Life Other than Fish
- Fish

Slide 5


Predicted and Observed Effects
bhpbilliton
Surface Hydrology
- Alteration to Drainage
- Water Storage Reduction
- Reduce Water Levels
- Stream Flow Alteration
- Snow and Ice Blockage in the PDC

◎ Table of Contents

Name (Organization)	Comment(s)	Response(s)
Tim (IEMA)	1a) Understands that fish habitat monitored after the spill was for trout and grayling, not cisco- some of the substrate that was affected seems like cisco habitat. It would be nice to see something addressing this issue; were cisco affected? Yes or no. 1b) Either way, response should be in EIR.	**Eric 1a):** Gave a response, but can't remember what
Bill (IEMA)	2a) Is Cladocera covered in this section?	**Rescan 2a)** No, covered later.


Predicted and Observed Effects
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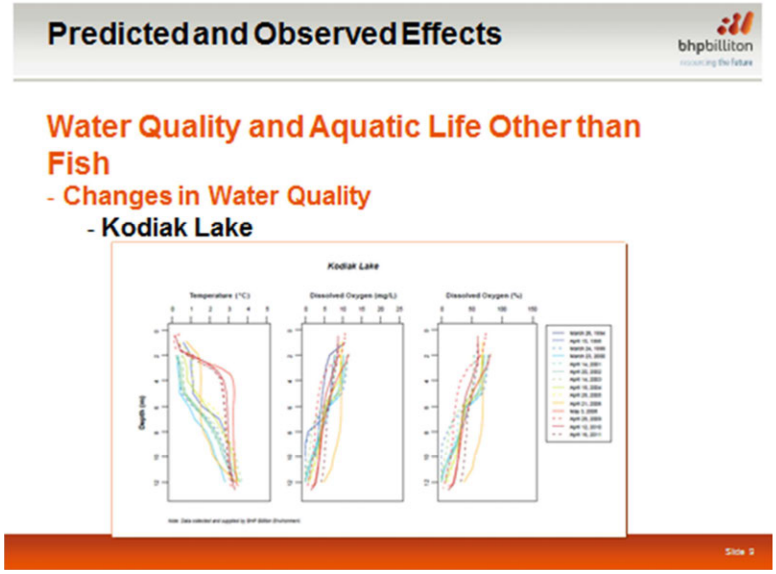
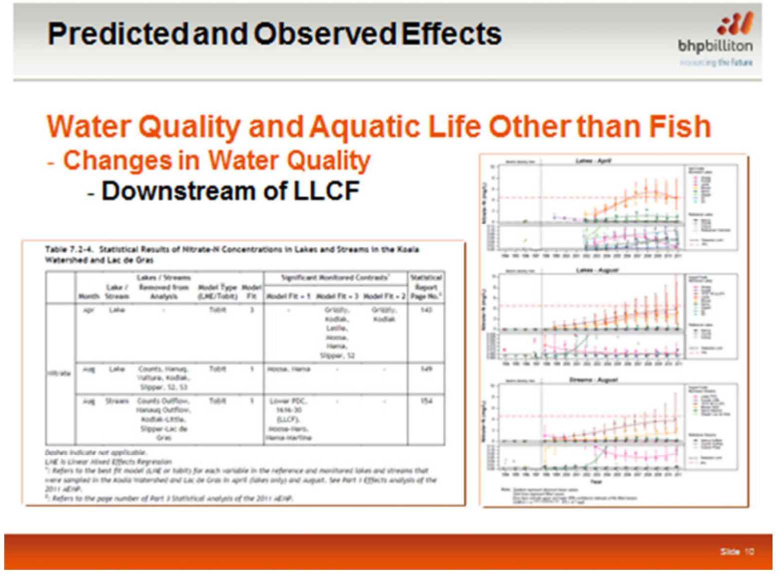
Water Quality and Aquatic Life Other than Fish
- Habitat Modification
▪ PDC



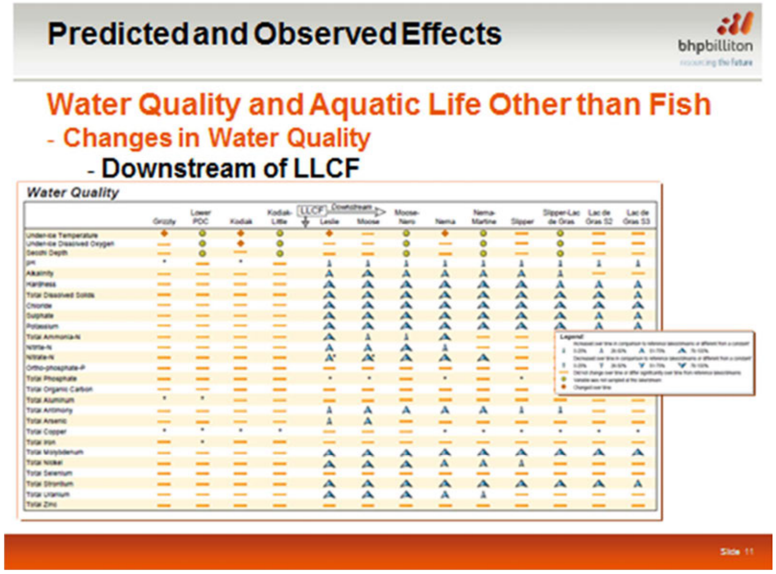
Name (Organization)	Comment(s)	Response(s)
BIll (IEMA):	1a) Ekati's response to low DO in Kodiak is a perfect example of adaptive management (observation, identification of problem, management, monitoring to determining success). BUT, cause of eutrophication is still uncertain (dewatering and in-sedimentation of Koala / sedimentation from PDC).	



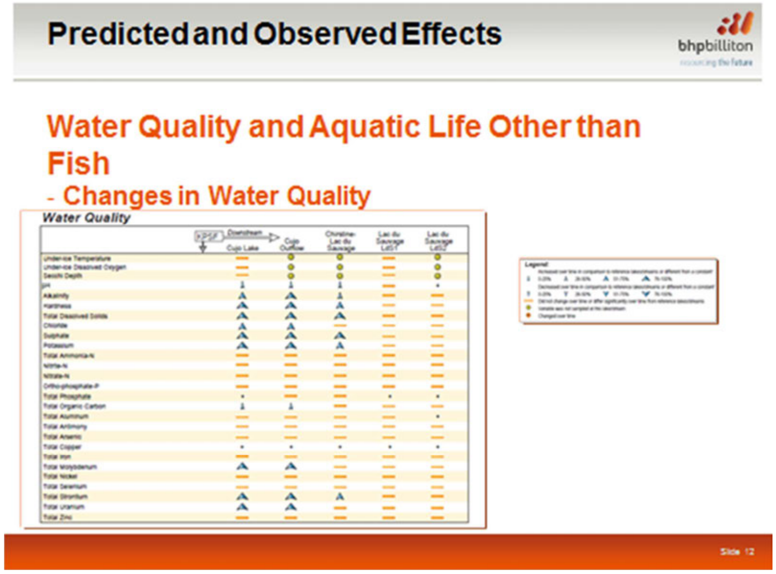
Name (Organization)	Comment(s)	Response(s)
Todd (YK Dene FN):	1a) Summary is necessary; How far downstream can you still detect a signal from the LLCF? 1b) How many km does this water flow?	**Rescan 1a):** Follow to next slide; effects have been detected all the way to LDG **Erin 1b):** 20-25 km.
Bruce (DFO)	2a) Has experience with Kodiak affected how you handle Cujo?	**Rescan 2a)** Established benchmarks within water license renewal have been adopted with AEMP and these are looked at in addition to regression models and fitted means. Recent conclusions regarding statistical analyses show that if CI exceeds benchmark, then sample has exceeded benchmark. These two analyses are examined differently.
Bill (IEMA)	3a) Just make it clear within the report that if the sample exceeds the benchmark, say so.	
Tim (IEMA)	4a) Ekati needs to be complimented on presentation of data (i.e. Evaluated parameters showing both historical trends of contaminants of concern for maximum and median concentration as well as future predicted concentrations and % of benchmark (very important to know)	**Rescan 4a)** Those charts came from water license renewal and Koala watershed prediction models
Todd (YK Dene FN)	5a) Is there a monitoring station downstream of LDG?	**Rescan 5a)** Two in LDG but nothing further.

	5b) Clarify: no information of what happens past LDG?	**Rescan 5b)** Currently examining need for further monitoring. Also important to note that increases in concentration by LDG are fairly minimal, and therefore increases past this point would be very difficult to capture. Next EIR might contain another station if it's determined that one is warranted. **Eric 5b)** Difficult to point at sources once you get to LDG
Tim (IEMA)	6a) Points to importance of monitoring cumulative effects. 6b) Are benchmarks upper limits or lower limits?	**Rescan 6b)** New CCME benchmarks have moved away from simple graphical presentations to a formula for determining exceedances. If we do present minimums or maximums for a figure then it's indicated on the figure itself. **Eric 6a)** AEMP crosses over with water license regarding water quality objectives. Benchmarks in WL application model may differ from those in AEMP because of timing of report finalization. If there is a site-specific water quality objective, that trumps other issues (used whenever applicable over generalized guidelines). Failing site-specific guidelines, we use CCME. Failing that, we look at provincial or international standards
Kevin (IEMA)	7a) Will EIR use old benchmarks, or those proposed in the water license? 7b) Site specific WQ objectives need to be accepted by land and water management board and therefore should not be used as benchmarks in EIR before that acceptance.	**Eric 7a)** Inasmuch as graphs are pulled from old reports, we did not alter benchmarks but new work moving forwards would use new benchmarks.
Bill (IEMA)	8a) Agrees with Kevin that you need land and water management board acceptance before switching any guidelines.	**Eric 8a)** You could challenge determination of site specific derivation using technical, scientific criteria. If you follow the established procedure then by definition, a site-specific guideline would be better than a generic one.
Kevin (IEMA)	9a) Doesn't disagree, but whenever site specific guidelines are chosen it leads to a higher level of pollution.	**Eric 9a)** Which isn't really surprising since we know that the generic standard aims to provide an ultra conservative standard to protect every

		thing in every environment.
Todd (YK Dene FN)	10a) This is only true if water has no intrinsic value; if you don't value water as is then you don't mind polluting it. This is not the approach that we use. We must treat land and water with respect. Idea of moving goalposts, especially away from nationally accepted guidelines, is not well regarded. The people who live here who are not part of the process would not agree with your determination	**Eric 10a)** So, then, we need a step before since CCME guidelines are derived from use-protection approach. So, do we move towards a use-protection approach? Or a tolerable change approach? We often don't say what our starting approach is, but ours is the use-protection approach, and so we assume that the water can adapt to a certain level of additions without affecting its use potential.
Loretta (AANDC)	11a) Using site specific WQ objectives for mine; how are these derived?	**Eric 11a)** CCME protocols have their own set of numbers and provides a formula for deriving site specific values.
Bill (IEMA)	12a) Disagrees that Ekati did the site specific derivation correctly.	**Eric 12a)** Needs to be clear if this is a conversation about if we did the site specific derivation correctly, or if our approach to benchmark determination is inappropriate.



Name (Organization)	Comment(s)	Response(s)
Bill (IEMA):	1) Most of these changes make a lot of sense, but not pH which is a log variable and therefore shouldn't be compared as a percentage. Be careful.	**Rescan 1):** Will address this in AEMP, not in EIR right now.



Name (Organization)	Comment(s)	Response(s)
Bruce (DFO)	1a) Was aquatic vegetation re-established in area where PK was deposited?	**Erin 1a):** Most of the area that was covered was in a boulder field, only ~20% of area was vegetated but no we haven't looked at this.
Stephanie (Lutsel K'e Dene FN):	2a) Is there information available comparing what Fay Bay was like and what it's like today 2b) Was the mine ever supposed to impact Fay Bay?	**Rescan 2a):** Yes; not as extensive as AEMP but historical baseline conditions are available and can be compared. **Rescan 2b)** Fay Bay was previously monitored in advance of Pigeon development and will continue to be monitored with pigeon being operational.

Predicted and Observed Effects

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Water Quality and Aquatic Life Other than Fish

- Changes in Water Quality

- Fay Bay

Slide 13

Predicted and Observed Effects

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Water Quality and Aquatic Life Other than Fish
- Changes in Sediment Quality

Sediment Quality

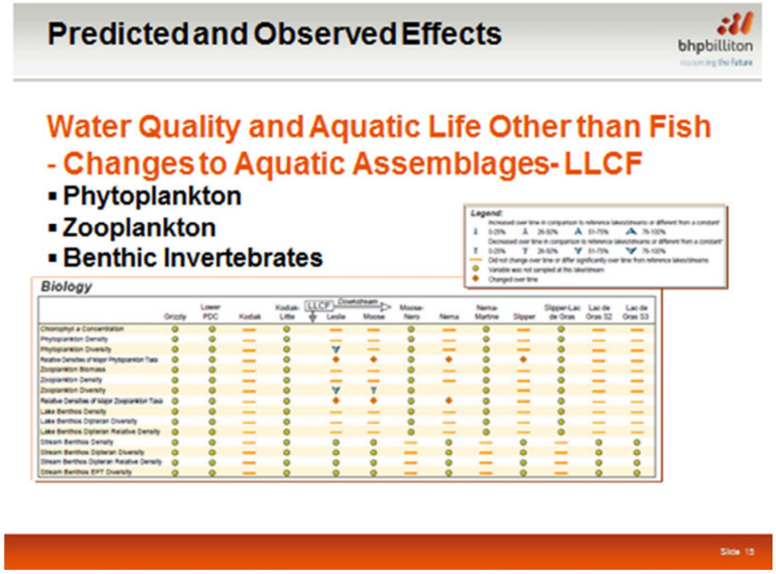
	Grizzly	Lower PDC	Kodiak	Kodiak-Little	Leslie	Moose	Moose-Nero	Nema	Nema-Martine	Slipper	Slipper-Lac de Gras	Lac de Gras S2	Lac de Gras S3
Total organic carbon	●	●	—	●	—	—	●	—	●	—	●	—	—
Available phosphorus	●	●	—	●	—	—	●	—	●	—	●	—	—
Total nitrogen	●	●	—	●	—	—	●	—	●	—	●	—	—
Aluminum	●	●	—	●	—	—	●	—	●	—	●	—	—
Antimony *	●	●	—	●	◆	◆	●	◆	●	◆	●	—	—
Arsenic	●	●	—	●	•	•	●	•	●	•	●	•	•
Copper	●	●	—	●	—	—	●	—	●	—	●	—	—
Molybdenum	●	●	—	●	▲	▲	●	▲	●	▲	●	—	—
Nickel	●	●	—	●	—	—	●	—	●	—	●	—	—
Selenium	●	●	—	●	—	—	●	—	●	—	●	—	—
Strontium *	●	●	—	●	◆	◆	●	◆	●	◆	●	◆	◆
Zinc	●	●	—	●	—	—	●	—	●	—	●	—	—

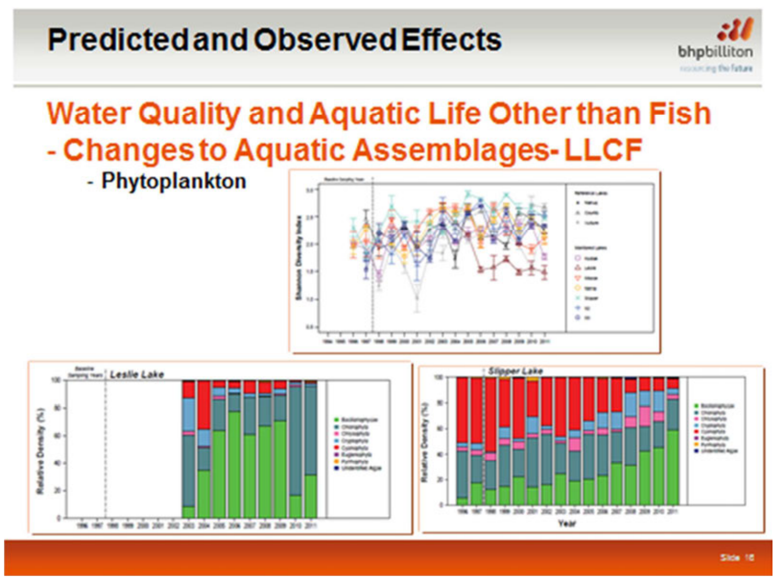
LLCF → Downstream

Nanuq Mid-depth

Legend:
Increased over time in comparison to reference lakes/streams or different from a constant
0-25% 26-50% 51-75% 76-100%
Decreased over time in comparison to reference lakes/streams or different from a constant
0-25% 26-50% 51-75% 76-100%
— Did not change over time or differ significantly over time from reference lakes/streams
● Variable was not sampled at this lake/stream
◆ Changed over time

Slide 14





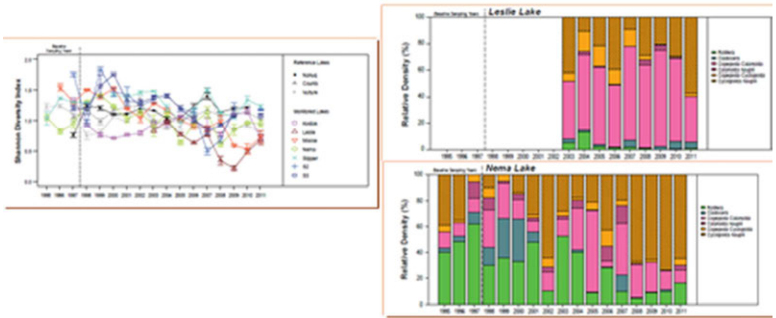
Name (Organization)	Comment(s)	Response(s)
Bruce (DFO)	1a) Did you also look at phytoplankton (edible/non-edible)?	**Rescan 1a):** Yes, mostly based on size comparison. Lots of AEMP has historically been compartmentalized so recent efforts have been made to tie together phyto- and zooplankton and water quality (also looking at how sediment quality and benthic invertebrates are affected by WQ).

Predicted and Observed Effects

bhpbilliton

Water Quality and Aquatic Life Other than Fish - Changes to Aquatic Assemblages-LLCF

- Zooplankton



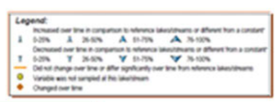
Slide 17

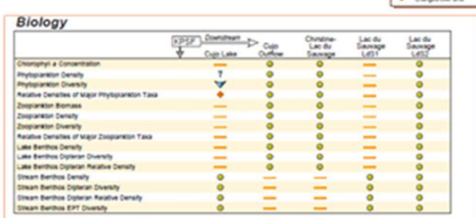
Predicted and Observed Effects

bhpbilliton

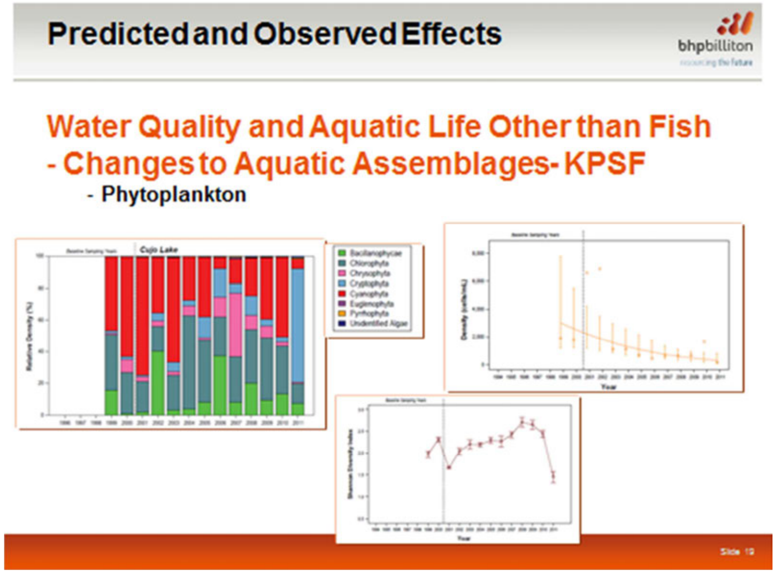
Water Quality and Aquatic Life Other than Fish - Changes to Aquatic Assemblages-KPSF

- Phytoplankton
- Zooplankton
- Benthic Invertebrates





Slide 18



Name (Organization)	Comment(s)	Response(s)
Tim (IEMA)	1a) Where is Seep-012? Identification in report of TPH/BTWX in seep-012 at this site for first time ever. 1b) Are these contaminants contained within LLCF 1c) Anything in EIR where it's coming from, or how this will be investigated?	**Kirsty 1b)** Yes. **Kirsty 1c)** Those parameters were analyzed here because it's close to CSCF, will continue to be monitored to see if it's a one time occurrence or continuing trend.

Predicted and Observed Effects

bhpbilliton

Fish
- Habitat Loss
  - PDC
  - Nero-Nema Stream

2001

2011

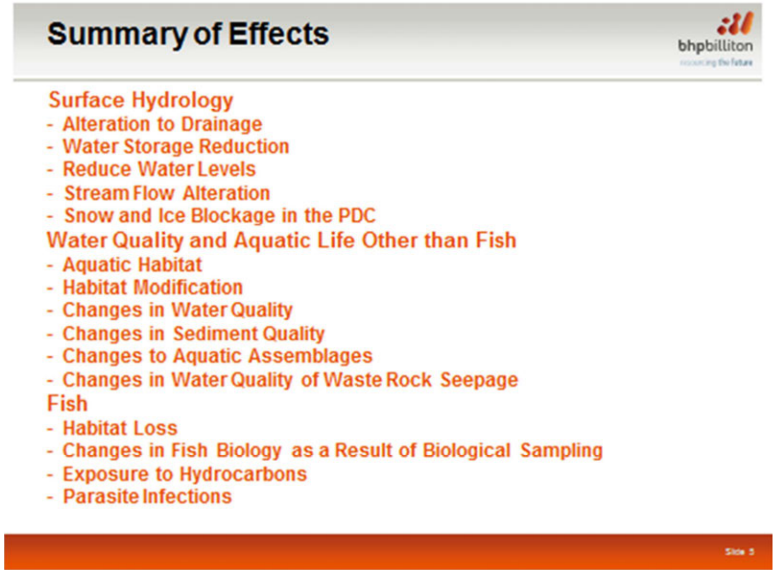
Slide 3

Predicted and Observed Effects

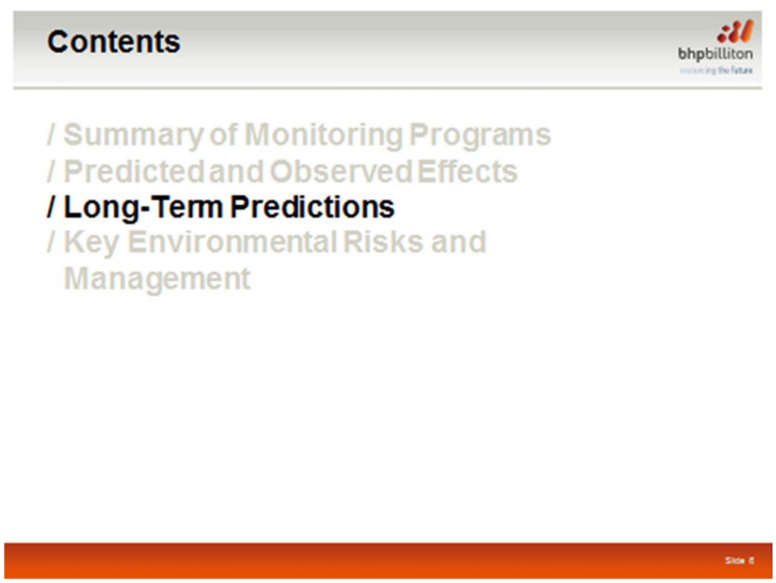
bhpbilliton

Fish
- Changes in Fish Biology as a Result of Biological Sampling
- Exposure to Hydrocarbons
- Parasite Infections

Slide 4



Name (Organization)	Comment(s)	Response(s)
Kevin (IEMA)	1a) Elevated dioxins and furans in Kodiak likely from incineration; has this been addressed? 1b) Dioxins and furans at least warrant a mention, maybe nothing beyond that.	**Rescan 1b):** Not included, but will be discussed in EIR.



Long-Term Predictions

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Regression Models
Koala Watershed Water Quality Model
AEMP Three Year Re-Evaluation
Panda Diversion Channel
Pigeon Stream Diversion Channel
Pigeon Waste Rock Storage Area and Associated Drainage

Slide 7

Contents

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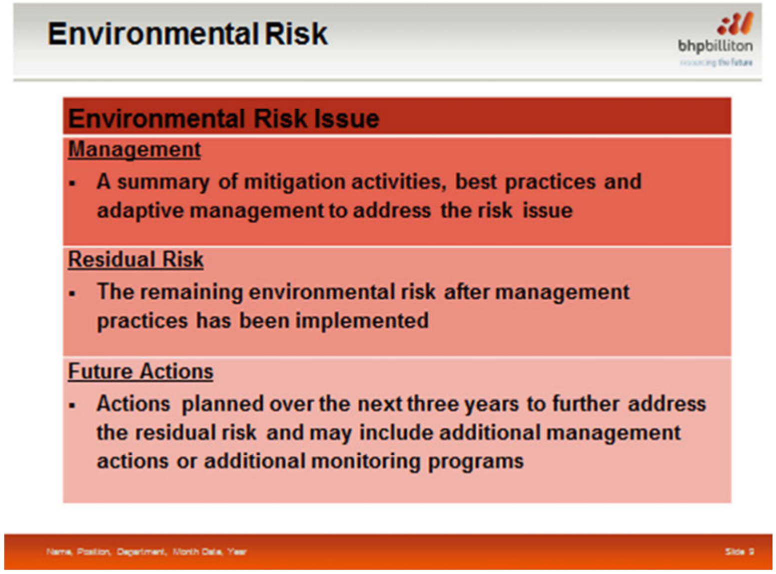
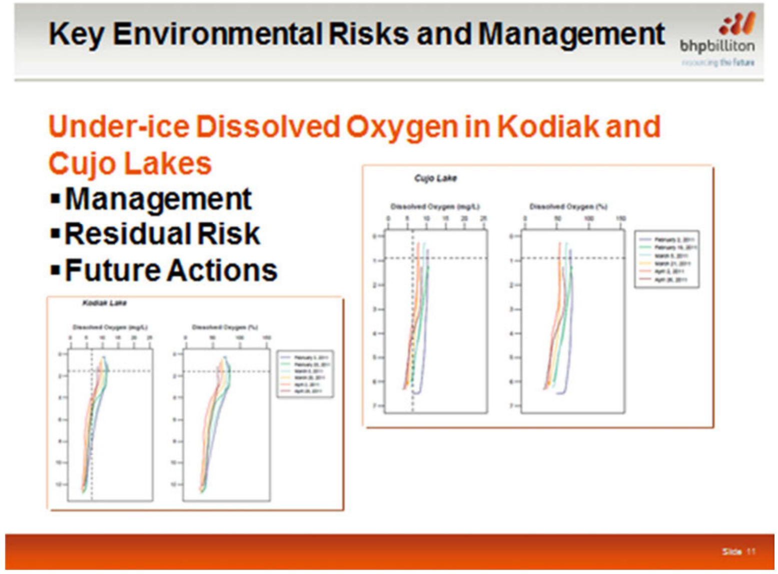
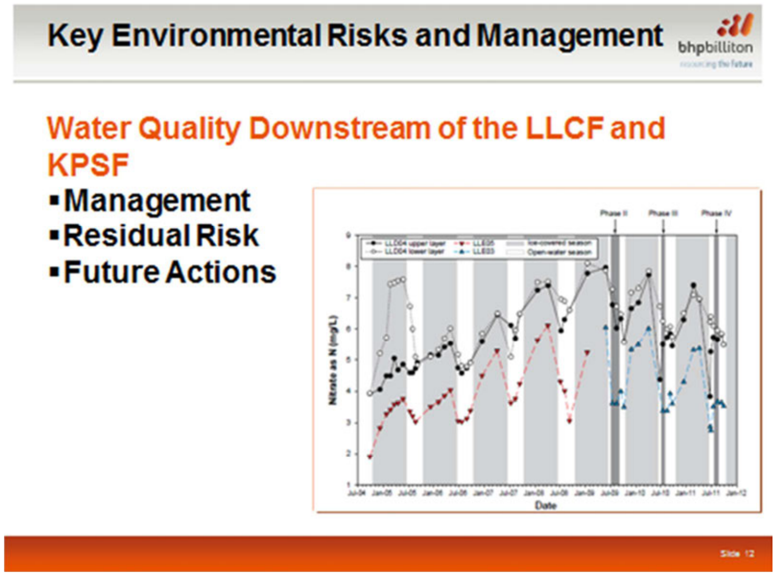
Slide 8


Environmental Risk
bhpbilliton
Environmental Risk Issue
Management
A summary of mitigation activities, best practices and adaptive management to address the risk issue
Residual Risk
The remaining environmental risk after management practices has been implemented
Future Actions
Actions planned over the next three years to further address the residual risk and may include additional management actions or additional monitoring programs

Name (Organization)	Comment(s)	Response(s)
Kevin (IEMA)	1a) Table 7.5-1 also includes BHP's proposal to do more regular inspections around outside of LLCF, the ultimate way to manage this risk, though, is to stop deposition into Cell B which the inspector agreed with.	**Claudine 1a):** North part of cell B is no longer used . **Rescan 1a)** More details more immediate response is included in text of report. **Eric 1a)** Moving forwards, there is zero deposition in Northern part of Cell B, effectively removing risk of occurrence.



Name (Organization)	Comment(s)	Response(s)
Bill (IEMA)	1a) Is there any evidence that snow clearing works?	**Rescan 1a)** Nothing from Cujo, but evidence from LLCF shows that blooms may be occurring. **Erin 1a)** You can see oxygen increasing in Cujo after clearing, comparison studies show that clearing does help keep oxygen levels higher.



Name (Organization)	Comment(s)	Response(s)
Kevin (IEMA)	1a) Noted that in-situ nitrate study indicated increases in other parameters (phosphorous, calcium, some others). Does this need to be identified as a risk? Or just an unanticipated consequence of an adaptive management practice 1b) Some discussion, especially as it refers to adaptive management is warranted.	**Rescan 1a)** Weekly monitoring of phosphorous and other metals to observe consequences of fertilization, so there was some degree of mitigation. This information informed decision to stop phosphorous addition in a timely and appropriate way (i.e. why we stopped fertilization processes). **Erin 1a)** This discussion is also included in AEMP- should it be included in EIR.
Bill (IEMA)	2a) If you can soundly conclude that the problem is addressed, say so. If you conclude that there is some level of risk, say so, especially since it took place during time frame of interest for EIR.	**Eric 2a)** Some of those by-products were anticipated and we watched for them and adjusted accordingly.
Todd (YK Dene FN)	3a) To include in EIR will help other companies and organizations to improve adaptive management strategies. What are future actions for nitrate?	**Erin 3a)** Diversion to Beartooth is already beneficial for chloride and will also help out nitrate concentrations in LLCF so we should continue to see downward trend of nitrate in LLCF even without future fertilization.
Bill (IEMA)	4a) When did Beartooth pit begin being a	**Eric 4a)** Beginning of 2010/end of 2009

	sump?	
Kevin (IEMA) **Bill (IEMA)**	5a) How much of decline in nitrate can you attribute to fertilization vs. diversion of mine water? 5b) Would like to see some discussion of relative contributions to nitrate reduction. Fox Pit saw mining operations that required less explosives therefore less nitrate residue to LLCF; did this affect nitrogen signature in LLCF? 5c) Would it have showed up in process plant water?	**Eric 5a)** In 2009 the observed drop, plus some (since we were still adding nitrate) was likely due to fertilization. In 2010, fertilization didn't really work so it was likely very effective in its first year, and less and less so following. **Eric 5b)** While this was helpful, it only applied to Fox mine water which isn't a major source. Also, timing of drop in nitrate indicates that it probably wasn't a big deal **Eric 5c)** Not that we noticed. We didn't notice anything in Fox sump water though**.**
Todd (YK Dene FN)	6a) Changes in plankton assemblages likely driven by differing levels of nutrients/chlorides/TDS and changes to site specific water quality. Is there not a connection here? And what about Beartooth pit?	**Rescan 6b)** We can see changes in nitrate downstream, site-specific water quality objectives now protects those phytoplankton and zooplankton assemblages. Chloride effect has largely been minimized now that UG water goes to Beartooth. Changes in TDS, effects are seen downstream but unclear whether this affects aquatic assemblages. Definitely lots of things happening, and we can pick out a few important things (i.e. nitrate, chloride, phosphorous) but there's no simple answer.
Bruce (DFO)	7a) If we didn't have Beartooth pit, how long would the LLCF take to surpass quality benchmarks?	**Eric 7a)** For nitrate and chloride, no EQC so we adopted water quality objective benchmarks as management guide. But predictions showed that chloride would've reached benchmark at some point in mine life (driver for establishing Beartooth pit as temporary holding facility) Todd: If we already see changes downstream and new benchmarks are higher than old benchmarks, won't changes get worse?

Todd (YK Dene FN)	8a) If we already see changes downstream and new benchmarks are higher than old benchmarks, won't changes get worse?	**Erin 8a)** It's possible, but new site-specific benchmarks are designed to be effective specifically at Ekati. Upcoming fish monitoring, also possible that small changes in aquatic assemblages might not lead to larger consequences (i.e. for fish population). Currently, no parameters exceed benchmarks so we don't' anticipate further problems.
Tim (IEMA)	9a) Rescan did multivariate analysis to address Cladoceran population decline, result was that TDS (chloride, hardness) provided most influence on this species and can therefore likely expect more changes from higher levels.	**Eric 9a)** Some organisms thrive on chloride, others don't. Either way, it's a change and we have to establish how much of a change, and if that change is acceptable in an ongoing conversation. "Change" is not the same as a negative effect in our vocabulary.
Bill (IEMA)	10a) Substance of dispute is lake trout, which are adversely affected by nitrate levels slightly below IPS level (which is way below site specific level). When you sample fish, if affect is most strongly felt by YOY, the fish might all die. Therefore, early warning signal should be existing literature rather than site testing. Measuring fish every five years will not give you an early warning indicator.	**Eric 10a)** Agreed that fish monitoring is not the leading indicator (it's a check to confirm health). **Rescan 10b)** Another early warning could be the water quality predictive models.
Stephanie (Lutsel K'e Dene FN)	11a) Where does mine drinking water come from?	**Rescan 11b)** Grizzly Lake.

Name (Organization)	Comment(s)	Response(s)
Kevin (IEMA)	1a) Higher levels of dioxins and furans in sediment; now that you know that there are elevated levels of the above in the sediments, is there any way to see if this problem has made its way up the food chain? How do you manage this as a potential risk?	**Rescan 1a)** Anne's study showed distinct line in sediment where you can see the dioxins and furans, unclear whether this contamination has continued. Would be good to put this in the EIR.
Tim (IEMA)	2a) Upcoming AEMP discusses dioxins but only in relation to hydrocarbons if they were detected. Is this true? Or will you be looking at dioxins in Kodiak Lake	**Erin 2a)** Hydrocarbon analysis can be clouded by PCBs and dioxins, so if we don't see results from the first analysis, then you can conclude you don't have PCBs and dioxins as well.
Kevin (IEMA)	3a) Now that issue with dioxins and furans are present in sediments, are there further management plans?	**Erin 3a)** Operation and monitoring of new incinerator, as this was identified as the source of the problem.
Stephanie (Lutsel K'e Dene FN)	4a) Why do you not know the source of hydrocarbons? Lack of testing? 4b) Doesn't seem so mysterious; there is a mine, there are hydrocarbons in the water and fish near the mine but you're not doing anything about it. 4c) Any baseline studies done on fish prior to hydrocarbons? 4d) Is the implication, then, that the source is	**Rescan 4a)** Studies to look at influence from roads, no historical spills near water bodies, all results suggest that hydrocarbons in water and sediment are less than analytical detection limits (which are set low enough to determine that there is no hydrocarbon in sample) so no results pointed to any particular source but work is

	not the Ekati mine?	ongoing to solve **Rescan 4b)** Hard to take mitigation measures if you can't identify the source. Work is ongoing to determine source in metabolites (which can be persistent over time) and all spills are documented and reported. Hydrocarbon management practices are in place to limit spills and address risk. **Rescan 4c)** No. **Rescan 4d)** No. Simply an uncertainty that Ekati is addressing in future monitoring programs including new technologies and continued monitoring.
Bruce (DFO)	5a) Are metabolites necessarily due to hydrocarbons or some other potential source?	**Rescan 5a)** Just hydrocarbons.
Kevin (IEMA)	6a) Agreed; seemed to be due just to hydrocarbons. Regarding Stephanie's comments, revised fish program will cover much larger area and should help to pinpoint the source more effectively (i.e. is exposure limited to LLCF?) and help determine management strategies.	

Key Environmental Risks and Management

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Unplanned Release of Ammonium Nitrate into Kodiak Lake

- Management
- Residual Risk
- Future Actions

Slide 14

Key Environmental Risks and Management

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Water Quality Associated with Misery Pit 'Push-Back'

- Management
- Residual Risk
- Future Actions

Slide 15

Name (Organization)	Comment(s)	Response(s)
Tim (IEMA)	1a) pg. 7-70 of report re: Pigeon WR runoff remaining in Koala watershed or LLCF, but NW corner of rock pile is actually against Exeter watershed; is there a seepage monitoring site planned for that location to ensure proper containment within current water management system? 1b) Good; clarified. 1c) Will there be a seep there to make sure?	**Eric 1a)** Intent is that that rock pile is within LLCF region, so this will be verified. There's also a water containment structure **Eric 1b)** Can see how it would look that way, but this is not the design. **Eric 1c)** Currently there's seep wherever there's water; if water materializes there, then yes.

Name (Organization)	Comment(s)	Response(s)
Stephanie (Lutsel K'e Dene FN)	1a) Were changes in seepage predicted in 1995?	**Rescan 1a)** Future action also includes identification of permafrost degradation potential and subsequent effects on seepage. **Rescan 1b)** Yes.
Kevin (IEMA)	2a) Will EIR address crushed gravel on pond body as sediment traps? 2b) Should be included since it's an example of management response.	**Erin 2a)** Yes.

Key Environmental Risks and Management

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Fish Usage of the PDC

- Management
- Residual Risk
- Future Actions

Slide 19

Key Environmental Risks and Management

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Long-term Stability of the PDC

- Management
- Residual Risk
- Future Actions

Slide 20


Key Environmental Risks and Management
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Changes in Fish Biology
▪Management
▪Residual Risk
▪Future Actions
Slide 21

Name (Organization)	Comment(s)	Response(s)
Claudine (BHP Ekati)	Do people need more time to provide feedback?	
Bill (IEMA)	1a) IEMA's been providing input as process moves along.	
Loretta (AANDC)	2a) Lots of our biologists haven't looked at it yet; based on timeline comments might not be feasible.	**Claudine 2a)** Will follow up.
Bill (IEMA)	3a) pg. 3-5 discusses reclamation and ICRP v.2.4. Does BHP, subject to approval from land and water board, not plan to make any changes to closure plan prior to 2 years before closure?	**Claudine/Rob 3a)** Not aware of any update to reclamation plan any time in near future but will check
Claudine (BHP Ekati)	4a) Wants to start discussion on residual effect rating.	
Bill (IEMA)	5a) There are serious problems with methodologies used to determine ratings, especially including "less disturbed" post-closure values, since site is definitely disturbed even past closure. These risk determinations were flawed in 95 and still flawed in 2012. 5b) Given flaws in determination scheme, Bill personally feels like Appendix F is not	**Claudine 5a)** Do you feel it's worthwhile to have a residual effect rating? Or is a statement of risk as a key component of EIR and subsequent follow-up info and discussion sufficient? (EIR states that we need them, but no consensus on methodology).

	necessary. 5c) Notes that it is in fact a requirement of EIR. 5d) Will get back to Claudine regarding consensus among IEMA members.	
Loretta (AANDC)	6a) Agrees that not really useful and that changes should be made.	**Claudine 6a)** Clarifies that most stakeholders have problems with or do not see the value in methodology from '99.
Todd (YK Dene FN)	7a) Language used in risk description was not transferred to risk assessment (hypocrisy).	**Claudine 7a)** Issue will be followed up upon with all stakeholders.

2012 Environmental Impact Report– Wildlife

Harry O'Keefe
Environment Advisor- Wildlife
July 11, 2012

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Contents

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Slide 2

Water- Summary of Monitoring Programs

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Section 8 of Material Provided

- Wildlife Effects Monitoring Program
- Breeding Bird Monitoring Program
  - North American Breeding Bird Survey (NABBS)

Slide 3

Contents

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/ Summary of Monitoring Programs
/ **Predicted and Observed Effects**
/ Long-Term Predictions
/ Key Environmental Risks and Management

Slide 4

Predicted and Observed Effects

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Three VECs

- **Caribou/Habitat**
- **Carnivores/Habitat**
- **Breeding Birds/Habitat**

Slide 5

Table of Contents

Name (Organization)	Comment(s)	Response(s)
Bill (IEMA):	1) Is there any way to tell whether mine infrastructure facilities involve capturing and killing caribou (i.e. if road edges hinder the ability of a caribou to escape)	**Harry 1):** Not possible to definitively say whether due to mine structure, possibly because we don't monitor caribou mortality outside of mine footprint.
Tim (IEMA):	2) When you find a carcass that's been predated, can you identify if it has been moved after killing?	**Harry 2):** Generally kills via predation are identified because the predator is still there, so it's likely that most are killed where they are found.
Charlotte (AANDC)	3a) Because of some mortalities, changes were made? 3b) Last year?	**Harry 3a):** Yes. Changes to airport fence to eliminate tangling hazard. **Rescan 3b):** Yes. Last August.
Bill (IEMA):	4) So barrier fence sounds good until you realize what weather is like at EKATI	**Harry 4):** Yes; proved that electric fence was greater hazard to animals than the airport itself. We also move carcasses away from site if found unattended to remove further interaction between animals and

		infrastructure.
Todd (YK Dene FN)	5) What is the plan to consider caribou mortalities in a larger sense?	**Harry 5)** The first step is identifying the problems (i.e. the fences) and trying different ways to deter caribou from infrastructure (and associated injuries and mortalities). We give caribou right of way on all roadways and continual changes are made to best adapt to caribou movement through site.
Stephanie (Lustel K'e)	6a) Is fence only around airport? 6b) Are you aware of any incidents of animals falling into pits? 6c) Clarify: there was an electric fence, and a new fence that caribou are still being caught in? 6d) Mortality on fence?	**Harry 6a):** No, that's the only continuously closed area but there are fences around pits and other potentially hazardous areas and motion cameras around these fences to monitor their effectiveness **Harry 6b):** No, these fences are put in just in case. **Harry 6c):** Not caught in, the caribou in particular jumped over the fence and did not respond to all of our deterrence measures **Harry 6d):** No, the rope that the caribou was entangled upon was on the electric fence. New fence has not been associated with any mortalities.

Predicted and Observed Effects

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Caribou/Habitat

- Behavioural Disturbance
- Movement Alterations
- The Long Lake Containment Facility as Potential Physical Hazard to Caribou

Slide 7

Name (Organization)	Comment(s)	Response(s)
Todd (YK Dene FN):	1a) Problem with way that information is presented (statement of uncertainty should be FIRST) i.e. before any conclusions are made 1b) Has there been any consideration re: observer bias for caribou behaviour monitoring? 1c) Clarify; how do you choose which animals to observe?	**Harry 1b):** BHP works in partnership with Diavik, who does behavioural surveys for animals off site. Surveys are done by BHP for anything within 2km of site, **Rescan 1c):** Opportunistic; if we know caribou are on site, we go out and do observations. **Harry 1c):** All employees on site are required to call in wildlife sightings, so we can increase possibility of encounter. **Harry 1d):** Obliged.
Bill (IEMA)	1d) Clarify; are employees obliged to report wildlife or asked to?	
Bill (IEMA):	2a) In draft, ZOI is alluded to; why wouldn't you actually give a number to the observed ZOI based on years of aerial observations, etc. For greater certainty, this concrete number	

	should be provided. 2b) Document describes purpose of aerial surveys and objectives include determining annual abundance. IEMA believes that relative distribution is the more important metric and role of aerial surveys and that this should be indicated if BHP agrees.	
Charlotte (AANDC)	3a) Should clarify in report that observations are opportunistic. Re: sample sizes, is small size related to new sampling methods? 3b) So will you have enough data in a few years to make accurate statements? In how many years?	**Harry 3a):** We still do scans, but added focal studies. Both require large number of observations and a large number of individuals (can't study the same caribou over and over). May take a few years to gather sufficient data for accurate energy budgets **Harry 3b)** We've started more aggressively monitoring data to increase sample size, also added cameras in order to facilitate observations.
Eric (BHP):	4) Does small sample size confounding our ability to draw conclusions apply to all conclusions? Or specific ones?	**Rescan 4):** Specifically referring to proportion of time spent in behaviours. Can still indicate trends but lack data to make statistical conclusions. Greater sample size will also allow us to explore reasons for changes in behaviours that are observed within the mine footprint.
Bill (IEMA)	5) Earlier, other observations regarding caribou behaviour on site was gathered through aerial survey. Is there some way of building on these observations to improve data set?	**Rescan 5)** Since there are several surveys ongoing, we now prioritize to focus on behavioural surveys when caribou are on site; continual challenge to schedule. Partner with Diavik to do scan samples, hopefully moving forward we don't have discrepancy between inter-annual variation on number of observations.
Todd (YK Dene FN)	6) If this is now the priority, perhaps this commitment should be included in report and recognition of past failures/weaknesses in data collection. Can reporting periods be standardized?	**Harry 6):** Yes, also recent changes to WEMP to encompass one calendar year to capture all major events per year (i.e. fall/spring migration and calving) so this goes partially to explain some of the discrepancies in reporting periods.
Kevin (IEMA)	7a) Really likes the charts that capture temporal and spatial trends in the AEMP. WEMP data seems lacking in this regard; can work be done to improve information representation (particularly on caribou)? 7b) Seeing that variation in tables/graphs would be useful and	**Harry 7a):** Good point; will be looked into. Difficult due to large variation, etc. but worth looking into.

	helpful both as information and to show that data is being examined.	
Ginger (Tlicho)	8a) Clarify; Where is the ZOI roughly and where do you expect to stop seeing effects? 8b) Tlicho elders are concerned about injuries as caribou move through site from the North. 8c) While there's no magic number, at some point in space the effects of the mine SHOULD stop being significant- is this 14 km?	**Harry 8a)** Re ZOI; there is a definition, but it is difficult to apply to a migratory group (since migration changes slightly every year) **Rescan 8a)** ZOI was set at 14 km around both Ekati and Diavik in post-calving period when animals were generally not as transient. Issue with ZOI is that we can see correlations but no causation and how this would effect populations. **Rescan 8b)** Re: conditions of caribou as they move through site. Plan is to invite community members to site during fall migration to aid in observations (behaviour, body condition, closer and farther from site) **Rescan 8c)** 14km is based on aerial and probability data and not specifically linked to on-site activities.
Bill (IEMA)	9a) Determination of ZOI is done by accumulating information over time and based on animal distribution; fact that caribou generally avoid mine infrastructure by about 14km = ZOI. IEMA encourages more explanatory information in EIR in this regard. 9b) There is a ZOI that has been determined in aforementioned way; the reasons for caribou avoiding mine infrastructure are not known and this leads to the need for further work (not just by BHP) and this should show up in an EIR.	
Sarah (ENR)	10a) Diavik does surveys greater than 2km? Is this for the focus studies? 10b) Are the aerial scans and focus surveys separate research permits? Is there a way to incorporate behaviour scans into determination of ZOI? 10c) Is diamond mine wildlife monitoring working group discussing ways to improve methodology?	**Rescan 10a)** Diavik just does scans, BHP partners with Diavik to do group scans **Harry 10b)** Diavik determines its own survey methodology and BHP plans to include field focal surveys to get this information **Rescan 10b)** Joint work on behaviour has been focus of previous technical workshops (recent focus has been grizzly bears).
Todd (YK Dene FN)	11) Within TK, it's almost unanimously known that mine activities have affected migration and to say that's it's hard to tell whether	

	or not caribou are affected is only true if you don't value TK.	
Ginger (Tlicho)	12) A better way to incorporate TK would be to include TK and elder involvement in developing monitoring programs, rather than just participating in programs that are established beforehand. Reference to TK report that highlights different forms of TK observations and knowledge. A preferred way to incorporate TK would be at the beginning of program development rather than the end. This might help to answer questions that elders have, since programs would be geared in this direction.	**Harry 12)** Agreed, mentions Charles' role as TK advisor. **Eric 12)** Our observations have to take place on and within the context of our mine site and we can play a role in larger scale discussion from this position. We try to take care of our piece of the equation by inviting people to site to share TK, and while to a point our methods don't necessarily fit the definition of TK, we are trying to make the best observations we can from our particular vantage point while learning from others. No real answers but effort is being made to have conversations **Harry 12)** Ongoing and consistent conversations are key because on site visits help share knowledge from elders to BHP staff which is then incorporated into every day work. Planned inclusion of site visits before observations will also help to prepare staff.
Tim (IEMA)	13) BHP has obligation to answer questions and deal with issues based on TK holders own criteria (i.e. fish biologists and TK holders have different definitions of a healthy fish). These criteria should be included	
Stephanie (Lutsel K'e)	14) Have we looked at changes in migration patterns?	**Rescan 14)** No, this information doesn't exist.
AANDC	15a) Did Diavik and BHP cancel joint efforts? 15b) Do Diavik and BHP have combined efforts on other programs?	**Harry 15a)** Decision was made to NOT cancel joint efforts, Diavik is coordinating caribou surveys and BHP is coordinating grizzly bears **Rescan 15b)** Grizzly bear studies, also partnered with DeBeers.
Kevin (IEMA)	16) Have methodologies changed in joint ventures?	**Rescan 16)** Not to my knowledge; **Follow up.**


Predicted and Observed Effects
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Caribou/Habitat
- Behavioural Disturbance
- Movement Alterations
- The Long Lake Containment Facility as Potential Physical Hazard to Caribou
Slide 7


Predicted and Observed Effects
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Caribou/Habitat
- Roads Acting as Barriers to Caribou
Slide 9

Predicted and Observed Effects

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Caribou/Habitat

- The Long Lake Containment Facility as Potential Physical Hazard to Caribou

Summary of Caribou Frequency within the Long Lake Containment Facility, 1999 to 2011

	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	Total
Surveys (#)	64	27	22	10	60	25	43	17	18	58	22	16	65	487
# Surveys Caribou Observed	27	3	15	6	2	8	14	3	0	3	1	4	5	91
% of Surveys Caribou Observed	42	27	68	60	3	32	33	18	0	5	5	25	8	19
Total Caribou Observed in LLCF (#)	-	3	48	7	3	40	66	402	0	16	2	30	5	622

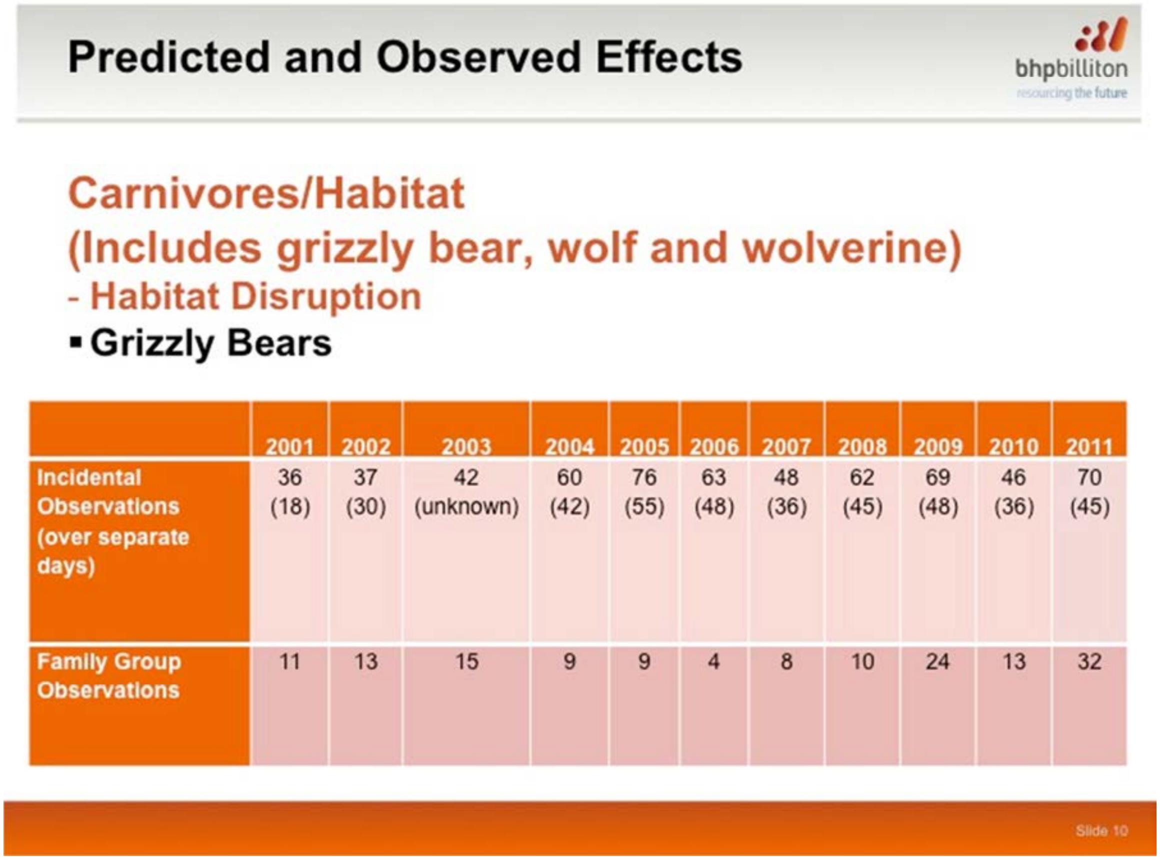
Slide 8

Name (Organization)	Comment(s)	Response(s)
Eric (BHP)	1) Preliminary assessment of bioaccumulation identified some risks that warrant future planned studies (Cell B pilot study)	
Tim (IEMA)	2a) p 8-18 identifies concern about direct ingestion of PK, but does not address mitigation→ need to fix this disconnect 2b) That's no small matter; should be addressed explicitly since it's a major concern for communities.	**Eric 2a)** ERA would incorporate both pathways
Kevin (IEMA)	3) Some of Harvey's reclamation work showed that salt would rise closer to the surface acting as a potential wildlife attractant; this work could be addressed in this section.	**Eric 3)** Agreed. **Make specific reference to this work.**

Name (Organization)	Comment(s)	Response(s)
Bill (IEMA)	1) Assuming these results are from the report to be released at the beginning of July- when will this report be released?	**Rescan 1)** Imminent.
Todd (YK Dene FN)	2a) Data shows that there are less caribou further away from roads, but no mention of difficulty in actually seeing caribou away from roads. Worried about sample bias. Can this be addressed? Put a caribou decoy farther away from road and see if anyone notices, for example. This creates the perception that caribou love roads (not just a problem with BHP, lots of groups use this methodology) 2b) Is there a way to rectify it? 2c) We need to know how many caribou we're missing. 2d) So cameras increase observations,	**Harry 2a)** No plan to address this in the past. **Harry 2b)** We always try to gather the best data, and we're limited by mine infrastructure **Harry 2c)** Goal of cameras is to identify how caribous react to road (i.e. like or dislike road, do they notice the road?) cameras give us much more consistent and continual monitoring that should help us reduce bias. **Harry 2d)** Hopefully yes. **Rescan 2e)** The camera report,

	but will they address whether or not caribou avoid or are attracted to roads? 2e) Is there a study outline showing how this data will be used and help management? 2f) Will it have analysis or just numbers? 2g) p. 8-17 needs more context to identify problem with increased observations at close proximity to mine site (misleading)	should be circulated next week. Contains results from last years study and proposal moving forwards to address these issues. **Rescan 2f)** It will have a proposal for future analysis. **Harry 2g)** Agreed.
Bill (IEMA)	3) IEMA wants to see logic of transitions in monitoring programs; has felt surprised by changes in the past and needs to see what is planned and why in future reports (EIR could be used to explain transitions and logic)	
Ginger (Tlicho)	4a) Clarify: predicted that roads would act as barrier? Is this what you observed?	**Rescan 4a)** Based on 1 year of camera trials, only certain sections of road act as barriers (steeper sections, e.g.) we have images of caribou using designed crossing locations to hopefully mitigate. Plan is to characterize road features that act as barriers by increased camera coverage. Preliminary results indicate that as a whole roads are not barriers, but some areas are. **Rescan 4b)** Part of the reason for transition to camera was to decrease inefficiencies in data collection, improve ability to interpret results and eliminate observer bias. **Rescan 4c)** We have now lots more data with the cameras, likely produces better results. **Harry 4c)** Bigger sample size allows us to make more correct interpretations instead of guesses **Rescan 4d)** Cameras are only intended to test road permeability
Todd (YK Dene FN)	4b) This results differs from past results. Why? 4c) Old results and new results are very different; is all of this difference due to observation technique?	
Bill (IEMA)	4d) Except if you only survey around the road you still miss information. Need to be careful about interpretations; cameras are not intended to capture off-road behaviour	
Todd (YK Dene FN)	4e) Is there a plan moving forward to make sense of differences between old and new data?	

		Harry 4e) Good point
Sarah (ENR)	5) Does "roads" refer to just Misery? All Ekati? Joint venture?	**Harry 5)** Specific focus on haul roads; not joint venture. Cameras on Misery and Sable since they're the longest and therefore thought to be biggest barrier
Ginger (Tlicho)	6a) Is there a table re: road closures when caribou are present and how significant this measure is as a mitigation effort. 6b) So it actually has been happening?	**Harry 6a)** We do close roads whenever herds are on road. **Rescan 6a)** Usually a few closures per migration, believes longest is up to a week but generally only lasts a few days. **Harry 6b)** Yes. Not optional.
Stephanie (Lustel K'e)	7) Clarify; Left to leave on their own except for one that wouldn't leave and was killed.	**Harry 7)** Necessary for human safety and located on airport.
Kevin (IEMA)	8) Wants to see data summary for caribou activity, road closure, etc. not just in text.	
Ginger (Tlicho)	9) Moving forward with other mines, knowing that significant mitigation measures (i.e. week long road closures) and other data would be appreciated especially comments on entire list of mitigation measures, changes to mitigation, etc. Overall comments?	**Harry 9) Will** be covered in later section.
Bill (IEMA)	10) Comments on overall population of Bathurst caribou herd. **Need to provide good up to date information in report.**	



	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011
Incidental Observations (over separate days)	36 (18)	37 (30)	42 (unknown)	60 (42)	76 (55)	63 (48)	48 (36)	62 (45)	69 (48)	46 (36)	70 (45)
Family Group Observations	11	13	15	9	9	4	8	10	24	13	32

Name (Organization)	Comment(s)	Response(s)
Stephanie (Lutsel K'e)	1a) What might be attracting bears to site? 1b) Are they using natural foraging sites? 1c) EKATI has a landfill? 1d) No composting program for organic wastes? 1e) No measures to mitigate waste deposits via compost? 1f) Notes link to air emissions that might be aided with composting	**Harry 1a)** Biggest concern is food waste, petroleum products, kitchen waste. Bears are naturally opportunistic feeders and so would be attracted to just about anything. Eliminating the reward for coming to investigate smells on site. **Harry 1b)** Yes, and we've identified that bears are still using critical habitat in and around mine site. **Harry 1c)** Yes, but no food-waste or other potential attractants (inert waste only). **Harry 1d)** Nothing in place. **Harry 1e)** Goal is always to minimize waste, but not via compost (recycling programs, etc.) **Harry 1f)** Agrees.

Predicted and Observed Effects

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Carnivores/Habitat (Includes grizzly bear, wolf and wolverine)

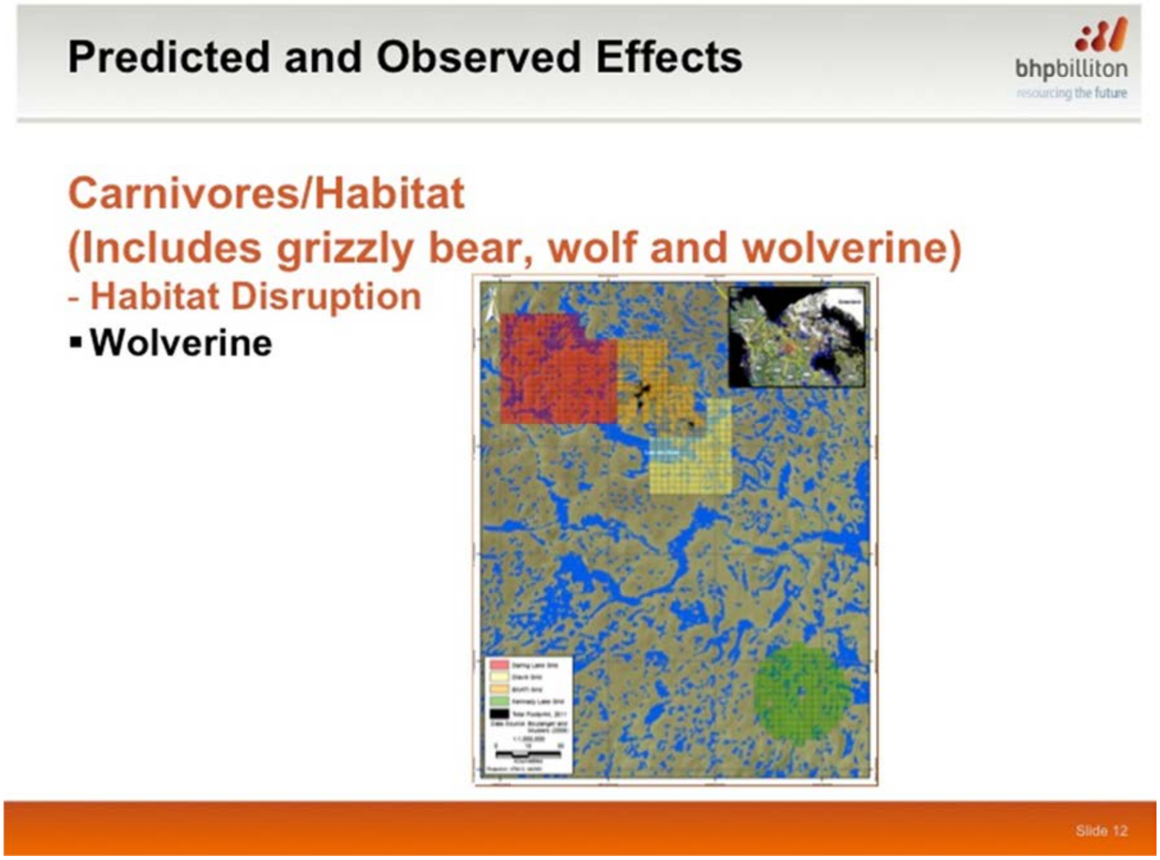
- Habitat Disruption
  - Wolves

	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011
Incidental Observations (over separate days)	38 (-)	59 (42)	54 (27)	58 (46)	58 (40)	47 (43)	34 (30)	55 (45)	58 (45)	25 (23)	41 (36)
Family Group Observations	-	-	-	22	20	13	21	16	20	10	14

Slide 11

Name (Organization)	Comment(s)	Response(s)
Stephanie (Lutsel K'e)	1a) Why can't you tell if the same family moves into new dens? 1b) When an adult wolf enters mine area and is seen, can these ones be tracked? 1c) Why did data only start in 2001? Is this the same data that appears in the EIR? (thought that EIR was to highlight differences in initial predictions). Notes that this issue has occurred in a number of slides 1d) Clarify; no records of wolf observations were made during exploration?	**Harry 1a)** ENR actually does the monitoring, BHP provides funding. Wolves are necessarily transitory and study goal was to get regional perspective on wolf population (focus on pups). **Harry 1b)** Yes. But not necessarily if it's reusing the same den. **Harry 1c)** Graph shows information that we have. **Rescan 1c)** There may be older information, but 2001 is when information is formally recorded. **Harry 1d)** **Will look into this.**

Mike (Lustel K'e)	2a) Notes importance of baseline data; no way to draw conclusions about mine impact otherwise. 2b) After closure, if monitoring capacity still exists, could recovery be recorded?	**Harry 2a)** Agrees. Notes difficulties associated with transient animals like wolves and caribou and interspecies relationships **Harry 2b)** Agrees.
Stephanie (Lustel K'e)	3a) Do you ever shoot wolves? 3b) When did this occur?	**Harry 3a)** 1 wolf, old and starving hung around near camp was put down. Will be discussed further. **Harry 3b)** 2007/08



Name (Organization)	Comment(s)	Response(s)
Bill (IEMA)	1a) Encourages that results are made available before 2015 EIR if possible.	
Stephanie (Lustel K'e)	2a) Have DNA studies shown any other species coming into area?	**Harry 2a)** Study is geared towards identifying specific individuals
Bill (IEMA)	2b) Recalls information re: several species being recorded.	**Harry 2b)** Agrees, but no new species.
Stephanie (Lustel K'e)	3) Ever observe black or polar bears?	**Harry 3)** Not to my knowledge.

Name (Organization)	Comment(s)	Response(s)
Tim (IEMA)	1a) Does EIR say anything about changes in populations of arctic vs. red fox at site? 1b) So this report will state RF, or just Foxes?	**Harry 1a)** We've had 1 observation of arctic foxes since 2009. **Rescan 1b)** Primarily RF; could be specifically mentioned in EIR.

Predicted and Observed Effects

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Carnivores/Habitat
- Injured Carnivores

▪ No vehicle related mortalities for VEC species

Slide 14

Name (Organization)	Comment(s)	Response(s)
Stephanie (Lutsel K'e)	1a) Seems that whenever an animal becomes habituated to mine it's disposed of and often incinerated. Why aren't these animals sent for testing to determine officially COD or other effects? 1b) Incineration represents a missed opportunity. 1c) So it depends on what ENR says? 1d) If tests were done, would results be included in EIR? 1e) What about metals testing in organs?	**Harry 1a)** Agrees **Harry 1b)** We did send the caribou away for testing and consumption (avoid waste) **Harry 1c)** We ask for advice. **Harry 1d**) Do not have results, but **will look into this.** **Eric 1d)** Suspects that ENR would notify EKATI if there were any

		problems. **Harry 1d)** All rabies tests come back. **Harry 1e)** Not sure what ENR tests for, but **can find information.** **Harry 1f)** Agrees.
Loretta (GNWT)	1f) Worth developing protocols for future incidents.	

◎ Table of Contents

Predicted and Observed Effects

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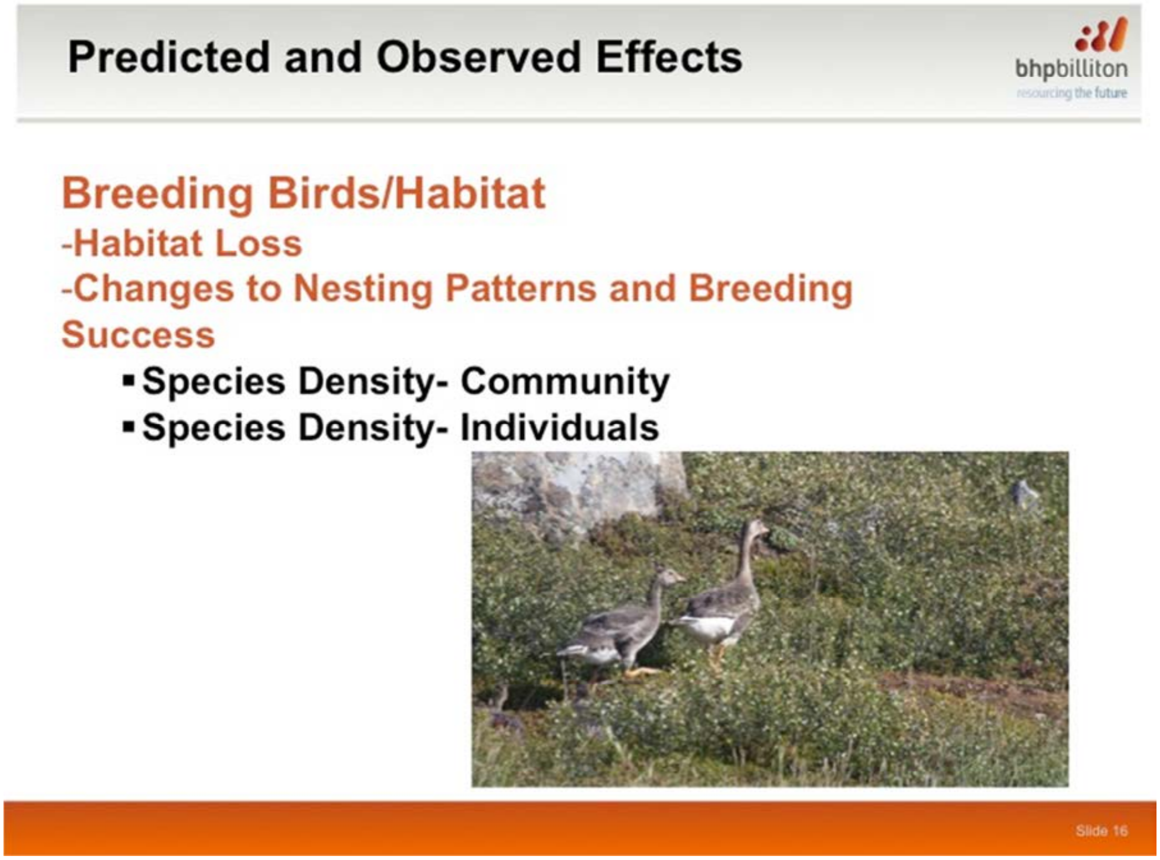
Carnivores/Habitat
- Habituation to Humans

Slide 15

Name (Organization)	Comment(s)	Response(s)
Mike (Lutsel K'e)	1a) When WL are on site, is there ever an option for capture and relocation? 1b) Why not?	**Harry 1a)** Not an option since we're not permitted to do it. **Eric 1b)** In 2007, a grizzly was relocated by ENR, BHP isn't permitted to do it. Also, generally, relocation isn't always effective since the bears often come back. Better to identify and mitigate risks and attractants.
Bill (IEMA)	1c) Recalls several wolverine relocations at EKATI.	**Eric 1c)** Yes, this was also ENR. BHP tries to deter, eventually if necessary ENR will get involved to relocate. Rob 1c) Relocation is always a last option within a stepped approach. On site deterrence is first. ENR directs and conducts any relocation. Since the animals sometimes come back, it's not necessarily an effective deterrent. ENR also directs moving and killing.

Sarah (ENR)	2a) Are there specific or detailed protocols for animal deterrence and relocation, including ENR involvement? 2b) Clarify; is it a flowchart or a procedure?	**Harry 2a)** Un-formalized flowchart for dealing with encounters and responsive to individuals and individual circumstances. If we can handle the attractant, then no need to get ENR involved. **Eric 2b)** A procedure that WL techs follow; flowchart is for other mine employees generally.
Tim (IEMA)	3) Points to interaction between vehicle interactions on roads (i.e. wildlife mortality on roads) and potential attractants.	**Harry 3)** Plan in place to either incinerate or relocate carcass to reduce road attractant.



Name (Organization)	Comment(s)	Response(s)
Bill (IEMA)	1a) Lots and lots of information on birds but EIR should not give readers the impression that birds are as important as caribou or grizzly bears.	**Harry 1a)** Noted.

Name (Organization)	Comment(s)	Response(s)
Stephanie (Lutsel K'e)	1a) Are birds landing in contaminated water? 1b) Can cameras measure speed of trucks passing by? 1c) Are there seagulls at the mine site?	**Harry 1a)** 3 ducks landed in oil contaminated water, they died. Since then land farm has been flagged and since then no reported landings. **Harry 1b)** Not sure. **Harry 1c)** Yes. None have been observed nesting on mine structures, though.
Loretta (GNWT)	2) It would be great if a table clearly outlining all mitigation steps for all species (what it mitigates, how mitigation came about, does it work) could be included. Put all information in one place. Other mines do that, so this would help with comparison.	**Harry 2)** Agreed; moving in this direction in WEMP.

◎ Table of Contents

Predicted and Observed Effects

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Breeding Birds
-Birds Nesting on Pit Walls

Slide 19

Predicted and Observed Effects

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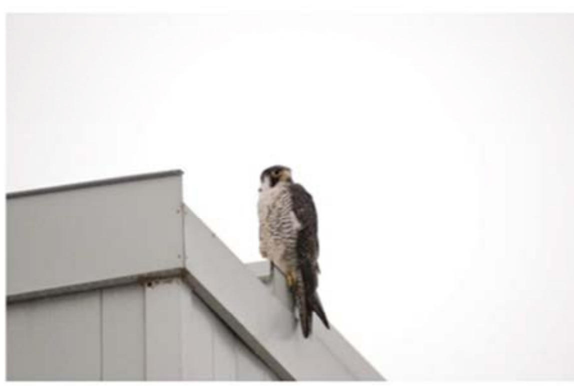
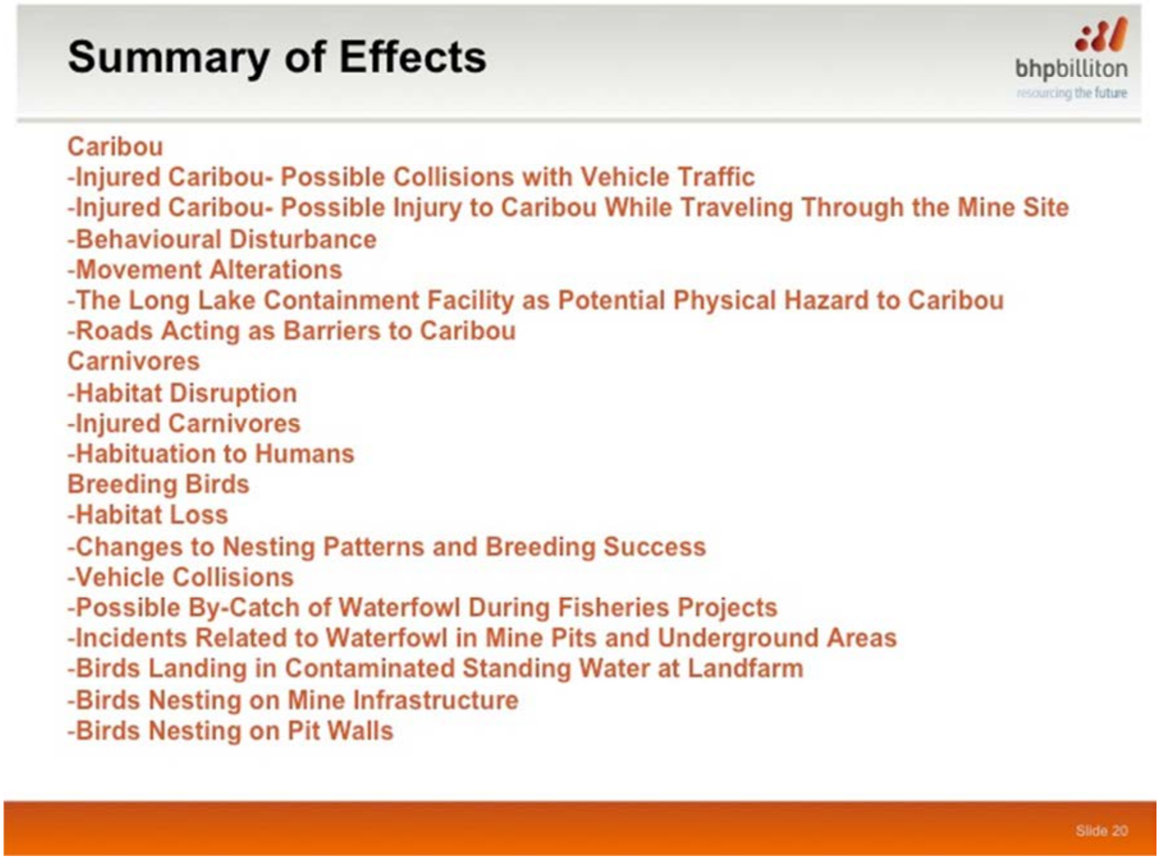
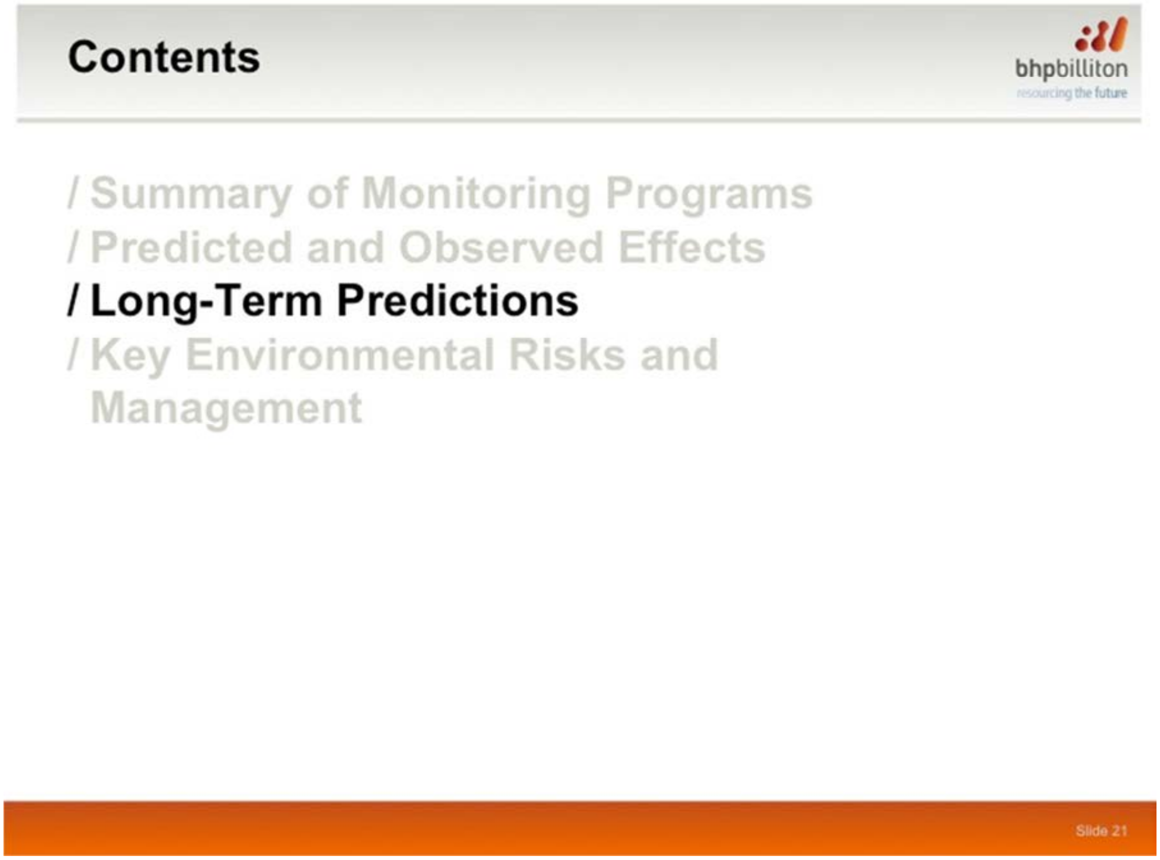
Breeding Birds/habitat
-Birds Nesting on Mine Infrastructure

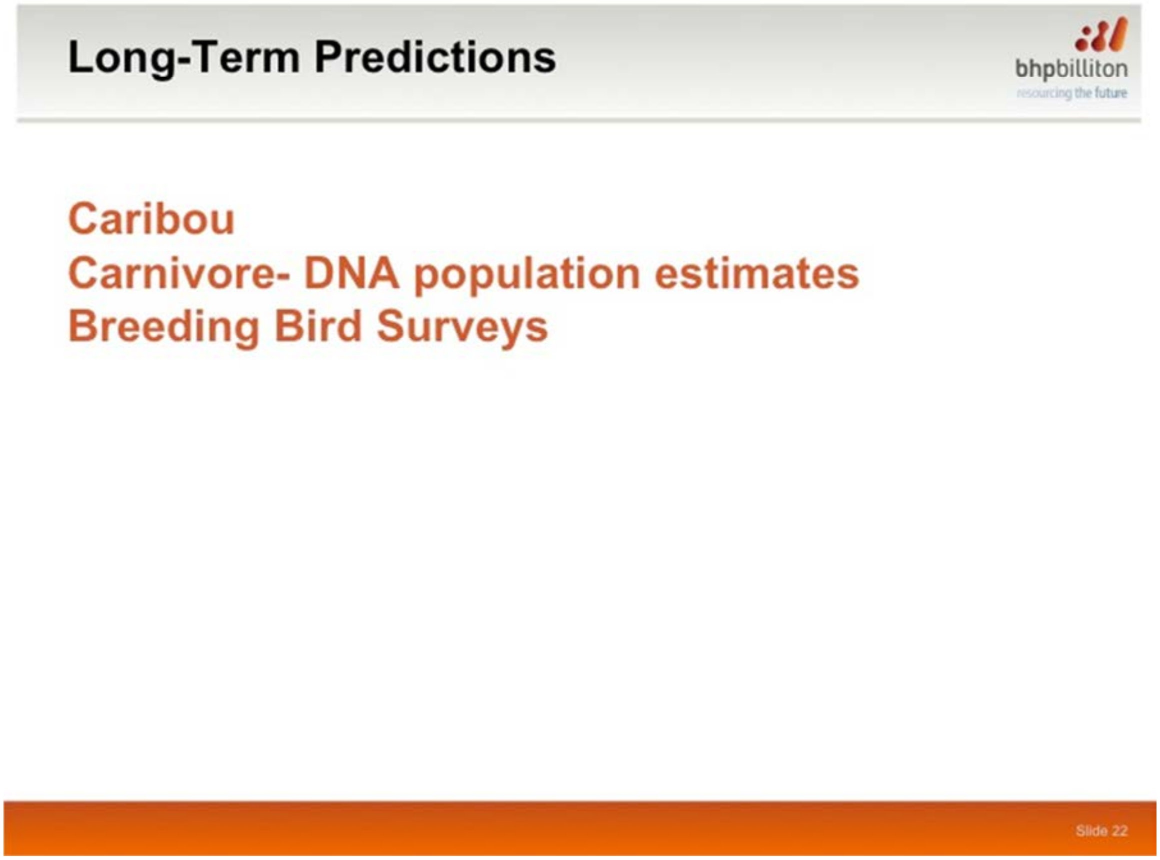


Slide 18



Name (Organization)	Comment(s)	Response(s)
Bill (IEMA)	1a) Env. Agreement obliges BHP to deal with cumulative effects. IEMA is particularly concerned about changes in population of Bathurst herd caribou, and human activities' role in these changes. EKATI's role and work to deal with these cumulative effects should be included in EIR.	Todd (YK Dene FN): Agrees and hopes to see real discussion on this issue.


Contents
bhpbilliton
resourcing the future
/ Summary of Monitoring Programs
/ Predicted and Observed Effects
/ Long-Term Predictions
/ Key Environmental Risks and Management
Slide 21



Name (Organization)	Comment(s)	Response(s)
Todd (YK Dene FN)	1a) The issue is not caribou and mine interactions: it is caribou and effects across the mine site, within the claim block and others. 1b) Lots of profit over life of mine so no sympathy about limitations, need to be more realistic.	**Harry 1a)** Yes, but we are confined to what we can monitor, can make improvements.
Bill (IEMA)	2) You are responsible for monitoring effects that the mine causes even if others contribute, need to collaborate more – Diavik, ENR, others, may need to stretch beyond claim block when monitoring effects (e.g. caribou may be avoiding claim block)	
Loretta (GNWT)	3) Is reminded of importance of coming together with other companies to monitor cumulative effects. And even if you have your own limitations, there's no reason why mines and all other parts can't work together in a consistent way. Hopes to see more of this in the future.	**Harry 3)** Agreed; notes that scale of caribou study requires sufficiently large collaboration, which is difficult.

Todd (YK Dene FN)	4a) Regarding objectives, suggests that EIR includes subsection (or similar) dealing specifically with past TK monitoring, what current TK proposal includes so that issue can be tracked for future EIRs. 4b) No. Seems EIR as way to track issues over years. WEMP isn't reviewed by and collaborated with by community groups so EIR has to provide this opportunity. Lessons learned, information developed as focuses.	**Eric 4a)** How do you see EIR working in tandem with WEMP? Part of what Todd has asked for is included in WEMP. Should EIR be the venue where we discuss changes in monitoring program? **Eric 4c)** Notes that WEMP doesn't have a process like the AEMP, so notes that EIR would probably fill some of that gap.
Kevin (IEMA)	4c) When IEMA raised agency of regular 3 year review of WEMP, BHP said that EIR already exists.	
Todd (YK Dene FN)	5) Lack of regulatory tool as such might be reason why water section is so much larger and more thorough than WL. Community concern is caribou, not water and reporting doesn't reflect this prioritization.	
Tim (IEMA)	6a) Difference between AEMP and WEMP also is that AEMP has definable benchmarks but WEMP doesn't. Hopefully with sufficient data collection, sufficient thresholds for change can be identified.	**Eric 6a)** No benchmarks since there's no reference. **Eric 6b)** Goal is to come back with an EIR that meets all stake holder expectations, so this feedback is good.
Loretta (GNWT)	6b) Benchmarks are developed through research and observation, so monitoring is key in this regard.	
Todd (YK Dene FN)	7) Appendix F. Risk ratings are an important tool for everyone to use to understand mine activities. Problem between language used and ratings assigned. Reluctance to change ratings from last EIR because no significant changes had occurred and the way the impact was laid out in the EIR wasn't well suited to impact assessment. What's the plan for this EIR, other than repeating grievances made for past EIRs?	
Bill (IEMA)	8a) Suggests that assessment of residual effects be driven by BHP's views about the most important things it has to do from now on, involves dropping 1995 assessments. Will be especially helpful to communities and others for knowing what's happening at mine right now. Will also help BHP set and identify priorities (and why they	**Rob 8a)** Clarify; so we should change design of EIR from 1999 format based on current knowledge and understanding of risks. Fundamental questions currently raised are not necessarily the ones that we thought would be important originally (i.e. downstream WQ and caribou).

	are priorities). Would also be consistent with previous discussions. IEMA's view is that top two priorities are caribou and downstream water quality, and that problems with slimy sculpin, etc. wouldn't be a priority. If BHP disagrees, that's fine, but needs to be explicit and detailed about what their priorities are. 8b) Yes. Report submitted two years ago suggests that and at the EIR workshops held over last two years showed that almost all participants agreed that EIR needs to evolve to reflect what we know now in 2012. 8c) A number of the changes that were implied and explicitly stated were responsive to the changes in discussion allow BHP to better identify the important matters. Using more recently expressed statements of concern and priority would be more useful and appropriate.	**Rob 8b)** So we should go back to "burning questions" and re-evaluate placement of priorities since it seems we're not answering the questions that are important to people today.
Todd (YK Dene FN)	9) It's time for an update. Walking a way from WEMP updates was supposed to be replaced with additional reporting efforts and venues. In view of YK Dene, the mines took this opportunity to do less work, not better work. If you're going to make changes to reporting, you still have to meet standards and thresholds of intent that satisfy stakeholders.	
Kevin (IEMA)	10) Need for method to identify priorities that includes criteria for selection, including what you've heard in review meetings, etc. SAYING that you are being responsive to comments from stakeholders is key. Gives stakeholders a sense of understanding where BHPs priorities lie, given knowledge of other's priorities.	
Todd (YK Dene FN)	11a) Reporting on successful mitigation and adaptive management would be opportunity to share lessons learned with other mines, etc. 11b) Exactly that was said during WEMP review process and result was not great (from a caribou perspective).	**Eric 11a)** Agreed. EKATI can be base of knowledge for others (PDC). **Rob 11a)** Collecting data but not doing anything with it is a wasted exercise. No reason why we shouldn't be able to use our data to understand our effects better. Notes potential for collaboration with others in production of best practices. **Rob 11b)** Agreed. Notes need for identifying key questions that need

		to be answered and keeping monitoring focused on finding answers to these questions. Also notes need to work collaboratively with other mines, etc.
Bill (IEMA)	12) Notes helpful exchanges of information about EKATI and EIR and is optimistic that 2012 EIR will be better than 2009. Thanks BHP for putting on workshop and communities for participation.	
Kevin (IEMA)	13) Notes greater openness in this EIR workshop that previous ones, less defensiveness this time re: risk ratings. Session was good, open, frank and helpful.	
Loretta (GNWT)	14) **Wants email follow-up including expectations.**	**Claudine 14)** Agreed.
Kevin (IEMA)	15a) Will notes/report come from this review session? 15b) Don't need comprehensive notes but highlights would be good. 15c) If you're making a summary anyways, it would be good to send this around especially to people who couldn't attend the review.	**Claudine 15a)** Yes, not sure what format though. **Eric 15b)** Summary of meeting will definitely show up in EIR itself, suggests that this would be sufficient. **Rob 15c)** Thanks for frank discussion necessary to meet expectations of stakeholders while meeting regulatory obligations.

Contents

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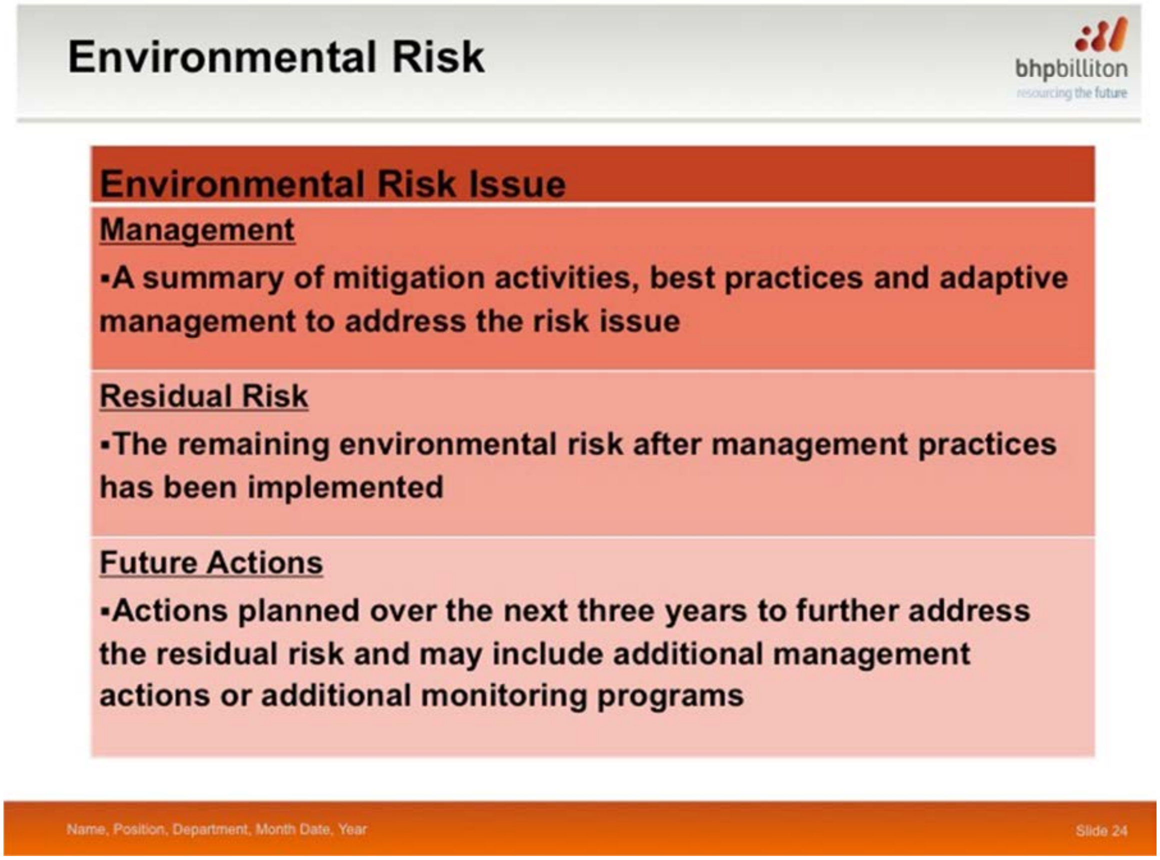
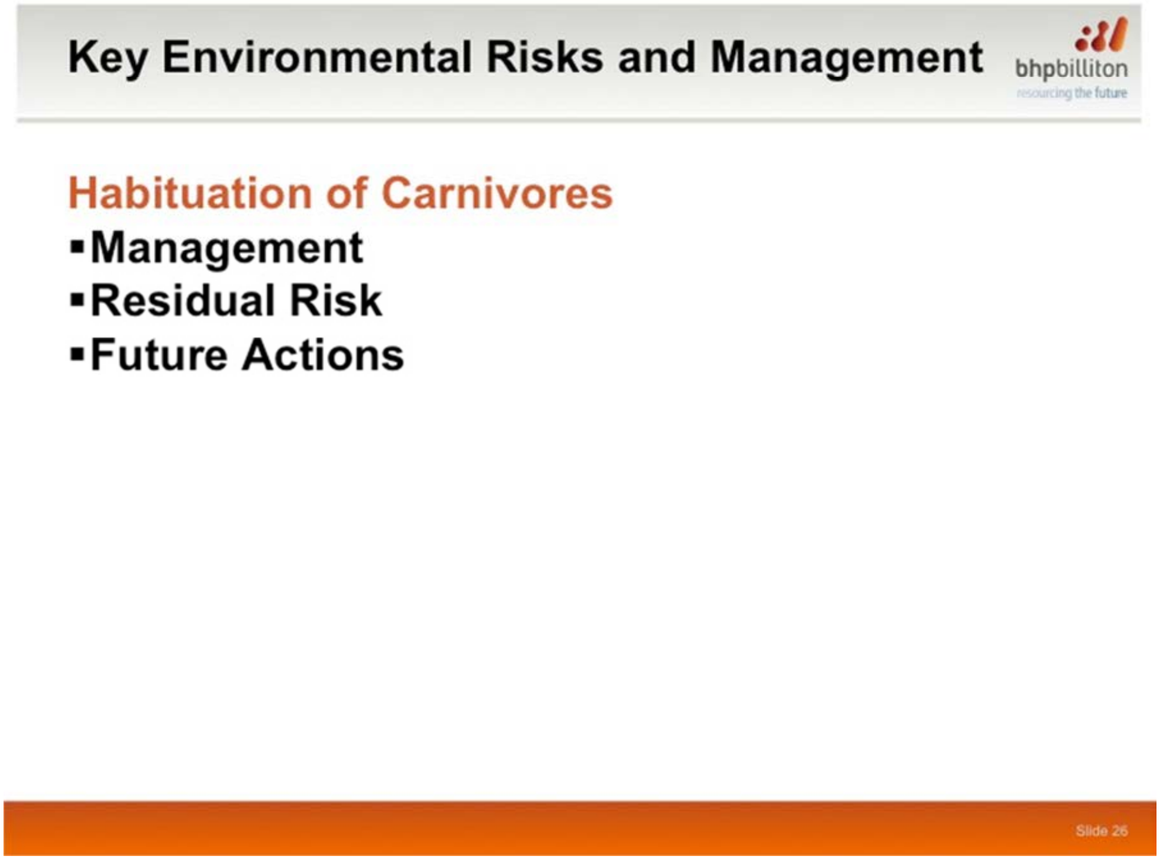
resourcing the future

Slide 23

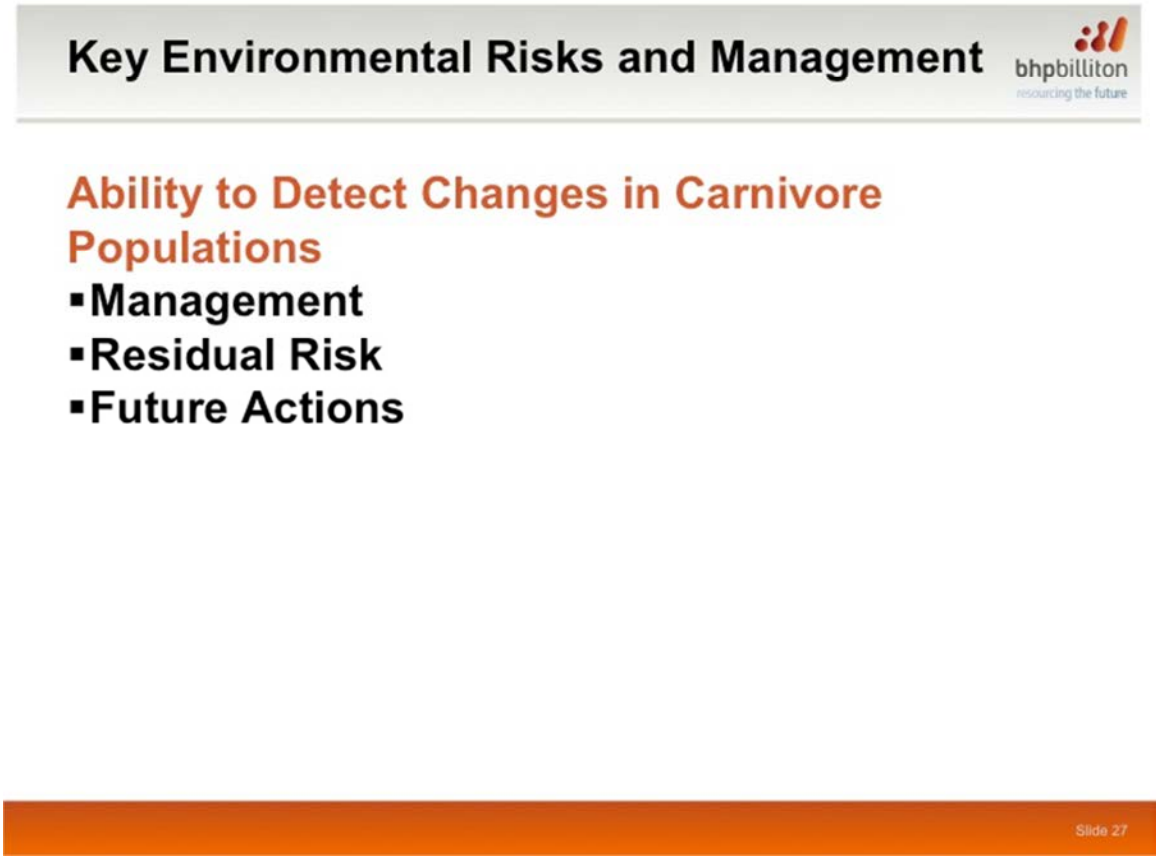


Name (Organization)	Comment(s)	Response(s)
Todd (YK Dene FN)	1) Table 8-5-1 only contains one item re: caribou. Caribou is THE priority for the communities and should be treated as such. Final EIR should be reorganized to recognize this.	
Bill (IEMA)	2) Agrees; especially since there are activities like aerial surveys ongoing.	
Tim (IEMA)	3) No discussion of efficacy of management items (ex: inukshuk placement). Understand that this is hard to measure, but BHP has obligation to monitor these measurements and assess their performance. Possible use of cameras to aid in monitoring efficacy. Especially in WL section, discussion on management effectiveness is lacking.	

Kevin (IEMA)	4) Surprised that residual risk does not identify ZOI for caribou, important to think about this especially after mine closure. What is driver of ZOI (dust? Noise?) If you understand what driver is then you can better manage. Diavik and others need to look for drivers of ZOI determination to figure out if caribou will still avoid the mine after closure.	
Ginger (Tlicho)	5a) Tli-Cho elders have noticed caribou staying away from inactive sites; agrees that identifying drivers of avoidance is important.	**Harry 5)** Agrees, and notes that this an important regional issue.
Kevin (IEMA)	6) Noted, but this does not mean that EKATI can't work within its own claim block on the issue.	
Todd (YK Dene FN)	7) Re: presentation of information, specifically in carnivore section. Most information is incidental observations (i.e. minor) and should not be treated same way as "major" issues.	



Name (Organization)	Comment(s)	Response(s)
Ginger (Tlicho)	1) Juice boxes?	**Harry 1)** People could not be trusted to properly dispose of juice boxes, so they were removed from site. Kitchen is now rinsing and recycling cans and cartons to reduce incinerator waste.



Name (Organization)	Comment(s)	Response(s)
Charlotte (AANDC)	1) No mention in document on inspection report; would like to see a summary of inspections (frequency, results, spills violations, etc). Is this addressed in yearly report?	**Claudine 1)** Yes, addressed in annual report. Agreed.

Name (Organization)	Comment(s)	Response(s)
Bill (IEMA)	1a) Why is ability to detect changes in carnivore populations a key risk? 1b) Two greatest risk are 1) changes to caribou and 2) ability to detect changes in carnivore. Seems that risk to caribou is much more important. 1c) IEMA supports carnivores.	**Harry 1a)** If we can't identify changes, we won't know if we're having an effect. Harry 1b) Healthy Grizzly bear population indicates healthy ecosystem. Need to track keystone species accurately to better understand entire ecosystem effects.
Loretta (GNWT)	2) Would like to see table including more information and explanation re: mitigation and effectiveness.	**Kevin (IEMA) 2)** Agrees since this is part of evaluating adaptive management system.

◎ Table of Contents