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Written Submission from

Environment Canada

In the Matter of

Ontario Power Generation Inc.

Proposed Environmental Impact Statement for OPG's Deep Geological Repository (DGR) Project for Low and Intermediate Level Waste

Joint Review Panel

September 16 to October 12, 2013

Mémoire d'

Environnement Canada

À l'égard de

Ontario Power Generation Inc.

Étude proposée pour l'énoncé des incidences environnementales pour l'Installation de stockage de déchets radioactifs à faible et moyenne activité dans des couches géologiques profondes

Commission d'examen conjoint

16 septembre au 12 octobre 2013

Canada

CANADIAN NUCLEAR SAFETY COMMISSION
CANADIAN ENVIRONMENTAL ASSESSMENT ACT
JOINT REVIEW PANEL

IN RESPECT OF

ONTARIO POWER GENERATION'S

DEEP GEOLOGIC REPOSITORY FOR LOW & INTERMEDIATE LEVEL RADIOACTIVE WASTES

SUBMISSION OF THE DEPARTMENT OF THE ENVIRONMENT (ENVIRONMENT CANADA)

July 23, 2013

Environment Canada Environnement Canada

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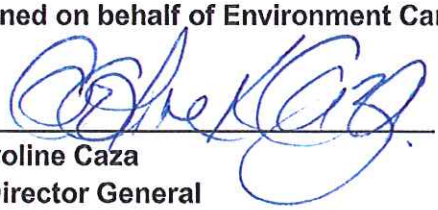
Signed on behalf of Environment Canada:



Caroline Caza
A/Director General
Environmental Protection Operations Directorate
Environment Canada

July 23, 2013

Date

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EXECUTIVE SUMMARY

On June 18, 2013, the Joint Review Panel (JRP) wrote to Environment Canada (EC) requesting the department's participation in the public hearing for the Deep Geologic Repository for Low and Intermediate Level Radioactive Wastes (DGR Project). The JRP requested that EC provide a written submission on the potential effects of the DGR Project based on the department's areas of responsibility and expertise.

EC has evaluated the Project, which includes the site preparation, construction, operation, decommissioning and abandonment of the Deep Geologic Repository and ancillary facilities at the Bruce Nuclear Generating Station site in the Municipality of Kincardine, Ontario, on the eastern shore of Lake Huron. The DGR Project is intended to provide long-term management of the low and intermediate level radioactive wastes produced by the nuclear reactors owned by Ontario Power Generation (OPG).

OPG has applied to the Canadian Nuclear Safety Commission for a *Licence to Prepare Site and Construct* under the *Nuclear Safety and Control Act* for the DGR Project. OPG will also need to submit future applications for a *Licence to Operate*, a *Licence to Decommission*,and a *Licence to Abandon.*

For projects that require a federal environmental assessment, EC, as a Federal Authority, provides specialist or expert information or knowledge on environmental matters, in accordance with the expertise that the department has available as it relates to EC's mandate, with section 20 of the *Canadian Environmental Assessment Act, 2012* (CEAA 2012), and with our regulatory responsibilities.

This submission summarizes EC's outstanding concerns and issues, and includes advice, observations and recommendations based on a review of the information provided by OPG. This includes the proponent's Environmental Impact Statement and supporting documents, their responses to the Information Requests issued by the Joint Review Panel, other information available to EC, and information posted on the Canadian Environmental Assessment Registry.

EC's submission focuses on concerns related to water quality, water quantity, air quality, accidents and malfunctions, migratory birds, species at risk and ecological risk assessment. A summary of EC's recommendations can be found in Chapter 7.

EC concludes that there would not be any significant adverse effects related to issues within our mandate that cannot be mitigated. The most important effect identified relates to the quality of effluent discharged by the Project. EC recommends that the effluent treatment system be designed so that the effluent meets the requirements of Subsection 36(3) the *Fisheries Act*.

EC also makes a number of recommendations regarding the verification of predicted effects, the design of Follow-Up and Monitoring Programs, updated modelling studies, measures to protect terrestrial wildlife and habitat, spill response planning, and best management practices for reducing air quality effects.

ABBREVIATIONS

ANFO	Ammonium Nitrate/Fuel Oil
BATEA	Best Available Technology Economically Achievable
BCR	Bird Conservation Region
BMP	Best Management Practice
BOD	Biological Oxygen Demand
Bq	Becquerel
C-14	Carbon-14 (a radioactive isotope of carbon)
CCME	Canadian Council of Ministers of the Environment
CEAA 2012	Canadian Environmental Assessment Act, 2012
CEARIS	Canadian Environmental Assessment Registry Internet Site
CEPA	*Canadian Environmental Protection Act, 1999*
CNSC	Canadian Nuclear Safety Commission
CO	Carbon Monoxide
COPC	Contaminants of Potential Concern
COSEWIC	Committee on the Status of Endangered Wildlife in Canada
CSA	Canadian Standards Association
CWS	Canadian Wildlife Service
DFO	Department of Fisheries and Oceans Canada
DGR	Deep Geologic Repository for Low and Intermediate Level Radioactive Wastes
DRLP	Derived Release Limit Pathways
EA	Environmental Assessment
EC	Environment Canada
EEM	Environmental Effects Monitoring
EIS	Environment Impact Statement
ELC	Ecological Land Classification
ERA	Ecological Risk Assessment

FUMP	Follow-Up and Monitoring Program
GLEC	Great Lakes Executive Committee
GLWQA 2012	*Great Lakes Water Quality Protocol of 2012*
IJC	International Joint Commission
IR	Information Request
JRP	Joint Review Panel
LSA	Local Study Area
MBCA	*Migratory Birds Convention Act, 1994*
µg/m3	Microgram per cubic meter
µSv/year	Microsievert per year
mGy/d	Milligray per day
MOU	Memorandum of Understanding
NAAQO	National Ambient Air Quality Objectives
NO_2	Nitrogen Dioxide
NO_x	Nitrogen Oxides
NRCan	Natural Resources Canada
OMNR	Ontario Ministry of Natural Resources
OPG	Ontario Power Generation
O_3	Ozone
PAH	Polycyclic Aromatic Hydrocarbon
PM	Particulate Matter
PM_{10}	Airborne particulate matter with a mass median diameter less than 10 µm.
$PM_{2.5}$	Airborne particulate matter with a mass median diameter less than 2.5 µm.
PMP	Probable Maximum Precipitation
PWQO	Provincial Water Quality Objectives
REMP	Radiological Environmental Monitoring Program
RSA	Regional Study Area
SARA	*Species at Risk Act*

SO_2	Sulphur Dioxide
SO_x	Sulphur Oxides
SPM	Suspended Particulate Matter
SSA	Site Study Area
SWMP	Stormwater Management Pond
TETSD	Terrestrial Environment Technical Support Document
TSS	Total Suspended Solids
VEC	Valued Ecosystem Component
VOC	Volatile Organic Compound
WMO	World Meteorological Organization
WRMA	Waste Rock Management Area
WWMF	Western Waste Management Facility
ZOI	Zone of Influence

CHAPTER 1 – INTRODUCTION

Environment Canada (EC) has evaluated the Deep Geologic Repository Project (DGR Project), which includes the site preparation, construction, operation, decommissioning and abandonment of the DGR and ancillary facilities at the Bruce Nuclear Generating Station site in the Municipality of Kincardine, Ontario, on the eastern shore of Lake Huron. The DGR Project is intended to provide long-term management of the low and intermediate level radioactive wastes produced by the nuclear reactors owned by Ontario Power Generation (OPG).

EC is responsible for the implementation of the Government of Canada's environmental agenda. EC's mandate covers the preservation and enhancement of the quality of the natural environment, including water, air and soil, flora and fauna, including species at risk and migratory birds. Science plays a fundamental role in enabling EC to deliver on the department's mandate by informing environmental decision-making and regulations and by supporting the delivery of services to Canadians. EC, as a Federal Authority (FA), provides specialist or expert information or knowledge to Responsible Authorities (RAs), mediators and panels on environmental matters, in accordance with the expertise that the department has available as required under section 20 of the *Canadian Environmental Assessment Act, 2012* (CEAA 2012).

In addition to EC's mandate to conserve and enhance the quality of the natural environment, the Department administers subsection 36(3) of the *Fisheries Act* which prohibits the deposit of a deleterious substance into fish-bearing waters. EC also participates in the regulation of toxic chemicals and the development and implementation of environmental quality guidelines pursuant to the *Canadian Environmental Protection Act, 1999* (CEPA). EC is responsible for protecting and conserving migratory birds, as populations and individual birds, under the *Migratory Birds Convention Act, 1994* (MBCA), and administers the *Species at Risk Act* (SARA), which has objectives to prevent wildlife species from becoming extirpated or extinct, to provide for the recovery of wildlife species that are extirpated, endangered or threatened as a result of human activity, and to manage species of special concern to prevent them from becoming endangered or threatened.

On June 18, 2013, the Joint Review Panel (JRP) requested EC's participation in the public hearing. The JRP requested that EC provide a written submission on the potential effects of the DGR Project based on the Department's areas of responsibility and expertise.

This submission summarizes EC's review of the Environmental Impact Statement (EIS) and supporting technical documents, the supplemental information provided in response to Information Requests issued by the JRP, and other information submitted by OPG throughout the EIS review process. This submission identifies any outstanding concerns related to issues the Department has identified, and makes recommendations for consideration by the JRP and other interested parties. If new information is brought

forward, the conclusions and recommendations provided in this submission may be reconsidered and amended as necessary[1].

EC's submission focuses on issues related to surface water quality (which also includes potential contamination from shallow groundwater inputs), water quantity (which also includes potential effects of shallow groundwater upon surface water levels and flows), effects of the environment on the Project, air quality, accidents and malfunctions, migratory birds, species at risk and ecological risk assessment. EC's review of the DGR Project was focused on potential effects of the Project upon the surface environment. The migration of contaminants out of the Repository during the Abandonment and Long-term Performance Phase is outside the scope of EC's mandate and expertise, and is being addressed by other agencies, namely the Canadian Nuclear Safety Commission (CNSC) and Natural Resources Canada (NRCan). However, EC has taken into consideration the conclusions of the review of those agencies in terms of the potential for contaminants to migrate to the surface environment and those considerations are reflected in our analysis and conclusions.

EC's comments related to these topics are found in Chapters 3 to 6 of this submission. Chapter 7 summarizes EC's list of recommendations by topic or subject area. Information on the legislation administered by EC is provided in Chapter 2. Appendix 1 provides additional context on these Acts as well as other federal policies, guidelines and international agreements which helped support the content and recommendations in this submission. The comments and recommendations on the above issues also incorporate cross-cutting environmental assessment considerations, such as cumulative effects and climate change (in context of effects of the environment on the project), when they are relevant to that topic.

EC based its analyses on the principle that the Project, if approved, should be planned, built, operated, and decommissioned in a manner that ensures the highest level of environmental protection so that the well-being of Canadians is enhanced and the natural environment is conserved.

EC has undertaken a science-based review of the issues of interest to the Department. Throughout the review and in EC's previous submissions to the JRP, the Department has asked questions that were necessary to ensure that scientific rigour was applied to any modelling and other analyses provided by OPG. EC did this to ensure that the data used to support the analyses and the predictions and conclusions were credible.

The review was guided by a number of over-riding principles or concepts, including the following:

- The precautionary principle, which recognizes that where there are threats of serious or irreversible damage, scientific uncertainty shall not be used to postpone cost-effective measures to prevent environmental degradation.

1 EC has undertaken its review based on the scenarios as presented by OPG. EC does not have the expertise to verify whether these releases are valid, therefore, EC must rely upon the expertise of the CNSC and NRCan for that validation. If the CNSC and/or NRCan indicate that a different release scenario or quantity should be used, EC will review potential effects within our mandate using the new scenarios/quantities.

- An ecosystem approach to environmental management, which is a method of environmental stewardship that focuses understanding, decision making, and program action on maintaining the capacity of a whole system to produce ecological goods and services by concentrating on the long-term health of ecosystem structure, processes and interactions. The intent is to proactively integrate environmental, economic, and social objectives within ecological scales and timeframes in order to achieve environmental sustainability.
- The use of Best Available Technology Economically Achievable (BATEA) and best management practices to prevent, reduce or eliminate the direct or indirect release of effluents and substances into aquatic, atmospheric and terrestrial ecosystems.

The CNSC and EC have an agreement to formally cooperate on matters related to the protection of the environment, embodied in the Memorandum of Understanding (MOU) between the Canadian Nuclear Safety Commission and Environment Canada(renewed by both parties in 2012). Specifically, the CNSC and EC agreed to cooperate *"on the conduct of environmental studies, assessments or research projects of potential interest to the regulation of nuclear facilities and activities, and in the sharing of expert assistance and financial resources in the conduct of these studies, assessments or research projects"*. A copy of this MOU is found in Appendix 3 of this submission.

EC has a regulatory interest in some of the environmental components of the DGR Project and it is EC's view that the Department possesses specialist information and expert knowledge related to the Project which would be of value during the detailed design and the various licensing phases. Therefore, throughout the recommendations in this submission, EC has identified when the Department's participation should be formally engaged.

The recommendations within this submission are provided for consideration by the JRP. However, this does not preclude OPG from adopting them in advance of any final recommendations by the JRP.

EC recommends that OPG should work with government agencies and other stakeholders, including EC, in designing and implementing appropriate Follow-up and Monitoring Programs to confirm predictions made in the EIS and facilitate the application of adaptive management to further minimize or eliminate identified impacts.

OPG has made a variety of commitments throughout their environmental assessment, which EC recommends should be addressed in approvals by appropriate regulators as well as an EA follow-up program to ensure these commitments are met.

CHAPTER 2 – EC: MANDATE, ROLES & RESPONSIBILITIES

2.1 Introduction

The mandate of Environment Canada is determined by the statutes and regulations assigned to it by Parliament through the Minister of the Environment. In delivering this mandate, the Department is responsible for the development and implementation of policies, guidelines, codes of practice, inter-jurisdictional and international agreements, and related programs.

The following describes specific relevant legislation and national environmental policies and programs administered or adhered to by EC and relevant to the DGR Project. The information is up-to-date as of July 23, 2013. The following summaries have been prepared for ease of reference and convenience only. For purposes of reliability and accuracy, and for interpreting and applying the Act, regulation or policy, it is recommended that the reader review the original document itself, including any subsequent amendments.

Section 20 of the *Canadian Environmental Assessment Act, 2012* sets out EC's obligation as a Federal Authority (FA) as follows:

> "Every federal authority that is in possession of specialist or expert information or knowledge with respect to a designated project that is subject to an environmental assessment must, on request, make that information or knowledge available, within the specified period, to
>
> (*a*) the responsible authority;
>
> (*b*) the review panel;
>
> (*c*) a government, an agency or body, or a jurisdiction that conducts an assessment of the designated project under a substituted process authorized by section 32; and
>
> (*d*) a jurisdiction that conducts an assessment, in the case of a designated project that is exempted under subsection 37(1)."

The scope of specialist or expert information or knowledge provided by EC in this submission to the JRP is within the Department's mandate as defined by the *Department of Environment Act* and through other legislation assigned to the Minister of the Environment.

Should the Deep Geologic Repository for Low and Intermediate Level Radioactive Wastes Project proceed, the pollution prevention provisions of the *Fisheries Act*, the *Canadian Environmental Protection Act, 1999 (*CEPA*)*, the *Migratory Birds Convention Act, 1994* (MBCA), the *Species at Risk Act (*SARA*)*, and regulations made under these Acts, would be applicable to the Project and would be binding on the Proponent. Amendments to legislation and future legislation would also be applicable. EC also advocates that the Federal Policy on Wetland Conservation be adhered to by federal regulators of the DGR Project.

The key pieces of relevant legislation administered or adhered to by EC that influenced the content of this submission are summarized in this chapter. Appendix 1 (Legislation

and National Environmental Policies) describes in more detail these and other relevant legislation, national environmental policies and programs, and international agreements.

EC's comments and recommendations in this submission are intended to provide expert support to the project proponent and decision-makers, in accordance with its program related responsibilities and associated guidelines and policies. These comments are in no way to be interpreted as any type of acknowledgement, compliance, permission, approval, authorization, or release of liability related to any requirements to comply with federal or provincial statutes and regulations. Responsibility for achieving regulatory compliance and cost effective risk and liability reduction lies solely with the project Proponent.

2.2 *Fisheries Act* – Subsection 36(3)

The responsibility for the administration (including the enforcement) of the pollution prevention provisions of the *Fisheries Act* (including subsection 36(3)) has been assigned to the Federal Minister of the Environment.

Subsection 36(3) of the *Fisheries Act* specifies that, unless authorized by federal regulation, no person shall deposit or permit the deposit of deleterious substances of any type in water frequented by fish, or in any place under any conditions where the deleterious substance, or any other deleterious substance that results from the deposit of the deleterious substance, may enter any such water. In the definition of deleterious, the *Fisheries Act* includes “any water that contains a substance in such quantity or concentration, or that has been so treated, processed or changed, by heat or other means, from a natural state that it would, if added to any other water, degrade or alter or form part of a process of degradation or alteration of the quality of that water so that it is rendered or is likely to be rendered deleterious to fish or fish habitat or to the use by man of fish that frequent that water.” Subsection 36(3) makes no allowance for a mixing or dilution zone.

In the application of the *Fisheries Act*, a discharge of effluent that is acutely lethal to fish is regarded as deleterious. In other words, results of tests designed to determine whether fish will die in an effluent or discharge within a specified time period will determine one aspect of deleteriousness. However, any substance with a potentially harmful chemical, physical or biological effect on fish or fish habitat would be deleterious. For example, substances that negatively alter or impact rearing areas or spawning grounds, or interfere with reproduction, feeding or respiration of fish, at any point in their life cycle would also be deleterious. Therefore, the discharge of a thermal effluent would be considered a deleterious substance if it had a potentially harmful chemical, physical or biological effect on fish or fish habitat.

Meeting the requirements of the *Fisheries Act* is mandatory, irrespective of any provincial regulatory or permitting system. The release of substances with the potential to be "deleterious” as defined in paragraph 34(1) of the *Fisheries Act*, from the construction, operation, reclamation or decommissioning stages of the Project to any waters frequented by fish, may constitute violations of the *Fisheries Act*.

Compliance with the terms and conditions of a provincial regulatory or permitting system does not absolve OPG from responsibility for compliance with the requirements of the

Fisheries Act or other federal legislation. Further, this submission does not constitute an authorization pursuant to subsection 36(4) of the *Fisheries Act*, and any deposit of a deleterious substance into water frequented by fish may constitute a violation of the *Fisheries Act* and warrant enforcement action.

2.3 *Canadian Environmental Protection Act, 1999*

The *Canadian Environmental Protection Act, 1999* (CEPA) provides the Government of Canada with tools to protect the environment and human health and establishes strict deadlines for controlling certain toxic substances. Determining a substance to be toxic under CEPA is a function of its release or possible release into the environment, the resulting concentrations in environmental media and its inherent toxicity. Section 64 of CEPA defines a substance as toxic "if it is entering or may enter the environment in a quantity or concentration or under conditions that:

- have or may have an immediate or long-term harmful effect on the environment or its biological diversity;
- constitute or may constitute a danger to the environment on which life depends; or
- constitute or may constitute a danger in Canada to human life or health."

CEPA also regulates environmental and human health effects from products of vehicle engine and equipment emissions, fuels, hazardous wastes, environmental emergencies, and other sources of pollution. For example, emissions from off-road diesel engines are regulated under the *Off-Road Compression-Ignition Engine Emission Regulations* that can be found at the following link:
http://www.ec.gc.ca/CEPARegistry/regulations/detailReg.cfm?intReg=88.

2.4 *Migratory Birds Convention Act, 1994*

EC's mandate includes the protection of migratory birds, nests and eggs. EC administers and enforces the *Migratory Birds Convention Act, 1994* (MBCA) and *Migratory Birds Regulations* (MBR).

The purpose of the MBCA is to implement the Migratory Birds Convention between Canada and the United States by protecting and conserving migratory birds, as populations and individual birds and their nests. Subsection 5.1 of the MBCA prohibits the deposit of a substance that is harmful to migratory birds in waters or an area frequented by migratory birds or in a place from which the substance may enter such waters or such an area. The Act prohibits the possession of a migratory bird, nest or egg without lawful excuse. The MBR provide for the conservation of migratory birds and for the protection of individuals, their nests and eggs. A prohibition against hunting is set out in section 5 of the MBR. The term “hunt” is given a specific definition in section 2 of the Regulations and includes attempting in any manner to kill, injure or harass migratory birds. A prohibition against the disturbance, destruction, or taking of a nest, egg or nest shelter of a migratory bird is set out in subsection 6(a) of the MBR.

2.5 *Species at Risk Act*

EC administers and enforces the federal *Species at Risk Act* (SARA), in partnership with the Department of Fisheries and Oceans, and the Parks Canada Agency. The purpose of the SARA is to prevent wildlife species from being extirpated or becoming extinct, to provide for the recovery of wildlife species that are extirpated, endangered or threatened as a result of human activity, and to manage species of special concern to prevent them from becoming endangered or threatened. Schedule 1 of the SARA provides a list of wildlife species at risk in Canada that are considered extirpated, endangered, threatened, or of special concern.

The SARA provides automatic protection for aquatic species and birds protected by the *MBCA*, if they are listed as extirpated, endangered or threatened. The prohibitions in sections 32 and 33 of the Act apply whether these species are on federal, provincial or territorial lands. These automatic prohibitions also apply to all other species listed as extirpated; endangered or threatened which are located on federal lands. As set out in the SARA, in certain circumstances the prohibitions could also apply on provincial lands.

Subsection 79(1) requires that the federal authorities responsible for the environmental assessment notify the competent minister(s) in writing if the project is likely to affect a listed wildlife species or its critical habitat. Under subsection 79(2), the federal authority must also identify adverse effects on listed species including species of special concern and on the critical habitat of extirpated, endangered and threatened species; and if the project is carried out, ensure that measures are taken to avoid or lessen those effects and to monitor them. These measures must: a) be consistent with best available information including any Recovery Strategy, Action Plan or Management Plan in a final or proposed version; and b) respect the terms and conditions of the SARA regarding protection of individuals, residences, and critical habitat of extirpated, endangered, or threatened species. Accordingly, the results of this environmental assessment will be used to inform the appropriate federal authority when they exercise their obligations under section 79 of the SARA.

The competent minister's role within environmental assessment is to provide technical advice and support to the federal authority to assist in addressing these requirements. However, it should be noted that the SARA competent minister also has certain specific obligations relative to species and critical habitat protection stemming from the SARA itself, separate from CEAA 2012 or the environmental assessment process. As such, the Proponent must also meet any statutory obligations under the SARA.

2.6 *Great Lakes Water Quality Protocol of 2012*

The *Great Lakes Water Quality Protocol of 2012* amended the Agreement between Canada and the United States of America on Great Lakes Water Quality, herein referred to as GLWQA 2012. The GLWQA 2012 is an agreement between Canada and the United States that provides a framework for binational consultation and cooperative action to restore and protect Great Lakes water quality and ecosystem health. The GLWQA was first signed by Canada and the United States in 1972 and replaced by a new GLWQA in 1978, which was amended by Protocol in 1983, 1987 and again in 2012.

The GLWQA 2012, substantially amended by Protocol, was signed on September 7, 2012 and entered into force on February 12, 2013.

The purpose of the GLWQA 2012 is *"to restore and maintain the chemical, physical, and biological integrity of the Waters of the Great Lakes."* To achieve this purpose the Parties (the Government of Canada and the Government of the United States) "*agree to maximize their efforts to: a) cooperate and collaborate, b) develop programs, practices and technology necessary for a better understanding of the Great Lakes Basin Ecosystem; and c) eliminate or reduce, to the maximum extent practicable, environmental threats to the Waters of the Great Lakes".* In addition, the Parties *"recognizing the inherent value of the Great Lakes Basin Ecosystem, are guided by a shared vision for a healthy and prosperous Great Lakes region in which the Waters of the Great Lakes, through sound management, use and enjoyment, will benefit present and future generations of Americans and Canadians".*

The GLWQA reaffirms, in the spirit of friendship and cooperation, the rights and obligations of both countries, Canada and the United States, under the *Boundary Waters Treaty of 1909*, in particular, the obligation not to pollute the waters.

The GLWQA 2012 sets out common water quality objectives and commitments, outlines provisions for the development of cooperative strategies and research, and assigns responsibilities to the International Joint Commission.

The GLWQA 2012 includes ten issue specific Annexes to address challenges to water quality and ecosystem health -- Areas of Concern, Lakewide Management, Chemicals of Mutual Concern, Nutrients, Discharges from Vessels, Aquatic Invasive Species, Habitats and Species, Groundwater, Climate Change Impacts, and Science.

Environment Canada has overall lead responsibility for coordinating the implementation of the GLWQA 2012 for the Government of Canada. Many federal departments and agencies, through activities and programs under their jurisdiction and mandates, contribute to the implementation of the GLWQA 2012. For example, Fisheries and Oceans Canada leads the work on the Aquatic Invasive Species Annex and, Transport Canada leads the work under the Discharges from Vessels Annex.

The Parties are responsible for decision-making under the GLWQA. The Great Lakes Executive Committee (GLEC) was established to assist coordinating, implementing, reviewing and reporting on programs, practices and measures undertaken to achieve the purpose of the Agreement. The Parties co-chair GLEC and membership includes federal agencies, state and provincial governments, tribal governments, First Nations, Métis, municipal governments, watershed management agencies, and other local public agencies, as well as observers from the Great Lakes Commission, the Great Lakes Fishery Commission, the International Joint Commission, non-governmental organizations, the province of Québec, and interested members of the public.

CHAPTER 3 - WATER ISSUES

3.1 Introduction

This chapter presents EC's review of the aquatic sections of the EIS and supporting documents. EC has a mandate to protect water quality and aquatic ecosystem health, as well as advise on the management of transboundary waters. This mandate is, in part, fulfilled through Compliance Promotion and Enforcement of the pollution prevention provisions of the *Fisheries Act* and the *Canadian Environmental Protection Act, 1999*. EC also conducts a number of other programs to fulfill this mandate, including administering Environmental Effects Monitoring programs for industries regulated under the *Fisheries Act*, maintaining the the Water Survey of Canada hydrometric network, as well as the Water Science and Technology Directorate research and monitoring science on issues affecting Canada's water resources.

EC, on behalf of the Government of Canada, has overall lead responsibility for coordinating the implementation of the GLWQA 2012. In addition, EC leads the negotiation and implementation of the Canada-Ontario agreements on the Great Lakes. The binational and domestic agreements outline the Government of Canada's commitments to work cooperatively to restore, protect and enhance the water quality and ecological health of the Great Lakes. EC also serves as a coordinating agency for multi-jurisdictional water initiatives and provides support to the International Joint Commission on water level management in the Great Lakes.

EC provides regional and long term temporal water quantity, water quality and climate data, and supporting information which is used by government agencies, project proponents, and other stakeholders to evaluate baseline conditions and predict project impacts.

As noted in Chapter 1, the following discussion relates to potential effects on surface water. The migration of contaminants out of the Repository during the Abandonment and Long-term Performance Phase is outside the scope of EC's mandate and expertise, and is being addressed by other agencies. However, we have taken into consideration the conclusions of the review of those agencies in terms of the potential for contaminants to migrate to the surface environment and those considerations are reflected in our analysis and conclusions regarding surface water effects.

EC's review related to impacts to surface waters was guided by the following general outcome objective:

- Aquatic systems are protected through the mitigation of impacts of the Project to ensure that effluent discharges are in compliance with Section 36 of the *Fisheries Act*.

EC identified the following broad water-related issues as being of primary concern for our review:

- Surface water quality (which also includes potential contamination by shallow groundwater);

- Surface water quantity (which also includes potential effects of shallow groundwater upon surface water levels and flows); and,
- Effects of the environment on the Project (i.e. site flooding hazards).

EC has reviewed the assessment of potential effects that may arise from these broad issues over the life cycle of the Project. A more detailed discussion of the key issues that EC has identified is provided in the following Sections:

- Water quality (Section 3.2)
- Water quantity, including site flooding hazards (Section 3.3)

EC has also provided a discussion on the implications of the *Great Lakes Water Quality Protocol of 2012* to the DGR Project in Section 3.4.

Regarding potential effects of the Project on water quality, the following was considered:

- Discharges of conventional substances from various sources of contaminated water; and,
- Discharges of radionuclides from various sources of contaminated water.

At present, EC does not consider thermal effects to be a concern for the effluent discharge from the DGR Project. However, OPG has indicated it may use an evaporator if water treatment is required to reduce salinity levels. Should this be the case, then EC would need to re-assess the issue of thermal effects.

The Site Preparation and Construction, Operation, and Decommissioning Phases of the DGR Project are expected to have effects on surface waters and shallow groundwater quality. Based on site hydrogeological conditions, effects on surface water levels and flows due to changes in shallow groundwater are expected to be negligible. The surface water quality effects will primarily occur in the Site Study Area (i.e. MacPherson Bay) due to the release of process effluents, groundwater pumped from the Repository, leachate from the waste rock, and conventional stormwater. Assuming that the effluent meets the *Fisheries Act*, no effects are anticipated in the Local Study Area and Regional Study Area.

No effects to surface water quality are anticipated during the Abandonment and Long-term Performance Phase.

3.2 Water Quality

A. Introduction

From the perspective of EC's mandate and the focus of the Department's review (i.e. Project effects on the surface environment), the most important potential effect associated with the Project is that of the proposed stormwater management pond (SWMP) effluent discharge on downstream surface water quality and aquatic biota. Effects can occur during the Site Preparation and Construction, Operation, and Decommissioning Phases of the Project.

B. Analysis and Conclusions

The Project will generate contaminated water from the following sources:

- groundwater that flows into the Repository;
- process water used to facilitate the underground development of the Repository (e.g. water used during drilling and blasting);
- leachate from the waste rock pile; and,
- conventional stormwater from the DGR Site.

The relative importance of these sources will vary during the different phases of the Project:

- Site Preparation and Construction Phase: All of the above sources will contribute contaminated water during this phase. The highest volume of process water will occur during this phase. Groundwater inflow might be at its peak as shaft development is underway, at least until the rock grouting program has been implemented to reduce inflow rates to intended design values. This peak flow of groundwater is important because of its very high salinity. The relative importance of leachate from waste rock as a source of contamination will gradually increase as the volume of waste rock stored at surface increases. Due to the stripping of vegetation and grading activities, stormwater will entrain higher-than-normal levels of total suspended solids (TSS) as a result of exposed soil, as compared to TSS levels entrained from a vegetated site. An even larger source of TSS identified by OPG was the TSS generated by drilling and blasting activity and entrained in water pumped from underground into the SWMP.
- Operations Phase: During this phase, which is expected to last several decades, all of the above sources will contribute contaminated water. However, during the Operations Phase, the importance of leachate will likely be at its maximum since all of the waste rock will have been extracted and stored at surface. Process water flows are greatly reduced during operations. Groundwater inflows will be stable and very predictable during this phase. Conventional stormwater quality should improve with respect to TSS since previously exposed soils will progressively re-vegetate. Stormwater quantity will be subject to annual variations in precipitation, and will therefore vary from year to year. Considering the length of the Operations Phase, climate change may have a measureable effect on the seasonality and overall amounts of precipitation, as well as on the duration and intensity of storm events.
- Decommissioning Phase: Water will no longer be pumped out of the Repository. The only remaining sources of contaminated water will be the leachate from the waste rock and conventional stormwater runoff. This situation will persist into the future, post-decommissioning.

Regardless of the phase of the Project, the site has been conceptually designed such that the flows from all of these sources of contamination will be captured within the SWMP. **As such, it is not a conventional urban stormwater management system (which would normally only capture true stormwater runoff). Rather, it is more similar to a wastewater treatment system and therefore needs to be designed accordingly.**

As currently designed, the SWMP will primarily achieve reductions of TSS through settling. Even so, TSS levels may not be adequately reduced to meet criteria for the

protection of aquatic life. There may potentially be some reductions of other contaminants, but it is unlikely that reliance on settling alone will adequately deal with the expected contaminant types and concentrations.

A range of contaminants are associated with the Project, as determined primarily by:

- natural contaminants (e.g. salinity) in the groundwater that will inflow into the overall Repository;
- contaminants associated with underground drilling and blasting operations;
- contaminants that will leach from waste rock, as determined by preliminary[2] geochemical tests conducted upon drill core samples of the rock that will be encountered during Repository construction; and,
- typical stormwater contaminants at a construction site or at a paved-surface industrial site.

Preliminary[3] water quality modelling was conducted to determine which contaminants could reach levels that have the potential to affect aquatic life.

EC's evaluation of the information about these different contaminant sources has identified the following contaminants to be of primary concern:

- salinity;
- total suspended solids;
- un-ionized ammonia , nitrate; and,
- various metals and metalloids (arsenic, copper, zinc, iron, aluminum, boron, cobalt, thallium, vanadium, chromium, lead, nickel).

Other parameters that may also be problematic include:

- oil & grease; and,
- petroleum hydrocarbons.

OPG tested the waste rock for its acid generating potential. EC supports the general conclusion that there should be sufficient neutralization potential to counteract any acidity generated. This is based on the assumption that the small sample size of the test material has adequately captured the actual compositional variability of the waste rock.

Recommendation #3.1:
EC recommends that conclusions about the acid generating potential of the rock be verified as part of a waste rock characterization program[4] which was originally outlined in IR# EIS-04-160 (CEARIS# 759).

EC believes that treatment will very likely be required in order for the effluent to be compliant with the *Fisheries Act*. With up to 370,000 mg/l of salinity in groundwater, and the leaching of salinity from the waste rock pile, **EC concludes that salinity has a very high probability of posing a water quality problem that will require treatment.** This

2 Additional discussion about the preliminary nature of these tests will be provided below.
3 Additional discussion about the preliminary nature of these tests will be provided below.
4 Note that the waste rock characterization program is further discussed below in the section titled "FUMP - Water Quality Predictions".

conclusion appears justified in light of the report titled *"Water Quality Modelling Results for the Stormwater Management Pond"* (CEARIS# 936 - note that the groundwater salinity value was quoted from this document). OPG's preliminary modelling of TSS levels (see *"Analysis of Stormwater Runoff Quantity and Total Suspended Solids Concentrations from the DGR Project Site"*; CEARIS# 954) also strongly suggests that TSS levels will be problematic in effluent. Metal leaching from waste rock might also pose water quality problems. Residues (e.g. un-ionized ammonia, nitrate, and oil and grease) generated by the underground drilling and blasting activities may also require treatment.

Considering that OPG designed the SWMP to meet Ontario stormwater criteria, OPG's proposed design may not be capable of reducing contaminants to levels that meet the requirements of the *Fisheries Act*. It is important to remember that the SWMP system receives much of its contaminated water from sources that are not considered conventional stormwater runoff. Therefore, the water that collects in the SWMP should be considered industrial effluent, rather than stormwater.

Recommendation #3.2:
EC recommends that treatment will be required for effluents from the DGR facility in order to meet Section 36(3) of the *Fisheries Act,* and that OPG revise the SWMP system design accordingly. A precautionary approach should guide the design of the effluent treatment system and the overall SWMP.

Additional information should be obtained as part of a Follow-Up and Monitoring Program (see "Future Commitments and Follow-Up" section below) to refine the estimates of water quality from the various sources. This information will help to inform the design of the SWMP including any treatment technologies.

Some uncertainties exist regarding water quality within the SWMP (i.e. prior to any treatment), which result from the following:

- OPG's assumptions about groundwater and process water flows may not be accurate; and,
- geochemical changes in leachate may occur over time (this is discussed further below in the section titled "Waste Rock Management Area").

Follow-Up Programs are recommended to address these uncertainties and inform the need for effluent treatment. EC recommends that the modelling be re-done at a future date when information on these aspects is available. Considering the relative importance of these uncertainties, EC did not critically evaluate the assumptions about precipitation and the hydrological modelling of stormwater runoff volumes that were made by OPG[5]. EC also recommends that OPG consult with the Department in advance for guidance on the precipitation inputs that should be used for the modelling.

5 These assumptions were made in the two reports titled *"Water Quality Modelling Results for the Stormwater Management Pond"* (CEARIS# 936), and *"Analysis of Stormwater Runoff Quantity and Total Suspended Solids Concentrations from the DGR Project Site"* (CEARIS# 954).

Recommendation #3.3:
EC recommends that the hydrological modelling be updated at a future point when additional information about leachate geochemistry is available, the various source flow rates can be verified, and an updated design of the SWMP is provided[6], and that EC be consulted by OPG for advice on precipitation inputs to this modelling.

Downstream Water Bodies

The discharge from the SWMP will be to the Un-named Ditch which subsequently discharges to MacPherson Bay in Lake Huron. Because the Project is isolated from Stream C and the marsh (also referred to as Wetland 4) to the northeast of the DGR Site by virtue of the design of the SWMP, no water quality effects are anticipated upon those waterbodies. Contaminated groundwater, which would mainly arise from seepage entering shallow groundwater systems beneath the waste rock pile, would not affect Stream C or the marsh.

The only plausible overland connection to Stream C is via the North Railway Ditch and South Railway Ditch. Effects to Stream C are only likely to occur during the Site Preparation and Construction Phase as the site is graded in order to achieve isolation from Stream C. It is possible that construction activities could cause sediment discharges into the railway ditches that would then convey suspended solids to Stream C. However, as long as sediment is controlled via silt curtains (as per OPG commitments) and construction best management practices during that phase, no effects are expected on Stream C.

After the site has been graded and the stormwater ditch network has been established, there will be no overland flow from the DGR Site to the North Railway Ditch (which leads to Stream C).

Accidents /Malfunctions

Spills of radioactive wastes or other conventional substances (e.g. fuels, lubricants, chemicals) are considered possible. Although the likelihood of such spills may be low, OPG should be prepared to deploy spill mitigation measures. At the DGR site, spills can be classified into three main categories:

- underground spills within the Repository;
- spills occurring along the roadway that passes over the railway ditches (e.g. during transfer of wastes from the WWMF to the DGR site); and,
- spills within the DGR site at surface.

If an underground spill occurs, standard spill mitigation measures can be deployed to prevent the spill from being released to surface. For example, the pumping of underground sump water can be suspended until the spill has been contained and cleaned.

For a spill that enters the railway ditches, standard spill mitigation measures can be deployed to prevent the spill from migrating into Stream C. The narrow ditches facilitate

6 See "*Fisheries Act* Considerations" below.

spill containment. The relatively low flow and flow speed within the ditches and the distance to Stream C (approximately 550 m) are also favourable for spill containment. However, preparedness for a spill into the railway ditches will be necessary to ensure successful containment.

For spills within the DGR site, all surfaces ultimately drain to the SWMP. Rapid deployment of spill containment and cleanup would prevent the spill from entering the SWMP. Should the spill enter the SWMP, an additional measure that could be undertaken would be to cease the discharge of effluent to contain the spill within the SWMP and allow for spill mitigation.

Recommendation #3.4:
EC recommends that a detailed spill response plan for the DGR be developed. The spill response plan should also include an assessment of containment methods, locations and strategies to demonstrate that spill mitigation could be deployed in time to prevent downstream effects.

Fisheries Act Considerations

Discharges from the DGR Project to fish habitat must be in compliance with Section 36 of the *Fisheries Act*. There is no existing regulation under the *Fisheries Act* applicable to the effluent of the DGR Project that would authorize the deposit of deleterious substances by OPG into waters frequented by fish. Currently, no other permits (e.g. federal, provincial, municipal) absolve OPG of the requirements of the *Fisheries Act.* Recent changes to Section 36 of the *Fisheries Act* under the Federal Government's Responsible Resource Development Plan of April 2012 added greater flexibility to the regulatory tools that can be used to more effectively manage deposits. Regulatory instruments for implementing these changes are under development and EC is having discussions with the CNSC on how these new tools can be used to give regulatory certainty to allow deposits that will still be protective of the aquatic community.

Where no specific regulation exists to authorize a deposit, the proponent should use the best available technology economically achievable to ensure that contaminant concentrations in the effluents are protective of aquatic life. Options to achieve this include meeting the water quality criteria established by the Canadian Council of Ministers of the Environment (CCME) for protection of aquatic life and/or Provincial Water Quality Objectives (PWQO), whichever may be more stringent. Effluent must, at a minimum, be non-acutely lethal to aquatic life. With regards to the toxicity testing of the effluents, OPG should provide the toxicity testing criteria (acute lethality and sublethal), test methodology and frequency of testing that they intend to use to demonstrate compliance with the *Fisheries Act*.

The effluent must be in compliance with the *Fisheries Act* at all times. EC notes that this consideration may not have been fully addressed by OPG in their intended design and operation of the SWMP. For example, during the initial development of the underground shafts, groundwater inflows may be greater than the steady-state design values they intend to achieve, particularly if they are advancing the shafts prior to grouting (grouting is intended to reduce groundwater inflow rates), or if the advance grouting is insufficient to achieve desired inflow rates. The SWMP system should be designed to handle these

larger flows, and to provide treatment for any contaminants in order for the effluent to be compliant with the *Fisheries Act*. Another example would be the size of the SWMP and associated retention time of contaminated waters during storm events. OPG has sized the SWMP to meet Ontario stormwater criteria, using a design storm (25 mm of precipitation in a 6 hour period) which is not a particularly large or infrequent event[7]. Larger storms, which are indeed anticipated to happen, would likely result in the SWMP (as currently designed) being unable to meet the *Fisheries Act* due to the inability to retain and treat these larger storm flows. In addition, climate modelling experiments point to a potential increase in the frequency and intensity of extreme precipitation events under a changed climate (Kharin *et al*. 2007; Kharin and Zwiers 2005). These studies found the annual mean precipitation rate over North America is projected to increase by less than 3% by the end of this century, however, the corresponding increase in the 20-year return values of annual extremes of 24-hour precipitation rates is projected to be 15% (A2 scenario). A more recent study focusing on southern Ontario found that the return values of annual maximum 3-day accumulated rainfall totals in the study area are projected to increase by 25–60% for the period 2051–2100 (Cheng *et al*. 2011).

Hydrological modelling will be required to support estimation of the stormwater runoff volumes, flow rates, storage pond capacities, etc.

EC notes OPG's commitment in their response to IR# EIS-04-130 to assess future climate change and modify the pond size accordingly.

Recommendation #3.5:
EC recommends that OPG assess future climate change effects and modify the SWMP pond size accordingly, and that this be incorporated into an adaptive management plan as a component of the Follow-Up Monitoring Program.

Also, in accordance with the *Fisheries Act*, EC considers the final point of control for effluent to be the point where undiluted effluent discharges from the SWMP into the first waterbody designated as fish habitat or where it is likely to enter fish habitat. For the SWMP, the final point of control for effluent is where it discharges from the SWMP since dilution from other intersecting ditch networks (i.e. the ditches along Interconnecting Road) would occur further downstream of that point. The final point of control indicated by EC is approximately 500m upstream of where OPG had suggested it should be established (i.e. OPG had proposed the final point of control to be where the Un-named Ditch discharges into MacPherson Bay).

Recommendation #3.6:
EC recommends that the final point of control for effluent be where it discharges from the SWMP since dilution from other intersecting ditch networks (i.e. the ditches along Interconnecting Road) would occur further downstream of that point.

7 A storm event of 25 mm precipitation in 6 hours would be expected to occur more frequently than once every 2 years.

The quarterly monitoring of surface water in the SWMP, as originally proposed by OPG, is considered to be inadequate by EC. Surface water quality may undergo significant changes due to:

- increasing volume of waste rock, as underground shaft and Repository are developed;
- changes in waste rock type as the shafts are developed;
- geochemical changes within the waste rock pile through time (particularly in the first few years); and,
- variable contribution from different sources of contaminated water.

EC recommends that a much higher frequency of water quality sampling is required within the SWMP, at least until stable chemistry is achieved and/or trends can be identified, so as to inform the need for treatment.

Although contaminants of greatest potential concern have been identified (see "Analysis and Conclusions" above), monitoring for a broader range of parameters will help to ensure that there are no other unanticipated parameters of concern.

Recommendation #3.7:
EC recommends that a broad spectrum of parameters (e.g. other metals, phosphate, total petroleum hydrocarbons) be monitored quarterly during the Site Preparation and Construction Phase, and later during the Operations Phase, to ensure that there are no other unanticipated parameters of concern.

EC has reviewed OPG's response to IR# EIS-08-395, which is directly related to the issue of monitoring frequency, and which merely states that it will be in accordance with CSA Standard N288.4-10. The CSA Standard is not readily accessible to all interested parties and may be subject to interpretation. Rather than pointing to the CSA Standard, EC's expectation was that OPG would have proposed a more detailed monitoring program with a scientifically sound rationale for the proposed parameters and monitoring frequency. Furthermore, since it is anticipated that seepage will discharge from the waste rock pile with some regularity, the leachate sampling program should not be limited to first flush events as OPG had proposed in their response.

With regard to the monitoring of the final effluent that is discharged from the SWMP, EC recommends more frequent monitoring, for example on a weekly basis, plus daily during any rainfall events. Considering that the Site Preparation and Construction Phase will take five to seven years, and that there could be varying concentrations of contaminants flowing into the SWMP system over that timeframe (such as from above-ground sources or from underground sump water), this potential variability dictates a fairly frequent monitoring schedule. OPG can request a reduction in the monitoring frequency after achieving steady state water quality conditions in the SWMP or after demonstrating regular compliance with the *Fisheries Act*. This monitoring can also meet the needs of a follow-up program for verifying effects of effluent on the receiving environment. The follow-up monitoring program (FUMP) related to the effluent discharge that is outlined below (see "FUMP - Effluent Discharge Quality and Downstream Effects") has been proposed in order to demonstrate compliance with the *Fisheries Act*. This monitoring program is based on the current understanding of parameters of concern, and can be modified in light of any new information which may arise, for example from the characterization of leachate or underground sump water quality.

Although OPG has conceptually described potential treatment options within the SWMP for various contaminants (e.g. salinity, nitrates), this needs to be examined in greater detail from the perspective of meeting the *Fisheries Act* (not only the Ontario stormwater criteria proposed by OPG), and as additional information is obtained about anticipated contaminant levels. In recognition of high salinity, TSS, and oil and grease from groundwater and process water pumped out of the Repository, OPG has described the possibility of pre-treating this water prior to discharging it into the SWMP. This may be a valid component of the overall treatment approach, considering that there are other sources of contaminants from stormwater and the leachate from the waste rock pile.

One of the options mentioned by OPG for the pre-treatment of salinity in the water pumped from the Repository was the use of an evaporator (see OPG response to IR#EIS-09-472 in CEARIS#949). If underground water volumes are large then the use of an evaporator may create a heated effluent if that treated water is discharged into the SWMP (rather than being released as steam). The possibility of a thermal effect on the aquatic environment should be considered when designing treatment components of the SWMP system. Other potential treatment options for salinity should also be considered.

OPG has also indicated that they might use some types of waste rock (e.g. shale) for berms and grading within the DGR Project Site. This is appropriate as long as any potential leachate from these materials will flow into the SWMP.

Recommendation #3.8:
EC recommends that any waste rock not be used or disposed outside of the boundaries of the SWMP collection system.

OPG assumes that the SWMP will no longer be required after the Decommissioning Phase of the project. Although this seems plausible (considering the likelihood that contaminant levels will decline over the duration of the Operations Phase, which will last at least 40 years), the decision should be based on monitoring of untreated SWMP water quality over the course of the Operations Phase and the Decommissioning Phase. This is an important consideration for the FUMP, which is discussed below.

Waste Rock Management Area

The Waste Rock Management Area (WRMA) will contain three main types of waste rock generated by the development of the underground shafts and Repository:

- Limestone;
- Dolostone; and,
- Shale.

When the waste rock is placed into the WRMA, precipitation will infiltrate the pile. Geochemical reactions will change the chemistry of the water. This water is commonly known as leachate. The type of contaminants and their concentration is largely controlled by the mineralogy of the rock, amongst other factors.

EC has already provided comments about the surface water quality concerns associated with leachate from the WRMA above in the *"Analysis and Conclusions"* section. EC also noted that there are uncertainties about the geochemical changes in leachate over time.

OPG's responses to IRs regarding leachate quality state a degree of certainty that does not seem justified based on the available information. EC does not agree that the information about leachate quality from the waste rock is conclusive. The composition of the leachate is likely to be variable and may take some time before significant changes in the chemistry develop and reach its maximum effect. Additional data about the potential for metals and salinity leaching from waste rock will need to be obtained and factored into the SWMP system design and any treatment that may be necessary.

EC concurs with certain commitments that OPG has made, including undertaking geochemical characterization of acid generating potential, elemental content, metal leaching potential, and hydrocarbon occurrence. However, based on OPG's IR responses, it appears that OPG does not intend to undertake kinetic tests on additional core samples or conduct any field cell studies. EC recommends that OPG conduct such kinetic tests. The data obtained by such tests would give better predictions of the potential future leachate chemistry before the full waste rock pile is developed, and would allow for any treatment system to be designed and implemented sooner. See the section below titled "FUMP - Water Quality Predictions" for EC's recommendations on further geochemical testing.

Metal(loid) leaching can occur at neutral and slightly elevated pH, especially for arsenic. OPG did not list arsenic as being of potential concern based on the average of all samples they tested. However, arsenic levels were elevated above Provincial Water Quality Objectives and Canadian Water Quality Guidelines in three of the six shake flask tests. This indicates a potential concern, one that warrants additional testing using larger sample sizes. OPG states: *"Further preliminary water quality modelling being completed in support of the design of the stormwater management pond has identified no potential concerns with metals in the stormwater pond discharge as a result of leaching from the waste rock"* (Golder Associates Ltd. 2011). The characterization of the materials is very limited and therefore the above statement is not sufficiently supported. Reliance on the short-term leach testing could be problematic for a number of reasons. Golder (2011) clearly outlines that there are limitations to the small size of the test material and that it may not capture actual compositional variability. It also identifies that since testing is conducted over a short period of time the dissolution of minerals with slow reaction kinetics will not necessarily be reflected in the leachate chemistry. The short-term nature of the leach testing utilized in Golder (2011) using the method specified in ASTM D3987 only measures readily soluble components.

Also, during the EIS public review period, much of the discussion that occurred about the waste rock was focused on acid rock drainage and metal leaching issues. However, as was pointed out by EC during the public review period, some of the geological strata have the potential for releasing considerable salinity. There are two main sources of salinity, and the rate at which salinity will be released could be influenced by the following:

- saline porewater (associated with the highly saline groundwater that has been reported by OPG to be as high as 370,000 mg/l), which might be released at a faster rate from the blasted waste rock; and,
- saline minerals, such as would be expected to occur in the Guelph Formation and Salina Group, which might release at slower rates over a longer period of time. Halite, in particular, had been identified to be "found in abundance in the Upper Ordovician shales", especially in the Blue Mountain Formation where the concentration was up to 1.4% weight percentage.

C. Future Commitments and Follow-Up Monitoring Programs

In order to verify the various effects predictions made in the EIS, and to address the uncertainties that will affect the final design of the SWMP system (including treatment), various FUMPs will be necessary for:

- water quality predictions from the various contaminated sources;
- water quality at various points within the SWMP system; and,
- effluent discharge quality and downstream effects.

FUMP - Water Quality Predictions

In lieu of field cell tests, a well-defined and controlled leachate sampling program is required for the waste rock pile in order to provide a more reliable understanding of how leachate chemistry will change over time. OPG's proposed approach to leachate monitoring (see OPG response to IR#EIS-05-172; CEAERIS #) was a single location that *"will characterize the surface water runoff from the waste rock piles and other areas of the DGR Project Site".* This approach is problematic since that location will measure diluted leachate which will complicate the understanding of leachate evolution, since the diluted leachate may also contain contamination from other water sources. Full-strength leachate needs to be monitored.

Recommendation #3.9:
EC recommends that full-strength leachate be monitored.

There remains merit with the waste rock monitoring program approach outlined in IR# EIS-04-160 (CEARIS #759) (i.e. the approach outlined in the IR, not OPG's response to that IR). The approach outlined was as follows:

> *Undertake a detailed waste rock monitoring program that:*
> - *Verifies predictions made during the EA regarding waste rock characterization and leachate quality; and*
> - *Evaluates the effectiveness of measures that have been implemented to prevent and control contaminant leaching.*
>
> *The waste rock monitoring program should include the following:*
> *1. confirmation (during construction) of mineralogy as well as contaminant levels in rock for each horizon;*
> *2. testing should there be potential for risk based on solids characterization; and*
> *3. management plans (e.g., segregation of problematic waste) if risk is confirmed.*

Recommendation #3.10:
EC recommends that a waste rock characterization program be required during shaft and Repository development. Where warranted by the results of the waste rock characterization program and associated shake flask tests, kinetic leach tests may also be required in order to reduce uncertainties regarding waste rock leachate.

FUMP - Water Quality Monitoring of Other Contaminated Sources

OPG indicated in the response to IR#EIS-05-172 (CEARIS# 793) that *"one sample location will be sited at the sump discharge, through which all underground water will flow, in order to characterize the sump water quality"*. EC concurs with the need for monitoring at this location. The parameters and monitoring frequency should be similar to what is recommended for the SWMP (see "FUMP - Effluent Discharge Quality and Downstream Effects").

FUMP - Effluent Discharge Quality and Downstream Effects

Monitoring undertaken for the purposes of demonstrating compliance with the *Fisheries Act* can also serve the needs of a FUMP. Based on information available to date regarding the various sources of contaminated water, the following parameters (at a minimum) should be monitored in the effluent discharging from the SWMP system:

- chloride, total dissolved solids (associated with salinity);
- total suspended solids;
- BTEX (benzene, ethylbenzene, toluene, xylene), un-ionized ammonia, total ammonia, nitrate (in consideration of ANFO[8] explosive residues and the use of diesel fuel in underground equipment);
- pH, temperature (basic monitoring parameters);
- BOD, chlorophyll a, (in consideration of potential nitrate issues and associated eutrophication);
- various metals and metalloids (arsenic, copper, zinc, iron, aluminum, boron, cobalt, thallium, vanadium, chromium, lead, nickel) which are associated with waste rock leachate;
- oil & grease (in consideration of underground drilling and other equipment being used);
- a broad spectrum of parameters (e.g. other metals, phosphate, total petroleum hydrocarbons[9]) should be monitored quarterly to ensure there are no other parameters of concern (see also Recommendation 3.7);
- flow rate;
- toxicity testing (acute, sublethal); and,
- radionuclides.

Monitoring of radionuclides is suggested to establish a baseline for comparison to detect any releases associated with radioactive wastes stored within the DGR[10]. Regular

8 Ammonium Nitrate/Fuel Oil.
9 Associated with natural seeps of petroleum from waste rock.
10 Also, tritium releases have been raised as a potential concern by various intervenors in regards to the inflow of tritium into the DGR shafts from the WWMF groundwater tritium plume.

monitoring of radionuclides should be undertaken since they are anticipated to be released to surface via the underground sump discharges (e.g. tritium will accumulate in underground condensation).

OPG has indicated that the stormwater system will no longer be required during the Abandonment and Long-term Performance Phase. Although this seems plausible (considering the length of the Operations Phase and the likelihood that contaminant levels will decline over that time), the decision should be based on untreated SWMP water quality as monitored over the course of the Operations Phase and Decommissioning Phase. Similarly, consideration may be given to scaling back the sampling frequency of final effluent once steady state conditions are established, or after demonstrating ongoing compliance with the *Fisheries Act*.

A similar suite of contaminants should be monitored in downstream surface waters and sediments to verify OPG's effect predictions. The main points of monitoring would be within the Un-named Ditch directly downstream of the SWMP and in MacPherson Bay, directly downstream from the discharge of the Un-named Ditch. The location of sampling points would need to be determined on the basis of suitable field conditions, particularly for collecting sediment samples. A higher frequency of downstream sampling should be initiated prior to any Project activities, in order to establish a baseline. Once Project activities have commenced, a quarterly sampling frequency for water quality and an annual sampling frequency for sediment would be appropriate. Adjustments to the sampling frequency and parameters can be made over time based on what is being observed.

Benthic invertebrates should also be sampled in MacPherson Bay, ideally at the sediment monitoring locations. A benthic invertebrate survey should be conducted to establish baseline data. This will also serve to compare to prior benthic surveys to show how stable the benthic community has been in this area over time. OPG should make every effort possible to sample sediment and benthics in MacPherson Bay as close as possible to the outflow of the Un-named Ditch. A caged bivalve study should also be located here, so as to provide a better indication of impacts specific to the effluent discharge.

Although EC is recommending the above monitoring as an initial program, a final FUMP will need to be developed by the proponent after obtaining additional information about:

- potential waste rock leachate quality;
- the actual quality of Repository sump and process water; and,
- the detailed re-design of the SWMP (i.e. to meet the *Fisheries Act*).

Recommendation #3.11:
EC recommends that a Follow-Up and Monitoring Program be developed for effluent discharge quality and downstream effects, in consultation with EC.

3.3 Water Quantity

A. Introduction

EC reviewed the DGR Project to assess its potential to affect surface water levels and flows. EC's main concerns relate to:

- impacts to water levels in the marsh (also referred to as Wetland 4) to the northeast of the DGR site;
- impacts to water flows in Stream C; and,
- the Maximum Flood Hazard Assessment for the overall DGR Site.

B. Analysis and Conclusions

Marsh (Wetland 4)

EC is concerned with the potential dewatering of the marsh as a result of the development of the SWMP system, including the establishment of ponds and ditches below the existing water table in the marsh. The concern arose from the possibility of whether groundwater flow from the marsh would be induced towards the SWMP system, thereby causing water levels to drop which would affect the ecological viability of the marsh.

EC concurs with OPG's determination that water levels in the marsh will not likely be affected, due to the very low permeability of the glacial tills that underlie the marsh and the remainder of the DGR site. However, this conclusion requires confirmation during the Site Preparation and Construction Phase, when the SWMP is graded and the ditch networks are excavated. There is potential for localized variability within the overburden stratigraphy, wherein more permeable overburden horizons could occur. If a more permeable horizon is intersected during the grading of the SWMP system, and if this horizon is hydrogeologically connected to the marsh, this could cause groundwater flow outward from the marsh which could cause surface water levels in the marsh to drop.

EC recommends that OPG provide verification of the overburden stratigraphy at the time the SWMP system is constructed. This should include reporting on whether there are any variances in glacial till and permeability values to those provided by OPG in the EIS and supporting documentation including IR responses. If problematic stratigraphy is encountered, OPG must assess its potential effect on water levels in the marsh and evaluate mitigation options. This will provide confirmation of OPG's assumptions. This, coupled with water level monitoring in the marsh, (see "FUMP – Marsh"), will provide a robust validation of the prediction that water levels will not drop.

Recommendation #3.12:
EC recommends that OPG provide verification of the overburden stratigraphy at the time when the SWMP system is constructed. If problematic stratigraphy is encountered, OPG must assess its potential effect on water levels in the marsh and evaluate and implement mitigation options.

Another EC concern relates to potential dewatering of the marsh as a result of the initial shaft development stages, when groundwater inflows into the shafts are likely to be greatest. OPG has indicated it will implement groundwater flow reduction measures,

such as freezing or grouting, to reduce inflow rates. Even so, a zone of influence (ZOI) of groundwater level drawdown is predicted to extend 54 m from the shaft. This ZOI will be temporary, occurring during shaft development. Emplacement of the shaft collar and final grouting to reduce inflows to design levels will essentially eliminate the ZOI.

EC believes that the shaft development is very unlikely to cause the drawdown of water levels in the marsh for the following reasons:

- most of the groundwater inflows into the shaft will occur through fractured carbonate rock, not overburden;
- the marsh is formed by a perched water table that sits upon a thick low permeability glacial till layer that limits downward infiltration of water, and therefore has limited hydraulic connection with the more rapidly dewatering carbonate bedrock; and,
- the predicted ZOI from the shafts is 54 m, as compared to the 500 m distance of the marsh from the shafts.

Stream C

OPG indicated that a small portion of the DGR Site forms part of the Stream C watershed. OPG is proposing to grade this portion such that it will drain into the SWMP system. By doing this, the size of the Stream C watershed would be slightly decreased, resulting in a 0.8% loss of flow to Stream C. EC considers this loss to be insignificant. Furthermore, the grading will prevent any contaminated waters from within the DGR Site from potentially flowing into Steam C. Once the grading has been completed, Stream C will essentially be protected from any potential water quality effects incurred by the DGR Project (please refer to *Chapter 3.2 Water Quality* for EC's evaluation of potential surface water quality impacts to Stream C during the Site Preparation and Construction Phase).

The DGR Project would not otherwise be expected to affect shallow groundwater flows (commonly referred to as baseflow) into Stream C, particularly when considering the distance of approximately 550 m between the eastern edge of the DGR Site and Stream C.

Site Flooding Hazards

OPG conducted a Maximum Flood Hazard Assessment that looked at three potential flooding risks that could affect the DGR Site:

- flood hazards associated with coastal flooding (i.e. from Lake Huron);
- flood hazards associated with riverine flooding (i.e. from nearby rivers and streams); and,
- flood hazards associated with direct on-site precipitation.

EC concurs with OPG's conclusion that there is no flooding risk from coastal flooding or from riverine flooding. Based on the preliminary design details presented in the EIS and supporting documents, there is a hypothetical risk of flooding of the DGR shafts due to direct on-site precipitation. This risk only exists for the Probable Maximum Precipitation Event which is the theoretical maximum precipitation event expected for this location. In the EIS OPG indicated that the flood hazard assessment was based on the preliminary design elevation of the finished ground surface of 186 m. OPG has

subsequently proposed (see OPG response to EIS-07-284; CEARIS#843) to increase the finished ground surface to 188 m to facilitate site drainage. OPG must therefore recognize that the originally assumed design elevation of the finished ground surface (186 m) is the same elevation (design height) as currently proposed for the shaft collars. It will therefore be necessary for OPG to adjust the shaft collar height according to:

- the revised design elevation; and,
- the findings of a revised flood hazard assessment that OPG proposes will be conducted during the final detailed engineering design.

Recommendation #3.13:
EC recommends that OPG conduct a revised flood hazard assessment based on the final detailed engineering design of the overall DGR Site and infrastructure, including the SWMP system. Considering the DGR Project will operate for at least 40 years, the revised flood hazard assessment should incorporate the potential effect of climate change upon the size of the PMP event. A rigorous sensitivity analysis should also be performed. The shaft collar heights should be increased to an appropriate elevation based on this revised flood hazard assessment.

EC notes that OPG made a commitment that is similar to this Recommendation, which was outlined in the OPG response to IR#EIS-04-143: *"As part of finalizing the site grading plan, OPG will be updating the Maximum Flood Hazard Assessment (AMEC NSS 2011) to provide assurance that the maximum flood level will be below the shaft collar height considering the latest estimates of PMP, including consideration of climate change."*

C. Follow-up Monitoring Program

FUMP – Marsh (Wetland 4)

Although EC concurs with OPG's determination that water levels in the marsh will not likely be affected, a FUMP should be designed to verify that the Project will not reduce water levels within the marsh.

Recommendation #3.14:
In addition to Recommendation #3.12, EC recommends that the following elements be included in a FUMP designed to verify that the Project will not reduce water levels within the marsh (Wetland 4):

1) Monthly monitoring of water levels in the marsh (Wetland 4) should commence prior to the Site Preparation and Construction Phase in order to establish a baseline. This program can be discontinued three years after construction of the SWMP system has been completed if there is no evidence of a water level reduction attributable to the Project (this may require a hydrological analysis of precipitation inputs to confirm that any reductions are attributable to variations in precipitation).

2) Groundwater inflow rates into the shafts and Repository should be reported during the Site Preparation and Construction Phase, and Operations Phase to verify the assumptions that support the effects conclusions.

FUMP - Stream C

EC concurs with OPG that the 0.8% flow reduction in Stream C will be difficult to detect. OPG has instead proposed to monitor the flows from the North Railway Ditch, which is expected to show a flow decrease of 31%. EC concurs with the flow monitoring in the North Railway Ditch. However, EC disagrees with the proposed quarterly frequency of monitoring for one year to establish a baseline, as well as the proposed quarterly frequency for the FUMP. Ideally, daily monitoring over a period of several years would be required to establish a statistically valid baseline for the North Railway Ditch. However, considering the relatively low risk and low impact effect predicted to Stream C, an alternative approach that undertakes the hydrologic gauging of a number of storm events may be adequate for establishing the baseline and for measuring the effects of the Project.

Recommendation #3.15:
EC recommends that an appropriate frequency of flow monitoring in the North Railway Ditch be developed in consultation with EC.

3.4 Great Lakes Water Quality Protocol of 2012

Introduction

Over the course of the EIS public review period for the DGR Project, a number of intervenors have made statements or asked questions about the applicability of the GLWQA 2012 with regards to the proposed DGR Project. The following information is provided to explain provisions of the GLWQA 2012 that reference nuclear issues.

GLWQA 2012 References to Nuclear Issues

The GLWQA 2012 includes references to nuclear issues:

- **Article 4 – Implementation** - commits Canada and the U.S., in cooperation and consultation with State and Provincial Governments, Tribal Governments, First Nations, Métis, Municipal Governments, watershed management agencies, other local public agencies, and the public, to develop and implement programs and other measures for pollution abatement, control, and prevention to fulfill the purpose of the Agreement and to help achieve the General and Specific Objectives laid out in the Agreement. Section Paragraph 2. (a) of Article 4 lists *"sources of radioactive materials"* for which pollution abatement, control, and prevention programs shall be developed.

This commitment, which first appeared in the 1972 GLWQA as *"measures to control the discharges of radioactive materials into the Great Lakes system"*, is addressed federally through the Canadian Nuclear Safety Commission's mandate to regulate the use of

nuclear energy and materials to protect the health, safety and security of Canadians and the environment.

- **Article 6 - Notification and Response** - states that *"the Parties shall notify each other, through the Great Lakes Executive Committee, of planned activities that could lead to a pollution incident or that could have a significant cumulative impact on the waters of the Great Lakes, such as:… i) the storage and transfer of nuclear waste or radioactive materials; …and, vi) nuclear facilities"*.

The notification requirement was met for the DGR Project. On June 21, 2013, Canada, through the GLEC Co-chair, notified the U.S. and the GLEC, of the September 16, 2013 DGR public hearing start date and the process for participating. No other action under the GLWQA is required for the DGR Project. It should be noted that mechanisms for submitting comments on planned activities that could lead to a pollution incident reside outside of the GLWQA under the appropriate federal authority responsible for assessing environmental impacts such as the Canadian Environmental Assessment Agency, National Energy Board or Canadian Nuclear Safety Commission. For example, the notification for the DGR Project informed the U.S. of the project and process for participating in the Joint Review Panel hearings. While not required under the1987 GLWQA, the Canadian Environmental Assessment Agency updated the Binational Executive Committee (the predecessor of the Great Lakes Executive Committee) on the DGR Project in June, 2011.

CHAPTER 4 – AIR ISSUES

4.1 Air Emissions - Conventional

Introduction

The following sections present EC's review of the atmospheric environment and air quality atmospheric dispersion modelling sections of the EIS (and supporting technical documents). EC has a broad mandate and policy framework with respect to air quality, including both national initiatives and international agreements.

Federal thresholds for air quality include Canada-wide Standards for ozone and particulate matter (PM) and National Ambient Air Quality Objectives (NAAQO), which are annual, 24-hour and 1-hour maximum acceptable concentrations for Nitrogen Dioxide (NO_2), Sulphur Dioxide (SO_2) and Carbon Monoxide (CO). For further information on criteria for assessing air quality please refer to the Canadian Council of Ministers of the Environment Canada Wide Standards pages (http://www.ccme.ca/ourwork/environment.html?category_id=108), and Health Canada's page on the National Ambient Air Quality Objectives (http://www.hc-sc.gc.ca/ewh-semt/air/out-ext/reg_e.html). Some new, single-tier NAAQO have been developed for certain substances (Particulate Matter and Ozone). However, for other substances such as NO_2 and SO_2, new standards have not been developed, and so the thresholds in the National Ambient Air Quality Objectives and Guidelines in Canada table remain valid.

Canada-Wide Standards for Particulate Matter (PM) and Ozone (O_3) state that new facilities and activities should incorporate best available technologies and best management practices (BMPs) to reduce emissions of PM and precursor pollutants.

Canada's primary legal tool for assessing and managing chemical substances in the environment is the *Canadian Environmental Protection Act, 1999* (CEPA 1999), jointly administered by Environment Canada and Health Canada. Substances determined to be toxic under CEPA 1999 are added to the List of Toxic Substances for management using regulations and/or other instruments to reduce the risks they pose to the environment or human health. Currently, numerous existing chemical substances are being assessed under EC's Chemical Management Plan to ensure that they are managed properly.

Analysis and Conclusions

EC undertook a review of the air quality assessment for conventional substances that will be emitted during the Site Preparation and Construction Phase, and the Operations Phase. This included a review of:

- the baseline meteorology;
- the atmospheric dispersion modelling approach that was used, including the establishment of baseline air quality;
- the various emission sources; and,
- the emission estimates.

For the Decommissioning Phase, the activities that would generate air emissions are expected to be similar to, or less than, those occurring during the Site Preparation and Construction Phase, so the Decommissioning Phase was not reviewed in any detail. For the Abandonment and Long-term Performance Phase, it is not expected that there will be any emissions of conventional air pollutants.

Overall, OPG's modelling approach and emission estimates were deemed to be appropriate, and the air quality predictions are credible and suitably conservative. The DGR Project is not expected to create new sources of hazardous air pollutants, nor expected to cause an increase in emissions from existing sources (e.g. WWMF incinerator, Bruce Nuclear Generating Station).

The only phase that will experience notable increases in conventional air pollution is the Site Preparation and Construction Phase. Exceedances of some air quality criteria are predicted to occur. During the Operations Phase, there will be some increases in short-term levels (e.g. 1-hour and 24-hour levels) of some pollutants, however no exceedances are predicted, and annual values are expected to remain at levels that are very similar to existing conditions.

The effects of the DGR Project on conventional air quality are discussed in greater detail below.

Criteria Air Contaminants - Site Preparation and Construction Phase

The main new sources of pollution for this phase include:

- on-road vehicular traffic (e.g. trucks, heavy machinery);
- site grading, clearing and grubbing (e.g. heavy machinery);
- concrete batch plant;
- excavation, drilling and blasting activity (e.g. shaft and Repository development); and,
- waste rock handling and storage.

The main conventional pollutants being emitted by the DGR Project include the following substances:

- nitrogen oxides (NO_x);
- sulphur dioxides (SO_2);
- carbon monoxide (CO);
- particulate matter (PM_{10}, $PM_{2.5}$) and dust (i.e. Suspended Particulate Matter (SPM));
- volatile organic compounds (VOCs); and,
- polycyclic aromatic hydrocarbons (PAHs).

The emissions are expected to cause some air quality criteria to be exceeded at the boundary of the Site Study Area[11], including:

- 24-hour SPM: 276.9 µg/m^3 > 120 µg/m^3 (NAAQO)
- 24-hour PM_{10}: 75.3 µg/m^3 > 50 µg/m^3 (NAAQO)
- 24-hour $PM_{2.5}$: 45.7 µg/m^3 > 30 µg/m^3 (NAAQO)
- 24-hour Acrolein: 0.784 µg/m^3 > 0.4 µg/m^3 (Ontario Ambient Air Quality Criteria)
- 1-hour Acrolein: 6.192 µg/m^3 > 4.5 µg/m^3 (Ontario Ambient Air Quality Criteria)

The exceedances at the boundary of the Site Study Area mainly occur for the 24-hour criteria, and they represent the maximum offsite concentration for these 24-hour criteria. The only 1-hour criteria exceeded is for acrolein. No criteria exceedances are predicted for offsite human receptors for these air quality parameters (1-hour, 24-hour, and annual criteria).

At the boundary of the Site Study Area, some air quality criteria are expected to approach, but remain below criteria, including:

- 1-hour NO_2: 321.7 µg/m^3 < 400 µg/m^3 (NAAQO)
- 24-hour NO_2: 141.2 µg/m^3 < 200 µg/m^3 (NAAQO)

Overall, it is important to note that the annual levels of these and other pollutants show a small increase with levels remaining well below the annual criteria. The peak increases and exceedances would occur during Stage 1 of the Site Preparation and Construction Phase, when concurrent activities are occurring, such as site preparation, construction of the surface facilities, and excavation of the shafts. Although the Site Preparation and Construction Phase will last 5-7 years, the peak emissions would only occur for a fraction of that time period. There would be some reduction in air quality effects after the peak Stage 1 activities.

Although these contaminant levels are predicted, the conservative nature of the estimates likely over-predicts the effect. Furthermore, OPG has committed to implementing BMPs[12] which are consistent with the actions that EC would recommend to mitigate air quality effects during site preparation and construction activities. Nevertheless, EC has recommended that a FUMP be established to verify the effect predictions. Additional actions could be implemented as an adaptive management measure if the FUMP identifies effects in excess of those predicted.

Criteria Air Contaminants – Operating Phase

During the Operations Phase, overall emissions of conventional air pollutants will drop to lower levels as construction activities cease. There are expected to be some increases in short-term levels (e.g. 1-hour and 24-hour levels) for some pollutants, relative to existing (i.e. pre-Project) conditions. Increases are noted for the following pollutants:

- 1-hour NO_2: 110.4 µg/m^3 existing versus 151.6 µg/m^3 predicted
- 24-hour NO_2: 26.5 µg/m^3 existing versus 67.8 µg/m^3 predicted

11 The Site Study Area corresponds to the property boundary of the of the overall Bruce Nuclear site, including the exclusion zone.

12 The OPG response to IR# EIS 04-137 (CEARIS#725) identifies a number of proposed mitigation measures.

However, no exceedances are predicted, and annual values remain at levels that are very similar to existing (i.e. pre-Project) conditions.

Criteria Air Contaminants – Decommissioning Phase

For the Decommissioning Phase, the activities that would result in air emissions will conceptually be similar to, or less than, those occurring during the Site Preparation and Construction Phase. Ambient air quality conditions at that time may differ from conditions existing today, and will therefore need to be re-assessed at that time. As such, this phase was not reviewed in any detail.

Abandonment and Long-term Performance Phase

After Decommissioning there will be no emissions of conventional substances.

Future Commitments and Follow-Up

Air quality monitoring should be undertaken to ensure effects from air emissions are consistent with the predictions made in the EIS. Continuous air monitoring should be undertaken during the Site Preparation and Construction Phase for NO_2, SPM, PM_{10}, $PM_{2.5}$ and acrolein. This monitoring should be undertaken at least to the end of Stage 1 of the Site Preparation and Construction Phase (i.e. when worst effects are predicted). The ongoing need for the monitoring should then be re-evaluated. Some factors to consider in this re-evaluation are whether or not exceedances are occurring and the effectiveness of mitigation measures. EC notes that OPG has committed to developing best management practices to mitigate air quality effects (see OPG response to IR# EIS-04-137; CEARIS# 725).

Recommendation #4.1:
EC recommends that a Follow-Up and Monitoring Program for air emissions be designed in consultation with EC and other relevant regulatory departments/agencies.

Recommendation #4.2:
EC recommends that OPG finalize and submit their best management practices for air emissions for review by EC and other regulatory agencies prior to commencing work for the Site Preparation and Construction Phase.

As a component of the BMPs, OPG should clearly outline the proposed mitigations, including action levels that may trigger certain mitigations, frequency of site inspections, record keeping regarding observed air quality and the mitigation actions implemented, etc. Air monitoring results should inform mitigation decisions.

4.2 Air Emissions - Radiological

Introduction

EC has reviewed the EIS related to radiological releases to air in context of our expertise regarding atmospheric dispersion modelling, atmospheric processes and availability and use of meteorological data. EC's review of the atmospheric dispersion modelling for radionuclides is used to inform the review of other federal agencies including Health Canada's review of radiological dose to humans, and CNSC's review of human dose, ecological risk assessment, evaluation of radiological environment monitoring programs, etc.

Atmospheric dispersion has a major influence on the distribution of any atmospheric radionuclide releases from the Project. Atmospheric dispersion will affect the geographic distribution of radionuclides, the environmental media that will be affected (e.g. air, water, soil, groundwater, sediment), and the concentrations and quantities of radionuclides being deposited, which in turn will ultimately affect radiological dose to humans and non-human biota.

Although EC does have expertise in atmospheric dispersion modelling conducted for radionuclides, it is important to note that because they are not specifically within our mandate, EC does not possess expertise to verify:

- baseline radiological emission estimates (i.e. from the existing Bruce Nuclear Generating Station and the WWMF); and,
- radiological emission estimates from the Repository.

Thus, EC does not have the expertise to verify the quantities of radionuclides that are inputs to an atmospheric dispersion model. That verification is undertaken by the CNSC.

Analysis and Conclusions

Various sources of radiological emissions to the atmosphere currently exist at the Bruce Nuclear site. The primary sources include:

- the Bruce Nuclear Generating Station (A and B);
- the Central Maintenance and Laundry Facility; and,
- the Western Waste Management Facility.

Emissions from the Bruce Nuclear Generating Station dominate the overall emissions. As a proportion of the total combined releases from the Bruce Nuclear site, the WWMF comprises:

- 3.44% of total tritium emissions;
- 0.11% of Iodine-131 emissions;
- 0.03% of radioactive particulate emissions; and,
- 0.16% of Carbon-14 emissions.

The releases from WWMF wastes and incinerator operations are therefore a small proportion of total existing releases.

Radiological Air Emissions - Site Preparation and Construction Phase

During this phase, the only radionuclide release that will potentially increase as a result of the Project is radon. Radon could potentially be released from natural sources within the host rock as the rock is excavated to develop the shafts and Repository. The radon will be released from the Repository as well as the waste rock pile which will be located on the DGR Site.

After factoring atmospheric dispersion, the largest predicted concentration in air for a human receptor offsite is in the order of 1.2E-3 Bq/m^3. This concentration (and the resultant radiological dose) is quite small in comparison to the natural background levels of radon that people are normally exposed to within their homes (i.e. average Canadian indoor concentration of 50 Bq/m^3).

Radiological Air Emissions - Operations Phase

As a result of the Project, radiological emissions to the atmosphere are predicted to increase during the Operations Phase, peaking in the year 2023 (i.e. five years after waste emplacement begins). These increases arise from gaseous releases of tritium and carbon-14 from the disposed wastes. The WWMF Incinerator emissions are predicted to remain the same, since OPG proposes that the incinerator will continue to operate consistently with operations occurring today.

To provide context, the DGR peak emissions for tritium will be 1.4E13 Bq/year, which is a 1% increase above the current overall Bruce Nuclear site releases. For carbon-14, the DGR peak emissions will be 1.9E12 Bq/year, which is a 78% increase above the overall Bruce Nuclear site releases.

In order to calculate the radiological dose implications from the increased emissions, OPG used two estimation methodologies:

- Derived Release Limit Pathways (DRLP); and,
- Bruce Radiological Environmental Monitoring Program (REMP).

Considering that the increases in tritium and carbon-14 are within the same order of magnitude as existing overall releases from the Bruce Nuclear site, EC considers the use of these methodologies to be appropriate. A separate, standalone atmospheric dispersion modellling exercise (for example, using AERMOD[13]) is not necessary.

The DRLP methodology factors atmospheric dispersion using Atmospheric Dispersion Factors. As for the Bruce REMP methodology, the dose calculations are based on actual (i.e. empirical) concentrations of radionuclides in various environmental media (e.g. air, water, soil, sediment, precipitation, milk, fish, fruits and vegetables, etc.) based on monitoring. Radiological doses to humans were scaled upwards, based on the 2009 REMP dose calculations, to reflect the DGR emissions. The DGR-related dose estimated by these two methodologies indicate that the incremental dose is quite low

[13] AERMOD is a widely used computerized atmospheric dispersion modelling system developed to support the United States Environmental Protection Agency's air quality regulations. It is the primary dispersion model approved by the Ontario government to demonstrate compliance with Ontario air quality standards and regulations.

relative to established benchmarks (1000 µSv/year) and relative to the existing dose arising from the overall Bruce Nuclear site. For example, the maximum human dose increase as a result of peak DGR emissions is estimated to be 0.21 – 0.56 µSv/year as compared to the Bruce Nuclear site dose of 4.4 µSv/year (based on 2009 REMP).

Dose implications for non-human biota are discussed in Section 6 Ecological Risk Assessment.

Radiological Air Emissions - Decommissioning Phase

Once all the wastes have been deposited below ground, and the Repository is sealed, there will be no further air emissions during this phase.

Radiological Air Emissions – Abandonment and Long-term Performance Phase

After the Decommissioning Phase, there will not be any routine emissions of radionuclides from the DGR Project. The only radionuclides being released to the atmosphere will be those predicted to occur in the Abandonment and Long-term Performance Phase as a result of migration outside the Repository. OPG's modelling predicts that gaseous radionuclides may eventually be released from the Repository, but the overall dose consequences to humans are low. As a result, atmospheric dispersion modelling is not warranted to support the analysis of radionuclide dispersion in the atmosphere during that phase.

Future Commitments and Follow-Up

EC concurs with the radiological parameters (tritium, particulate, and carbon-14) that OPG proposes to monitor in underground ventilation exhaust. In addition, radon should also be monitored to verify the low levels that have been predicted.

Recommendation #4.3:
EC recommends that radon be included in the ventilation exhaust monitoring to verify the low levels of radon that have been predicted.

4.3 Meteorological Monitoring Requirements

Introduction

On-site meteorological monitoring is important to enable ongoing safe operation and development of nuclear facilities at the Bruce Nuclear site. Site-specific meteorological monitoring is important for assessing atmospheric dispersion and the deposition of conventional and radiological contaminants that are emitted during normal operations or during accidents and malfunctions. On-site measurements are also important for understanding and modelling thermal plume[14] behaviour in Lake Huron, since winds

14 The thermal plume is associated with the cooling water discharge from the Bruce Nuclear Generating Station.

affect lake currents. Meteorological data contribute to the design of monitoring programs, and are also used for radiological dose calculations (reported under the Radiological Environmental Monitoring Programs), since a portion of the dose calculation (i.e. for those areas where actual radionuclide data measurements are unavailable) is modelled based on local air measurements.

Key weather elements vary on the scale of tens of kilometres to a degree that it is doubtful that distant measurement sites can be considered representative of local conditions. Parameters such as wind and temperature can also change significantly at interfaces like the shores of large lakes. Onsite monitoring provides the most representative data on the meteorological conditions experienced at the Project site.

Analysis and Conclusions

Two meteorological monitoring stations are operated at the Bruce Nuclear site, collecting wind and temperature data. One station, located near the Bruce Nuclear Generating Station, is a 50 m tower that monitors at both the 10 m and 50 m heights. A 10 m station is also operated near the Bruce Nuclear Visitor's Centre.

For the atmospheric dispersion modelling undertaken to assess conventional air quality effects, OPG decided to use the 10 m wind data collected at the 50 m tower. EC concurs with the use of this data since it is most representative of the site. The use of the 10 m data is also consistent with accepted standards of air dispersion modelling.

Some wind data (1.4% of the data) and temperature data (4.2% of the data) was missing, and was supplemented by using data collected at the Wiarton Airport. EC also concurs with this data substitution. The approach used by OPG was acceptable. However, some further discussion of the temperature data is required.

On-site hourly temperature observations for the period 2005-2009 were used for air quality dispersion modelling. However, the temperature readings were measured at the 10 m height on the 50 m tower which is not in accordance with recognized meteorological monitoring standards. Temperatures at 10 m are on-average observed to be slightly lower than those recorded near the surface, as acknowledged by OPG in their response to IR#EIS-01-10.

It must be noted that (from the perspective of monitoring accuracy) there is a surprisingly large difference between the onsite temperature data and that measured at the Wiarton Airport weather station (about 60 km north-northeast of the DGR Project site). The mean annual temperature for 2005-2009 at the onsite station (Atmospheric Environment TSD, table 5.3.2-1) was about 1.3^{o}C higher than observed at Wiarton Airport for the same period. Temperature analyses (examining both concurrent years and 30-year climate averages for Wiarton, Goderich and Sarnia) indicate that annual temperatures vary relatively slowly along eastern Lake Huron north to the Bruce Peninsula. The difference in annual average temperatures between the Bruce site and Wiarton is expected to be substantially less than 1.3 degrees. The higher on-site temperature readings might be caused by deficiencies in designing a solar radiation shield or screen to provide an enclosure surrounding the thermometers. The WMO Guide to Meteorological Instruments and Methods of Observation (WMO-No. 8, 2012) indicates that a solar radiation *"shield or screen should be designed to provide an enclosure with an internal temperature that is both uniform and the same as that of the outside air. It should*

completely surround the thermometers and exclude radiant heat, precipitation and other phenomena that might influence the measurement."

Recommendation #4.4:
EC recommends that OPG review the meteorological observation program at the Bruce Nuclear Station, to ensure adherence to appropriate siting and maintenance standards and guidelines, such as:

1) Environment Canada's *Guidelines for Co-operative Climatological Autostations*

***2) World Meteorological Organization Guide to Meteorological Instruments and Methods of Observation* (WMO-No. 8, 2012)**
http://library.wmo.int/opac/index.php?lvl=notice_display&id=12407

3) Campbell Scientific's *Weather Station Siting and Installation Tools* (1997)
http://www.campbellsci.com/documents/technical-papers/siting.pdf (basic siting and installation).

Recommendation #4.5:
EC recommends that the thermometers at the Bruce Nuclear site be situated inside a WMO standard screen, which should be mounted at a height consistent with the WMO and EC guidelines (1.25 m to 2 m).

CHAPTER 5 – TERRESTRIAL ENVIRONMENT

5.1 Introduction

During the Site Preparation and Construction Phase and the Operations Phase of the DGR Project there will be potential impacts on migratory birds, biodiversity, wetlands and any species at risk that may be present within the project area due to the following:

- Loss of woodland and wetland habitat within the footprint of the DGR facilities;
- Mortality of birds and other wildlife during land clearing activities;
- Disturbance of breeding birds due to noise during site preparation/construction and operation activities; and,
- Exposure of wildlife to contaminants that may be emitted from the facility, including radionuclides.

EC has considered these impacts in the context of our legislated mandates under the *Migratory Birds Convention Act, 1994* (MBCA) and the *Species at Risk Act* (SARA). The conclusions and recommendations that follow are guided by the following:

- Compliance with the MBCA and its regulations, including no disturbance or destruction of migratory birds or their nests;
- Compliance with SARA, including the prohibition against the killing or harming of all listed species or the damage or destruction of residences of the individuals of a species or destruction of the species' critical habitat;
- Mitigation and monitoring for adverse effects on species at risk that are consistent with recovery strategies and action plans;

- Maintenance of regional stability of migratory bird populations and species biodiversity.

EC's comments related to exposure to contaminants by wildlife are not included in this chapter, but are found in Chapter 6 on Ecological Risk Assessment.

5.2 Migratory Birds

<u>Analysis and Conclusions – Habitat Loss</u>

The terrestrial portion of the Site Study Area (SSA) measures approximately 2.5 km x 4 km. This is the area that will be most directly affected by the DGR. The largest remaining forests within the SSA exist to the south, approximately 1 to 2 km from the DGR Site. These are the least fragmented forests in the SSA and are contiguous with the forests in Inverhuron Provincial Park. Forests to the east of the SSA, approximately

300 m to 2 km from the DGR, are much more fragmented and are not as contiguous with adjacent forested areas.

According to the Terrestrial Environment Technical Support Document (TETSD), approximately 63 percent of the SSA is in active industrial use or in barrens that have been created by past clearing and/or grading and infilling. Approximately 25 percent of the SSA consists of forest which has been intersected by, or lies adjacent to or near buildings and related infrastructure. The woodland consists of 12 separate units, indicative of a high degree of forest fragmentation. At the DGR Site, a total of 8.9 ha of mixed forest, comprised mostly of Eastern White Cedar (which is common and abundant within and surrounding the SSA), is spread amongst three forest fragments that will be lost as a result of the Project.

These three small remnant forest patches on the southern half of the DGR Site do not represent pristine habitat and are too small and isolated to support viable populations of area sensitive breeding bird species. Area sensitive breeding bird species have a preference for larger woodlots over smaller woodlots, and in southern Ontario are typically absent or found in low numbers in forests that are less than 30 ha in size. The three forests on the DGR Site, which amount to 11% of the mixed forest within the SSA, and only 2.9% of all forests within the SSA, are not connected to the larger forests in the area such as the forests of nearby Inverhuron Provincial Park.

The TETSD offers the following assessment of the forests and other non-developed areas within the SSA: *"Generally, the vegetation communities found in the Site Study Area are not outstanding examples of their type in this part of southern Ontario"* (Sec. 5.4.1, p. 59, para. 3). EC believes this assessment is reasonable. It is further stated with respect to the SSA forests: *"These areas are capable of supporting wildlife species which are not dependent on forest interior …"* (TETSD, Sec. 5.5.1, p. 66, para. 4).

Based on the above information, EC concludes that migratory bird species of conservation concern are unlikely to be found in significant numbers on the DGR Site in those habitats closest to the core of the existing infrastructure, since the woodlands have already been impacted by the existing industrial development. EC believes that the remaining small fragmented blocks of natural habitat, which are surrounded by existing infrastructure (including buildings, and roads), cannot support the breeding requirements of notable populations of breeding bird species of high conservation concern (e.g., Species at Risk, Bird Conservation Region Priority Species).

Many of the migratory bird species that utilize fragmented forests are tolerant of disturbed habitats and often occur in high abundance because there is an ample supply of these habitats in southern Ontario. The 8.9 ha loss of this habitat type at the DGR site does not pose any serious concerns. Area sensitive breeding bird species do occupy fragmented habitats but invariably in much lower abundance and diversity than in similar, large habitats (see analysis below re breeding bird point count baseline data). EC therefore believes that the loss of a small quantity of low quality forest habitat will not have a significant adverse environmental effect on provincial or even regional breeding bird populations. This is primarily a local migratory bird issue where a small number of

forests will be directly and indirectly affected, subsequently affecting primarily local populations of breeding birds, the large majority of which have robust populations.

EC notes that OPG provided a conceptual revegetation plan for the waste rock pile that will be contained within the Waste Rock Management Area (WRMA). Revegetation of the rock pile provides an opportunity to create habitat for some bird species. EC accepts that the revegetation plan is conceptual at the moment with the understanding that a more detailed revegetation plan should be submitted at a later time, based on actual site requirements and conditions, including whether or not there is a need to minimize water infiltration into the rock pile to reduce leachate generation. EC can help identify the most beneficial habitat type that can be supported in light of site conditions.

Recommendation #5.1:
EC recommends that it be consulted by OPG during the development of the detailed revegetation plan.

Analysis and Conclusions – Noise and Disturbance

A number of buildings/structures that currently exist outside of the proposed DGR footprint are much closer to the southern and eastern forest blocks than buildings associated with the DGR. One would expect that, given the age of the Bruce Nuclear Site, the birds that currently breed in these forests are already adjusting to a certain level of disturbance regularly emanating from the existing infrastructure. It is stated that, *"It was postulated in this report that noise and disturbance from construction activities at the WWMF adjacent to some of the survey locations may have resulted in a decreased number and diversity of species recorded than would normally make use of habitat in that area*" (TETSD, Sec. 5.7.1.1, p. 75, para. 3).

EC conducted an analysis of the 2007 and 2009 breeding bird point count baseline data, which involved comparing the abundance of Bird Conservation Region (BCR) 13 priority species at various distances from the Western Waste Management Facility (WWMF). Keeping in mind that more birds occur in an area than are found during point count surveys (i.e., point counts sample a finite area and do not necessarily cover the entire site), EC concluded that the number of individuals of BCR priority species that have been potentially affected by the existing WWMF, and that will be potentially affected by DGR site preparation, construction and operation are small and do not constitute a significant portion of provincial populations.

Noise levels at the DGR Site are unlikely to have an adverse effect on breeding bird populations, except at a very local scale, given the fragmented condition of the forests within the SSA. As indicated above, many of the breeding bird species that currently utilize these fragmented habitats are already adapted to disturbance, including the activities and noise associated with the existing facility (e.g., the WWMF). Noise effects from the DGR site preparation and construction (i.e., associated with heavy machinery and blasting) are temporary effects (i.e., intermittent and staged over approximately six

years), which are reversible. Noise from ongoing DGR operations (e.g., ventilation fans for the two shafts and the air compressor plant), will be constant, and more similar to the existing facility.

In summary, the Project may result in adverse noise impacts on migratory birds, but the SSA is already heavily impacted by industrial disturbance (e.g., habitat fragmentation, noise, lighting, traffic, buildings). The habitats closest to the DGR will experience a notable increase in noise impacts, but this will not affect significant numbers of breeding birds that have been identified as high priority species within BCR 13. Local bird populations already seem acclimated to a high degree of anthropogenic disturbance.

Incidental Take

Project works or activities, such as, construction access, site grubbing, vegetation clearing and construction activities, are potentially destructive or disruptive activities to birds, their nests or eggs and should be avoided at key locations or during key periods, including the breeding periods and periods of high usage such as migration and/or feeding. These locations and periods vary by region and by species. While avoidance is the best approach, in order to minimize the risk of detrimental effects to migratory birds appropriate preventive and mitigative measures should be developed and implemented to minimize the risk of incidental take and to help maintain sustainable populations of migratory birds. Additional information about incidental take can be found at: (http://www.ec.gc.ca/paom-itmb/default.asp?lang=En&n=1B16EAFB-1).

Recommendation #5.2:
EC recommends that the proponent avoid engaging in potentially destructive or disruptive activities to migratory birds. In order to achieve that, the proponent is advised to develop and implement a management plan that effectively avoids or minimizes the risk of detrimental effects to migratory birds, their nests and eggs.

5.3 Wetlands

Introduction

As a supplement to EC's review of the EIS and all other supporting documents and information provided by OPG (e.g., OPG responses to Information Requests), EC staff conducted a site visit of the DGR Site and adjacent Site Study Area on April 16, 2013, which focused on "Wetland 3" and Wetland 4. The analysis and conclusions presented below incorporates the observations of EC's Canadian Wildlife Service staff during the site visit to these two areas, which were identified during a spring 2012 survey as having the potential to provide foraging and/or over-wintering habitat for turtle species at risk. The full report on the 2013 site visit is attached as Appendix 2. Please refer to Appendix 2 in order to view the figures that are noted in the discussion below.

It should be noted that the main body of Wetland 4, located adjacent to the DGR Site, was included in the EIS because it met the definition of a marsh based on the Ecological Land Classification (ELC) system (e.g., soil type, vegetation community composition); "Wetland 1", "Wetland 2", "Wetland 3" [18] and the western 'finger' of Wetland 4 did not meet the definition of a wetland.

Analysis and Conclusions – "Wetland 3"

There is a very small "wetland", referred to as "Wetland 3", located approximately in the center of the DGR Site, which has marginal habitat for a turtle species listed under the federal SARA, the Snapping Turtle (Special Concern).

"Wetland 3" and other "wetland" areas identified in Figure 1 (see Appendix 2) were delineated by a recognized independent turtle researcher. This was undertaken for the purpose of conducting a spring 2012 targeted survey of wet areas within the DGR Site, which have the potential to provide habitat for turtle species at risk. As was the case with "Wetland 1" and the western 'finger' of Wetland 4, which are also located within the DGR Site, "Wetland 3" was not originally[15] included in the EIS as it did not meet the definition of wetlands based on the Ecological Land Classification (ELC) system (e.g., soil type, vegetation community composition). It should be noted, however, that a single Snapping Turtle was found in "Wetland 3" during the targeted survey for turtle species at risk conducted under favourable weather conditions in spring 2012.

Two EC staff conducted a site visit at "Wetland 3" in April 2013 with the same independent turtle researcher who conducted the spring 2012 survey, and who has experience conducting turtle surveys since 2007 in Bruce County, including the Baie du Dore area immediately northeast of the SSA. The "wetland" was thoroughly searched for turtles during this visit by several qualified biologists, including the Ontario Herptofaunal Atlas coordinator, under ideal survey conditions (i.e., relatively warm sunny weather immediately following ice-off), and no turtles were found in 2013. Nonetheless, EC recommends that mitigation be in place to prevent turtles from entering "Wetland 3" prior to and during site preparation and construction, and that efforts be made to trap and relocate Snapping Turtles, if they are found, to Wetland 4 (see comments below in Chapter 5.4 Species at Risk). The infilling of "Wetland 3" should be delayed until the latter years of the site preparation and construction phase, if possible, as it could potentially serve as a refuge for turtles while site preparation/construction is occurring on other areas of the DGR site; it also allows more opportunity for trapping and re-locating of turtles at "Wetland 3".

[15] Information about these non-ELC "wetlands" was provided by OPG in it's response to IR#EIS-05-168.

Recommendation #5.3:
EC recommends that the infilling of "Wetland 3" should be delayed until the latter years of the site preparation and construction phase, if possible.

As a result of the DGR Project, "Wetland 3" will be buried under the waste rock pile within the WRMA. Although OPG indicated that *"appropriate environmental management plans will ensure that potential effects on sensitive turtles that might be utilizing the habitat at that time are controlled through generally accepted mitigation measures"* (EIS-05-168, p. 10, para. 4), OPG does not define these *"generally accepted mitigation measures"*, nor have they provided appropriate environmental management plans with respect to turtles. EC has addressed this gap by outlining appropriate mitigation measures in Chapter 5.4 Species at Risk.

Analysis and Conclusions – Marsh (Wetland 4)

EC understands that a new Wetland 4 outlet channel/ditch will be created (see Appendix 2) adjacent to the western boundary of the western 'finger' of Wetland 4 (Figure 3 in Appendix 2). This channel will be located immediately parallel to the proposed SWMP to convey the intermittent drainage from Wetland 4 along the eastern edge of the pond to the northwest. The water level in the main body of Wetland 4 will remain unchanged unless the narrow 'sill' (see Appendix 2) significantly erodes over time.

EC recommends that the water level in the western 'finger' of Wetland 4 remain unchanged during and after the re-routing of the existing drainage ditch. EC believes this should be possible since the 'finger' does not intersect the footprint of the SWMP system. If the construction involved with re-routing the ditch will impact the water level in the western 'finger' temporarily, it should be conducted during the active season for turtles (mid-April to beginning of September) to mitigate any potential impacts to turtles attempting to use the western 'finger' to hibernate during the winter period.

Recommendation #5.4:
EC recommends that the proponent implement appropriate mitigation measures to maintain water levels in the western 'finger" of the marsh (Wetland 4) during and after the re-routing of the drainage ditch to ensure that habitat for Snapping Turtle is not affected.

Analysis and Conclusions – Other Wetlands

With regard to all other "wetlands" and "forested wetlands" identified in Figure 1 (see Appendix 2), no at-risk turtles were found during the targeted survey conducted by the independent turtle researcher in April 2012. "Wetland 1" is very small, and while it could provide potential foraging opportunities for Snapping Turtle, exclusion fencing (as outlined below) should be effective in preventing turtles from entering this "wetland" during the active season. Suitable Snapping Turtle habitat was not found in either of the

forested wetlands on the DGR Site (i.e., “Forested Wetland 1” and “Forested Wetland 2”) based on the surveys conducted in April 2012. In addition, “Wetland 2”, located immediately outside of the southwestern boundary of the DGR Site is extremely small in size, and was similarly deemed to not have suitable habitat for Snapping Turtle.

5.4 Species at Risk

Analysis and Conclusions

Potential adverse effects of the DGR on SARA listed wildlife species have been identified for the Snapping Turtle, Eastern Ribbonsnake and the Eastern Milksnake (all Special Concern). If the Project is carried out, the Federal Authority that conducts the environmental assessment must ensure that under SARA ss. 79(2) measures are taken to avoid or lessen and to monitor those effects on SARA listed wildlife species which include species of Special Concern. The following represents the best available information in EC’s possession concerning mitigation measures regarding those species.

Snapping Turtle

As previously noted, one adult Snapping Turtle was observed foraging in “Wetland 3” and another individual was observed foraging in Wetland 4 during the April 2012 survey. In addition, one adult Snapping Turtle was found in Wetland 4 during the April 2013 site visit. During the year prior to site preparation and construction, and during site preparation and construction (up to the time that “Wetland 3” is infilled), trapping of Snapping Turtles should occur at “Wetland 3” as outlined in the paragraph below.

“Wetland 3” is small (i.e., 40 m X 45 m) and it should be possible to trap virtually all of the Snapping Turtles (if any) and relocate the individuals. EC recommends setting a large, commercially available ‘Hoop’ or ‘Rectangular Box Trap’ in the deeper (i.e., northern) area of “Wetland 3” when the water levels are high and the turtles are most active (typically the end of May to early June, but as late as the end of June during cooler summers). Cans of sardines in spring water is an effective bait when holes are poked in the cans, but care must be taken to prevent the turtles from drowning once they enter the traps. More specifically, the traps must be set so at least part of the trap will be above water level, keeping in mind how much the water level is expected to rise due to severe spring storms. Traps should be checked daily.

Since “Wetland 3” contains some small patches of suitable spring/summer habitat for turtles, and there appears to be suitable habitat adjacent to the east side of the DGR Site, in the stream corridor, exclusion (silt) fencing for reptiles (including both turtles and snakes) should be erected as a mitigation measure on the south and east sides of the DGR Site in early spring, the year prior to site preparation and construction. More specifically, this fencing would need to extend along the southern edge of the DGR site (north of the adjacent abandoned rail bed, from the southeast corner of the DGR Site to

a point 50 m east of the Waste Package Haul Road Rail Bed Crossing; EIS, Sec. 4.4.1, p. 45, Fig. 4.4.1-2) and the full length of the eastern edge of the DGR site (as far north as Interconnecting Road). This would prevent entry of turtles (and snakes) into the DGR site from the stream corridor area to the east of the site, during the active season (i.e., early April to the end of October).

Silt fence installation should begin as soon as the ground becomes workable in the spring, and must be fully installed before early April of the year prior to site preparation and construction and remain in place until construction is completed. Snapping Turtle is the largest and most difficult species to exclude with fencing, and therefore the fencing for the DGR Site should be designed with that species in mind. EC recommends that the fence height be 1 m from the ground surface, and that the base of the fence be buried in the soil along its entire length to a minimum depth of 10 to 20 cm before backfilling with soil, to ensure effectiveness. Heavy-duty geotextile silt fencing, typically constructed of a thick felt-like fabric (also called 'double row' or 'trenched' fencing) should be used. This fencing uses a woven wire fence (e.g., chain link), page wire fence, or some other structure for support. The wire supporting fence/structure should be installed on the construction area side of the fabric so that animals outside the construction area are prevented from using it for leverage to climb into the exclusion area while allowing any animals found inside the construction area a greater chance of escape. Geotextile fencing with nylon mesh lining should be avoided due to the risk of entanglement by snakes. Fences 1 m in height are also appropriate to exclude snakes that may occur in the area. Stakes need to be on the construction side of the fence so that snakes do not use them to climb over. Even and tight placing of the stakes, securely driven into the ground to a depth of 30 cm, will usually keep the supporting fence/structure and silt fencing upright. The main issues with this type of fencing in terms of its effectiveness for excluding turtles and snakes during active season is that it can be pushed over by surface water flow, or be damaged by mammals. The fence can also be damaged by snow and ice during the winter. The fence should be inspected for damage caused by snow, ice or mammals in the spring of any given year following installation, in late March or whenever most of the snow is gone. To ensure the exclusion fence remains effective, its integrity should be inspected every other day from the date of installation (first year) or initial inspection (usually late March in subsequent years) until mid-April, and daily when most turtle species are most active, from late April until the end of July. The frequency of fence inspections can be reduced to every other day from early August to the end of October (as opposed to twice a week and after significant rain events as outlined in the protocol OPG provided). Sections of the fencing should be replaced (in whole or in part) when/if necessary to maintain its integrity. EC recommends that the proponent refer to a document recently-published by the Ontario Ministry of Natural Resources (OMNR), Species at Risk Branch, entitled *"Reptile and Amphibian Exclusion Fencing"* for further details on exclusion fencing specifications (available at: http://www.mnr.gov.on.ca/en/Business/Species/2ColumnSubPage/MNR_SAR_TLBX_EN.html).

If turtles or snakes are found against the inside edge (i.e., construction side) of the exclusion fence during regular inspections (as above) they should be relocated to safe areas of suitable habitat outside of the fence (e.g., Wetland 4 for turtles). In addition to trapping Snapping Turtles from "Wetland 3", and moving turtles from the inside edge of the exclusion fence during inspections, female Snapping Turtles should be captured during a two week period beginning from late May to early June, with the input and advice of the OMNR, if they attempt to nest inside of the exclusion fence to the south (near the abandoned rail bed), along the shoulders of adjacent roadways, or in piles of fine aggregate (if any). It would not be difficult to capture the Snapping Turtles by trapping them from "Wetland 3", collecting them along the inside of the exclusion fence, and collecting them at nest sites nearby "Wetland 3" within the DGR Site. Snapping Turtles and other turtle species (e.g., Painted Turtle) found incidentally at the time of trapping/collection could be relocated outside of the DGR Site to marshy areas of Wetland 4, immediately to the northeast, where single individuals were found during targeted surveys in April 2012 and 2013 (as above).

Even though the Snapping Turtle is a species of Special Concern and the general prohibitions and permitting requirements under SARA do not apply to this species, requirements under ss. 79(2) of SARA still apply (as above). Snapping Turtle is also provincially listed as Special Concern (Species at Risk in Ontario List, Ontario Regulation 230/08). Given that the species is at risk both federally and provincially, EC is recommending that turtles captured in "Wetland 3", at nearby nesting locations, and against the inside edge of the exclusion fence be relocated to Wetland 4.

Recommendation #5.5:

EC recommends that, as a precaution, during the year prior to and during the years of site preparation and construction, and prior to finally infilling "Wetland 3" in early to mid-May, a qualified biologist (experienced in turtle surveys) conduct a minimum of three turtle surveys of "Wetland 3" on sunny days, beginning as soon as the ice cover has melted off (typically from the middle to the end of April). The first two surveys should occur shortly after ice-off and the third should occur no later than mid-June. Snapping Turtles and non-SAR turtles (e.g., Painted Turtle) located in "Wetland 3" are to be relocated to Wetland 4.

Recommendation #5.6:
EC recommends that efforts be made to trap and relocate Snapping Turtles to Wetland 4 if they are found in "Wetland 3" prior to its infilling.

EC further recommends that a detailed relocation/handling plan be prepared by the proponent and be reviewed by EC and OMNR to ensure that the proponent is dealing with Snapping Turtles in an acceptable manner. The following are some items that should be included in such a plan:

1) The setting of the traps and the relocation of the Snapping Turtles must be conducted by qualified biologists.

2) The turtle traps are to be set using appropriate protocols (including details described above) regarding timing and leaving a portion of the trap well above water level (taking into consideration flooding due to storm events) to allow breathing room for the species.

3) The locations where the Snapping Turtles will be released must be clearly identified.

4) The timing of turtle capture/relocation activities must be specified.

See Recommendation #5.8 which also applies to turtles.

Eastern Ribbonsnake and Eastern Milksnake

There are two records of Eastern Ribbonsnake, a species listed as Special Concern under SARA, occurring within the SSA in 1999 and more recently the species has been incidentally observed by Golder Associates and OMNR staff. The DGR Site is also within the known extant range of Eastern Milksnake, a species listed as Special Concern under SARA. Its presence in both Inverhuron Provincial Park (immediately to the south) and MacGregor Point Provincial Park (to the north) is confirmed, and a single individual was found within the SSA during a bio-inventory study in 2001. Therefore, it is possible that both of these species could move into the DGR Site even though they have not been specifically observed at the DGR Site.

EC recommends that there be some general mitigation measures in place for both Eastern Ribbonsnake and Eastern Milksnake from the outset of the Project, given that:

- there is the potential for the species to occur on the DGR Site;
- Eastern Milksnake, in particular, can be difficult to detect when present in an area; and,
- species-specific snake surveys were not conducted within the context of this Project.

The measures within the Environmental Management Plan under Section 14.5 “Faunal Management” are quite basic and would not provide adequate mitigation on their own for Eastern Milksnake and Eastern Ribbonsnake. While mitigation is not mentioned within the OPG response to IR EIS-10-498 relating to the possible presence of Eastern Milksnake, the response to IR EIS-10-490 relating to best management practices /mitigation measures for potential impacts on snakes does indicate that basic mitigation for Eastern Milksnake and Eastern Ribbonsnake will occur through “generally accepted measures for snake mitigation (all Ontario species)”. Typical mitigation for snakes involves the erection of exclusion fencing for reptiles; the exclusion fencing, should be designed to keep out both turtles and snakes (as noted in the Snapping Turtle section above), to help prevent Eastern Ribbonsnake and Eastern Milksnake from entering the DGR Site from neighbouring areas.

Recommendation #5.7:
EC recommends that the proponent seek input and advice from OMNR to ensure site preparation and construction activities do not disrupt hibernation and gestation sites of Eastern Ribbonsnake and Eastern Milksnake and, in particular, if an individual of these species, snake eggs (Eastern Milksnake) or hibernacula are found.

Recommendation #5.8:
EC recommends that mitigation (i.e., appropriately designed, located and installed exclusion fencing) be in place to prevent turtles and snakes from entering the DGR site prior to and during site preparation and construction. More specifically, EC recommends that exclusion fencing be in place along the southern edge of the DGR site (north of the adjacent abandoned rail bed, from the southeast corner of the DGR Site to a point 50 m east of the Waste Package Haul Road Rail Bed Crossing) and the full length of the eastern edge of the DGR site (as far north as Interconnecting Road) to prevent turtles from entering the DGR Site, and in particular, “Wetland 3”, prior to and during site preparation and construction.

CHAPTER 6 – ECOLOGICAL RISK ASSESSMENT

Introduction

EC has a mandate to protect migratory birds and species at risk, pursuant to the *Migratory Birds Convention Act, 1994* and the *Species at Risk Act*, respectively. On that basis, EC conducted a review of OPG's assessment of ecological risk for conventional substances and for radiological substances in relation to impacts on biota.

EC conducted a review to ensure that the general methodologies were appropriate, and to ensure that the valued ecosystem components (VECs) were appropriately assessed since these species acted as surrogates for all species found onsite, including the federally mandated species.

With regard to radiological ecological risk assessments (ERAs), it is important to note that EC does not possess expertise in some related areas since they are not strictly within our mandate. EC does not have the expertise to verify the validation of radiological dose calculations to biota to ensure that the calculations are done in accordance with internationally accepted standards and practices. The CNSC has the mandate and expertise to review the radiological ERA in more specific detail and EC defers to the CNSC's Departmental Submission for additional context on the radiological ERA.

The migration of contaminants out of the Repository during the Abandonment and Long-term Performance Phase is outside the scope of EC's mandate and expertise, and is being addressed by the CNSC and NRCan. However, we have taken into consideration the conclusions of the review of those agencies in terms of the potential for contaminants to migrate to the surface environment and those considerations are reflected in our analysis and conclusions.

Analysis and Conclusions

After evaluating the information contained in the EIS submission and OPG's responses to various IRs (some of which were posed by EC), EC has no outstanding concerns. EC's detailed evaluation is outlined below in four sections:

- Non-Radiological ERA: Site Preparation and Construction Phase, Operations Phase, Decommissioning Phase;
- Radiological ERA: Site Preparation and Construction Phase, Operations Phase, Decommissioning Phase;
- Non-Radiological ERA: Abandonment and Long-term Performance Phase; and,
- Radiological ERA: Abandonment and Long-term Performance Phase.

Non-Radiological ERA: Site Preparation and Construction Phase, Operations Phase, Decommissioning Phase

After evaluating potential effects of the DGR Project on the environment, OPG concluded that a non-radiological ERA was not warranted because the Project would not

contribute significantly to non-radiological contamination. EC concurs with that conclusion.

Air emissions, which are associated primarily with the operation of heavy machinery, will occur during the Site Preparation and Construction Phase. However, those emissions are temporary, and most of the substances emitted are low enough that they would meet human health criteria.

EC's view is that the only meaningful Project contribution of non-radiological contaminants that can potentially affect biota is from the effluent discharged from the SWMP, which ultimately will enter MacPherson Bay via the Un-named Ditch. As discussed in Chapter 3.2, effluent from the SWMP will likely require treatment during the Site Preparation and Construction Phase, and the Operations Phase in order to meet the requirements of the *Fisheries Act*. Assuming that the relevant effluent criteria are met in the final effluent discharge, residual ecological risk is not expected to be an issue. However, this should be re-evaluated based on the results of the FUMP for effluent.

Recommendation #6.1:
EC recommends that the need for a non-radiological ERA be re-evaluated based on effluent and downstream sediment monitoring data (see Section 3.2 for EC recommendations regarding the FUMP for effluent).

Radiological ERA: Site Preparation and Construction Phase, Operations Phase, Decommissioning Phase

As noted in Section 4.2, radiological releases will increase during the Operations Phase and peak in 2023. Therefore, there will be incremental radiological risk to non-human biota that peaks during the Operations Phase. The Operations Phase can be considered the worst case scenario and it is not necessary to conduct a separate assessment of the Site Preparation and Construction Phase, or the Decommissioning Phase.

OPG predicts that the DGR will increase emissions of tritium by 1% and carbon-14 by 76% relative to existing emissions from the overall Bruce Nuclear site. Instead of conducting a full-scale ERA for the DGR Project, the incremental risk to biota[16] was calculated only in regard to the increased emissions of tritium and carbon-14. OPG used environmental concentration data collected under the Radiological Environmental Monitoring Program (REMP). REMP data reflects the effects of emissions from the overall Bruce Nuclear site. Maximum concentrations were selected from the REMP data, then multiplied by two to factor the increased emissions from the DGR Project. Overall, this is a conservative approach that overestimates the dose that would arise from DGR emissions. The incremental dose to the most-affected receptor, the White-tailed Deer, only increases by 0.1% of the dose criteria of 1 mGy/d due to C-14, and by 0.3% of the dose criteria due to tritium. In light of the conservative approach, and the minimal dose effect, EC concurs with OPG's approach.

16 The species selected for the incremental dose assessment are adequate for consideration of impacts on the overall ecosystem that would support any species at risk that may be present.

This is further supported when considering the results of previous radiological ERAs. The ERA for the WWMF Refurbishment Waste Storage Project (June 2005), which was based on overall emissions from the Bruce Nuclear site and actual environmental data collected under the REMP, did not demonstrate significant radiological risk to biota in the WWMF site study area. The highest dose predicted in that ERA was for the White-tailed Deer, but the dose was below accepted standards. Subsequent sampling of deer demonstrated that the ERA was conservative, since actual samples of deer tissue were lower than predicted by the ERA.

Based on OPG's methodology, there is a small incremental dose predicted for non-human biota due to the increased emissions of tritium and C-14. These incremental doses are typically three orders magnitude lower than the strictest Estimated No Effect Values (i.e. dose is a small fraction, measured in thousandths). For example, the incremental dose to the earthworm, which receives the second highest predicted dose as a result of DGR emissions, is expected to increase to 1.1e-03 mGy/d during the Operations Phase as compared to the 5.7e-04 mGy/d dose under existing conditions. These doses are a small fraction of the 1mGy/d criteria.

Therefore, no significant increase in radiological risk to biota is expected to arise from the DGR Project during the Site Preparation and Construction Phase, Operations Phase, and Decommissioning Phase.

Non-Radiological ERA: Abandonment and Long-term Performance Phase

On the basis of OPG's predictive modelling of non-radiological contaminants during the Abandonment and Long-term Performance Phase, the concentrations of non-radiological contaminants migrating to the surface will be much lower than established environmental quality criteria. The highest predicted concentration estimated is 1E-6 (i.e. one-millionth) of the criteria for Niobium and Chromium in well water while the majority of the other parameters are predicted to be less than 1E-10 of the environmental criteria. Since the predicted concentrations of non-radiological contaminants in environmental media are orders of magnitude below environmental quality criteria, a non-radiological ERA was not conducted by OPG. EC concurs that an ERA is not warranted under those circumstances.

Radiological ERA: Abandonment and Long-term Performance Phase

On the basis of OPG's predictive modelling of radiological releases during the Abandonment and Long-term Performance Phase, the ecological risk to biota is quite small, being orders of magnitude below any risk criterion. Even in the disruptive scenarios that were modelled, radionuclides were not predicted to approach the Estimated No Effect Value dose for the representative indicator species, based upon the individual No-Effect Concentrations. Risk levels are predicted to be far below international standards. For example, under the natural evolution simplified base case scenario, the total predicted releases of radionuclides to the biosphere is 3E-13 Bq/kg to sediment and 4E-12 Bq/kg to soil.

Since the predicted concentrations of radiological contaminants in environmental media are orders of magnitude below environmental quality criteria, a radiological ERA was not conducted by OPG. EC concurs that an ERA is not warranted under those circumstances.

A very minor increase in risk to biota is predicted for the scenario involving a severe shaft seal failure (characterized as a very unlikely scenario).In this scenario, carbon-14 will potentially exceed surface water criteria, locally, by a factor of 1.4.

Even in the worst case scenario assessed for exposure to biota (drill core debris left on the surface and mixed with soil resulting in exceedances of soil criteria by a factor of 20), the site specific biota would receive approximately 3% of the relevant dose criterion.

Future Commitments and Follow-Up

Radiological contaminants (i.e. tritium and gross beta[17]) in precipitation should be included in the initial scope of the FUMP. The deposition of radiological contaminants via precipitation is a significant pathway of radiological contamination to terrestrial and aquatic environments. Monitoring at strategic locations within the Site Study will verify the minimal effects predicted to occur during the Site Preparation and Construction Phase, Operations Phase, and Decommissioning Phase. Data collected prior to the Site Preparation and Construction Phase can establish a baseline. Baseline data collection is recommended considering that tritium in precipitation was last monitored within the SSA in 2002. The need for an updated baseline is further supported by trends in the Local Study Area. The tritium concentration in precipitation in the LSA has gradually increased two-fold from 2001 to 2009 (such as at monitoring locations B2 and B4, which are located in the LSA closest to the SSA). This suggests that tritium levels in precipitation may also be increasing within the SSA. EC supports the ongoing monitoring of tritium in precipitation and gross beta in the LSA and Regional Study Area via the REMP program.

Recommendation #6.2:
EC recommends that Radiological contaminants (i.e. tritium and gross beta) in precipitation be included in the initial scope of the FUMP.

17 Gross beta is a parameter that measures radioactive particulates.

CHAPTER 7 – SUMMARY OF RECOMMENDATIONS

This section summarizes the specific recommendations made by EC related to our evaluation of the assessment of effects from the Project based on the information provided by OPG related to areas of interest to EC, as discussed in the preceding chapters of this submission.

Chapter 3 – Water Issues

Recommendation #3.1:
EC recommends that conclusions about the acid generating potential of the rock be verified as part of a waste rock characterization program[18] which was originally outlined in IR# EIS-04-160 (CEARIS# 759).

Recommendation #3.2:
EC recommends that treatment will be required for effluents from the DGR facility in order to meet Section 36(3) of the *Fisheries Act,* and that OPG revise the SWMP system design accordingly. A precautionary approach should guide the design of the effluent treatment system and the overall SWMP.

Recommendation #3.3:
EC recommends that the hydrological modelling be updated at a future point when additional information about leachate geochemistry is available, the various source flow rates can be verified, and an updated design of the SWMP is provided[19], and that EC be consulted by OPG for advice on precipitation inputs to this modelling.

Recommendation #3.4:
EC recommends that a detailed spill response plan for the DGR be developed. The spill response plan should also include an assessment of containment methods, locations and strategies to demonstrate that spill mitigation could be deployed in time to prevent downstream effects.

Recommendation #3.5:
EC recommends that OPG assess future climate change effects and modify the SWMP pond size accordingly, and that this be incorporated into an adaptive management plan as a component of the Follow-Up Monitoring Program.

18 Note that the waste rock characterization program is further discussed below in the section titled "FUMP - Water Quality Predictions".

19 See "*Fisheries Act* Considerations" below.

Recommendation #3.6:
EC recommends that the final point of control for effluent be where it discharges from the SWMP since dilution from other intersecting ditch networks (i.e. the ditches along Interconnecting Road) would occur further downstream of that point.

Recommendation #3.7:
EC recommends that a broad spectrum of parameters (e.g. other metals, phosphate, total petroleum hydrocarbons**) be monitored quarterly during the Site Preparation and Construction Phase, and later during the Operations Phase, to ensure that there are no other unanticipated parameters of concern.**

Recommendation #3.8:
EC recommends that any waste rock not be used or disposed outside of the boundaries of the SWMP collection system.

Recommendation #3.9:
EC recommends that full-strength leachate be monitored.

Recommendation #3.10:
EC recommends that a waste rock characterization program be required during shaft and Repository development. Where warranted by the results of the waste rock characterization program and associated shake flask tests, kinetic leach tests may also be required in order to reduce uncertainties regarding waste rock leachate.

Recommendation #3.11:
EC recommends that a Follow-Up and Monitoring Program be developed for effluent discharge quality and downstream effects, in consultation with EC.

Recommendation #3.12:
EC recommends that OPG provide verification of the overburden stratigraphy at the time when the SWMP system is constructed. If problematic stratigraphy is encountered, OPG must assess its potential effect on water levels in the marsh and evaluate and implement mitigation options.

Recommendation #3.13:
EC recommends that OPG conduct a revised flood hazard assessment based on the final detailed engineering design of the overall DGR Site and infrastructure, including the SWMP system. Considering the DGR Project will operate for at least 40 years, the revised flood hazard assessment should incorporate the potential effect of climate change upon the size of the PMP event. A rigorous sensitivity analysis should also be performed. The shaft collar heights should be increased to an appropriate elevation based on this revised flood hazard assessment.

Recommendation #3.14:
In addition to Recommendation #3.12, EC recommends that the following elements be included in a FUMP designed to verify that the Project will not reduce water levels within the marsh (Wetland 4):

1) Monthly monitoring of water levels in the marsh (Wetland 4) should commence prior to the Site Preparation and Construction Phase in order to establish a baseline. This program can be discontinued three years after construction of the SWMP system has been completed if there is no evidence of a water level reduction attributable to the Project (this may require a hydrological analysis of precipitation inputs to confirm that any reductions are attributable to variations in precipitation).

2) Groundwater inflow rates into the shafts and Repository should be reported during the Site Preparation and Construction Phase, and Operations Phase to verify the assumptions that support the effects conclusions.

Recommendation #3.15:
EC recommends that an appropriate frequency of flow monitoring in the North Railway Ditch be developed in consultation with EC.

Chapter 4 – Air Issues

Recommendation #4.1:
EC recommends that a Follow-Up and Monitoring Program for air emissions be designed in consultation with EC and other relevant regulatory departments/agencies.

Recommendation #4.2:
EC recommends that OPG finalize and submit their best management practices for air emissions for review by EC and other relevant regulatory agencies prior to commencing work for the Site Preparation and Construction Phase.

Recommendation #4.3:
EC recommends that radon be included in the ventilation exhaust monitoring to verify the low levels of radon that have been predicted.

Recommendation #4.4:
EC recommends that OPG review the meteorological observation program at the Bruce Nuclear Station, to ensure adherence to appropriate siting and maintenance standards and guidelines, such as:

1) Environment Canada's *Guidelines for Co-operative Climatological Autostations*

***2) World Meteorological Organization Guide to Meteorological Instruments and Methods of Observation* (WMO-No. 8, 2012)**
http://library.wmo.int/opac/index.php?lvl=notice_display&id=12407

3) Campbell Scientific's *Weather Station Siting and Installation Tools* (1997)
http://www.campbellsci.com/documents/technical-papers/siting.pdf (basic siting and installation).

Recommendation #4.5:
EC recommends that the thermometers at the Bruce Nuclear site be situated inside a WMO standard screen, which should be mounted at a height consistent with the WMO and EC guidelines (1.25 m to 2 m).

Chapter 5 – Terrestrial Environment

Recommendation #5.1:
EC recommends that it be consulted by OPG during the development of the detailed revegetation plan.

Recommendation #5.2:
EC recommends that the proponent avoid engaging in potentially destructive or disruptive activities to migratory birds. In order to achieve that, the proponent is advised to develop and implement a management plan that effectively avoids or minimizes the risk of detrimental effects to migratory birds, their nests and eggs.

Recommendation #5.3:
EC recommends that the infilling of "Wetland 3" should be delayed until the latter years of the site preparation and construction phase, if possible.

Recommendation #5.4:
EC recommends that the proponent implement appropriate mitigation measures to maintain water levels in the western 'finger" of the marsh (Wetland 4) during and after the re-routing of the drainage ditch to ensure that habitat for Snapping Turtle is not affected.

Recommendation #5.5:

EC recommends that, as a precaution, during the year prior to and during the years of site preparation and construction, and prior to finally infilling "Wetland 3" in early to mid-May, a qualified biologist (experienced in turtle surveys) conduct a minimum of three turtle surveys of "Wetland 3" on sunny days, beginning as soon as the ice cover has melted off (typically from the middle to the end of April). The first two surveys should occur shortly after ice-off and the third should occur no later than mid-June. Snapping Turtles and non-SAR turtles (e.g., Painted Turtle) located in "Wetland 3" are to be relocated to Wetland 4.

Recommendation #5.6:

EC recommends that efforts be made to trap and relocate Snapping Turtles to Wetland 4 if they are found in "Wetland 3" prior to its infilling.

EC further recommends that a detailed relocation/handling plan be prepared by the proponent and be reviewed by EC and OMNR to ensure that the proponent is dealing with Snapping Turtles in an acceptable manner. The following are some items that should be included in such a plan:

1) The setting of the traps and the relocation of the Snapping Turtles must be conducted by qualified biologists.

2) The turtle traps are to be set using appropriate protocols (including details described above) regarding timing and leaving a portion of the trap well above water level (taking into consideration flooding due to storm events) to allow breathing room for the species.

3) The locations where the Snapping Turtles will be released must be clearly identified.

4) The timing of turtle capture/relocation activities must be specified.

Recommendation #5.7:

EC recommends that the proponent seek input and advice from OMNR to ensure site preparation and construction activities do not disrupt hibernation and gestation sites of Eastern Ribbonsnake and Eastern Milksnake and, in particular, if an individual of these species, snake eggs (Eastern Milksnake) or hibernacula are found.

Recommendation #5.8:
EC recommends that mitigation (i.e., appropriately designed, located and installed exclusion fencing) be in place to prevent turtles and snakes from entering the DGR site prior to and during site preparation and construction. More specifically, EC recommends that exclusion fencing be in place along the southern edge of the DGR site (north of the adjacent abandoned rail bed, from the southeast corner of the DGR Site to a point 50 m east of the Waste Package Haul Road Rail Bed Crossing) and the full length of the eastern edge of the DGR site (as far north as Interconnecting Road) to prevent turtles from entering the DGR Site, and in particular, "Wetland 3", prior to and during site preparation and construction.

Chapter 6 – Ecological Risk Assessment

Recommendation #6.1:
EC recommends that the need for a non-radiological ERA be re-evaluated based on effluent and downstream sediment monitoring data (see Section 3.2 for EC recommendations regarding the FUMP for effluent).

Recommendation #6.2:
EC recommends that Radiological contaminants (i.e. tritium and gross beta) in precipitation be included in the initial scope of the FUMP.

CHAPTER 8 – REFERENCE LIST

AMEC. 2011. Maximum Flood Hazard Assessment. AMEC NSS Ltd. report for the Nuclear Waste Management Organization NWMO DGR-TR-2011-35 R000. Toronto, Canada.

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APPENDIX 1 - LEGISLATION, NATIONAL ENVIRONMENTAL POLICIES & INTERNATIONAL AGREEMENTS

1. Introduction

The mandate of EC is determined by the statutes and regulations assigned to it by Parliament through the Minister of Environment. In delivering this mandate, the Department is also responsible for the development and implementation of policies, guidelines, codes of practice, inter-jurisdictional and international agreements and related programs. The following lists specific legislation and national environmental policies and programs administered or adhered to by EC that influenced the content of this submission.

Legislation
Department of the Environment Act
Canadian Environmental Assessment Act, 2012
Canadian Environmental Protection Act, 1999
Fisheries Act – Pollution Prevention Provisions
Migratory Birds Convention Act, 1994
Species at Risk Act

Policies, Plans, Guidelines, Strategies and Agreements
The Federal Policy on Wetland Conservation
Canada-United States Great Lakes Water Quality Agreement

2. *Department of Environment Act*

The mandate of EC is defined by the *Department of Environment Act* (DOE Act) which provides EC with general responsibility for environmental management and protection. The Department's obligations extend to and include all matters over which Parliament has jurisdiction and have not, by law, been assigned to any other department, board, or agency of the Government of Canada. The DOE Act delegates responsibility to the Minister of the Environment for:

- Preservation and enhancement of the quality of the natural environment, including water, air, and soil quality;
- Renewable resources including migratory birds and other non-domestic flora and fauna;
- Water;
- Meteorology;
- Enforcement of any rules or regulations made by the International Joint Commission relating to boundary waters and questions arising between the United States and Canada, as they relate to the preservation and enhancement of the quality of the natural environment; and,
- Coordination of policies and programs respecting preservation and enhancement of the quality of the natural environment.

The DOE Act states that EC has a mandated responsibility to advise heads of federal departments, boards and agencies on matters pertaining to the preservation and enhancement of the quality of the natural environment. As such, EC's mandate is broad.

3. *Canadian Environmental Protection Act, 1999*

Proclaimed on March 31, 2000, the goal of the updated *Canadian Environmental Protection Act*, *1999* (CEPA) is to contribute to sustainable development through pollution prevention and the protection of the environment, human life and health from the risks associated with toxic substances. CEPA shifts the focus from managing pollution after it has been created to preventing pollution before it happens. CEPA provides the federal government with tools to protect the environment and human health, establishes strict deadlines for controlling certain toxic substances, and requires the virtual elimination of toxic substances which are bioaccumulative, persistent and result primarily from human activity. CEPA also manages environmental and human health impacts of products of biotechnology, marine pollution, disposal at sea, vehicle engine and equipment emissions, fuels, hazardous wastes, environmental emergencies, and other sources of pollution. Substances that are declared "toxic" under CEPA are added to the List of Toxic Substances in Schedule 1 of the Act.

CEPA establishes authority for Canada to enact regulations or other control instruments to manage toxic substances to reduce or eliminate their release into the environment. Examples of preventive and control instruments include:

- Regulations;
- Pollution prevention plans;
- Environmental emergency plans;
- Environmental codes of practice; and
- Environmental release guidelines.

One of the regulations under CEPA that may be relevant to the Project is the *Environmental Emergency Regulations.*

Environmental Emergency Regulations

In the context of the Project and with respect to civil emergency preparedness in general, EC is responsible for developing and maintaining civil emergency plans and has a lead role for:

1. The identification of environmental hazards and their associated risks.
2. The assessment and mitigation, in collaboration with provincial and territorial authorities, of conditions or incidents causing pollution of the environment, including mystery spills and land-based spills emanating from federal facilities or property, but excluding other marine spills.
3. Conducting observations and forecasts, and providing timely warnings to the general public and to emergency responders, with respect to weather, ice and sea-state, ice jams and groundwater behaviour.

4. Projecting the dispersion of toxic or polluting substances in air and water, determining estimates of land contamination, and providing other scientific advice and information with respect to environmental processes and impacts.
5. Assessing and mitigating the damaging effects of emergencies upon migratory birds and their habitats.
6. Dealing with the disruptive impacts of emergencies on the operational capability of departmental facilities and communications systems, on the maintenance of adequate interfaces with responding agencies, the media and the public, and on the safe conduct of mitigative and other priority departmental operations.

Authority to require emergency plans for toxic or other hazardous substances set out in Schedule 1 to the *Environmental Emergency Regulations* is provided in Part 8 of CEPA. The *Environmental Emergency Regulations* are aimed at enhancing the protection of the environment and human life and health by promoting the preparedness for response to and recovery from environmental emergencies at fixed facilities of a release of a substance on Schedule 1 to the Regulations. The Regulations require those who own, have charge, management or control of toxic and hazardous substances set out in Schedule 1 to the Regulations at or above the specified thresholds to provide required information on the substance(s), their quantities and to prepare and implement environmental emergency plans. The primary goal of preparing and implementing an environmental emergency plan is to prevent emergencies from occurring and provide appropriate response activities in the event that an emergency does occur.

For additional detail see:
http://www.ec.gc.ca/CEPARegistry/regulations/detailReg.cfm?intReg=70

4. *Fisheries Act* – Pollution Prevention Provisions

The Minister of Fisheries and Oceans is legally responsible to Parliament for administration and enforcement of all sections of the *Fisheries Act*. However, under a Prime Ministerial Instruction (1978) and a Memorandum of Understanding (1985), EC administers and enforces those aspects of the Act dealing with the prevention and control of pollutants affecting fish and fish habitat. In this context, EC works to:

- Advance pollution prevention technologies;
- Promote the development of preventative solutions; and
- Work with the provinces, territories, industry, other government departments and the public on issues relating to the pollution provisions of the *Fisheries Act*.

The Compliance and Enforcement Policy[20] for the Habitat Protection and Pollution Prevention Provisions of the *Fisheries Act* states that compliance with the federal *Fisheries Act* is mandatory. Subsection 36(3) of the *Fisheries Act* specifies that, unless authorized by federal regulation, no person shall deposit or permit the [deposit] of deleterious substances of any type in water frequented by fish, or in any place under any conditions where the deleterious substance, or any other deleterious substance that results from the deposit of the deleterious substance, may enter any such water. Proponents should note that only a federal regulation under the *Fisheries Act* or another Act of Parliament can authorize a discharge of a deleterious substance; no federal

20 For more info please refer to: <http://www.ec.gc.ca/ele-ale/default.asp?lang=en&n=D6765D33> BROKEN LINK

permit, provincial, territorial or municipal regulatory permit or approval allows for exemption from the *Fisheries Act*. [21]

In the application of the *Fisheries Act*, a discharge of effluent that is acutely lethal to fish is regarded as deleterious. In other words, results of tests designed to determine whether fish will die in an effluent or discharge within a specified time period will determine one aspect of deleteriousness. However, any substance with a potentially harmful chemical, physical or biological effect on fish or fish habitat is also deleterious. For example, substances (such as sediment) that smother nesting areas or spawning grounds, or interfere with reproduction, feeding or respiration of fish at any point in their life cycle are also considered deleterious. In general, any substance with a potentially harmful chemical, physical or biological effect on fish or fish habitat may be considered deleterious. Heated discharges are also considered deleterious since the definition of deleterious (*Fisheries Act* section 34) also includes water that has been so changed by heat that it can be deleterious to fish and fish habitat.

The act of depositing a deleterious substance is a violation of the *Fisheries Act*, regardless of whether the water itself is made deleterious by the deposit. Subsection 36(3) of the *Fisheries Act* makes no allowance for a mixing or dilution zone. Any measurements or tests to determine whether something is deleterious should be done where the substance is at its highest concentration, typically at the point of discharge to the receiving water.

5. *Migratory Birds Convention Act, 1994*

EC's mandate includes the protection of migratory birds, nests and eggs. EC administers and enforces the *Migratory Birds Convention Act* (MBCA) and *Migratory Birds Regulations* (MBR).

The purpose of the MBCA is to implement the Migratory Birds Convention between Canada and the United States by protecting and conserving migratory birds, as populations and individual birds and their nests. Subsection 5.1 of the MBCA prohibits the deposit of a substance that is harmful to migratory birds in waters or an area frequented by migratory birds or in a place from which the substance may enter such waters or such an area. The Act prohibits the possession of a migratory bird, nest or egg without lawful excuse. The MBR provide for the conservation of migratory birds and for the protection of individuals, their nests and eggs. A prohibition against hunting is set out in section 5 of the MBR. The term “hunt” is given a specific definition in section 2 of the Regulations and includes attempting in any manner to kill, injure or harass migratory birds. A prohibition against the disturbance, destruction, or taking of a nest, egg or nest shelter of a migratory bird is set out in subsection 6(a) of the MBR.

21 Recent changes to Section 36 of the Fisheries Act under the Federal Government’s Responsible Resource Development Plan of April 2012 added greater flexibility to the regulatory tools that can be used to more effectively manage deposits.

6. *Species at Risk Act*

EC administers and enforces the federal *Species at Risk Act* (SARA), in partnership with the Department of Fisheries and Oceans, and the Parks Canada Agency. There are different ministers responsible for species listed under the SARA depending on the type of species and their location. They are referred to as "competent ministers" under the Act. The Minister of Fisheries and Oceans is responsible for aquatic species at risk other than individuals in or on federal lands administered by the Parks Canada Agency. The Minister of the Environment as Minister responsible for Parks Canada Agency is responsible for species at risk found in national parks, national historic sites or other protected heritage areas. The Minister of the Environment is also responsible for all terrestrial species at risk on lands not administered by the Parks Canada Agency.

The purpose of the SARA is to prevent wildlife species from being extirpated or becoming extinct, to provide for the recovery of wildlife species that are extirpated, endangered or threatened as a result of human activity, and to manage species of special concern to prevent them from becoming endangered or threatened. Schedule 1 of the SARA provides a list of wildlife species at risk in Canada that are considered extirpated, endangered, threatened, or of special concern.

The SARA provides automatic protection for aquatic species and birds protected by the *MBCA*, if they are listed as extirpated, endangered or threatened. This protection is found in the prohibitions in sections 32 and 33 of the Act (described below) which apply whether these species are on federal, provincial or territorial lands. These automatic prohibitions also apply to all other species listed as extirpated; endangered or threatened which are located on federal lands. Finally, prohibitions set out in sections 32 and 33 of the SARA can also apply on provincial and territorial lands if the Governor in Council makes an order to that effect. The SARA provides that the Minister of the Environment is required to recommend the making of such an order when he is of the opinion that the laws of the province or territory do not effectively protect a species or its residence.

Subsection 32 (1) of the SARA states that no person shall kill, harm, or harass an individual of a species listed as endangered or threatened. Section 33 states that no person shall damage or destroy the residence of one or more individuals of a wildlife species listed as an endangered or threatened (a "residence" being defined as a dwelling-place such as a den, nest or other similar area or place that is occupied during all or part of the species life-cycle).

Under section 58 and 61, there is an additional prohibition to not destroy any part of the critical habitat of listed species under SARA. The Act defines the critical habitat of a species as "*the habitat that is necessary for the survival or recovery of a listed wildlife species and that is identified as the species' critical habitat in the recovery strategy or an action plan for the species*." Prohibitions set out in sections 58 and 61 of the SARA apply to federally managed protected areas and upon an order by the competent minister can apply to other federal lands; it can also apply on provincial and territorial lands if the Governor in Council makes an order to that effect. The SARA provides that the Minister of the Environment is required to recommend the making of such an order when he is of the opinion that the laws of the province or territory do not effectively

protect the critical habitat, or provisions in another federal act or SARA itself do not protect critical habitat on non-federal land.

Subsection 79(1) requires that the federal authorities responsible for the environmental assessment notify the competent minister(s) in writing if the project is likely to affect a listed wildlife species or its critical habitat. Under subsection 79(2), that federal authority must also identify adverse effects on listed species including species of special concern and on the critical habitat of extirpated, endangered and threatened species; and if the project is carried out, ensure that measures are taken to avoid or lessen those effects and to monitor them. These measures must: a) be consistent with best available information including any Recovery Strategy, Action Plan or Management Plan in a final or proposed version; and b) respect the terms and conditions of the SARA regarding protection of individuals, residences, and critical habitat of extirpated, endangered, or threatened species. Accordingly, the results of this environmental assessment will be used to inform the appropriate federal authority when they exercise their obligations under section 79 of SARA.

The competent minister's role within environmental assessment is to provide technical advice and support to the federal authority to assist in addressing these requirements. However, it should be noted that the SARA competent minister also has certain specific obligations relative to species and critical habitat protection stemming from SARA itself, separate from CEAA 2012 or the environmental assessment process.

7. The Federal Policy on Wetland Conservation

The Federal Policy on Wetland Conservation was adopted in 1991. The objective of this policy is to promote the conservation of Canada's wetlands to sustain their ecological and socio-economic functions, now and in the future. The policy is a shared federal responsibility that directs all departments to sustain wetland functions in the delivery of their programs, services or expenditures. The goals of the Policy include:

- maintaining the functions and values of wetlands;
- ensuring no net loss of wetland functions on all federal lands and waters;
- enhancing and rehabilitating wetlands in areas prone to degradation and loss;
- recognizing wetland functions in resource planning and management with regard to federal programs, policies and activities; and,
- securing significant wetlands; and recognizing and utilizing sustainable management practices to conserve wetlands.

The policy promotes the concepts of cooperative approaches to wetland conservation, the need for linkages between wetlands conservation and other related initiatives (e.g. water policy, wildlife conservation), and the promotion of wetland protection through adequate consideration of wetland concerns in environmental assessments. Wetlands, as identified in the policy, include bogs, fens, marshes, swamps and shallow waters.

8. *Great Lakes Water Quality Protocol of 2012* and Canada-Ontario Agreement

The GLWQA 2012 was adopted by Protocol in 2012. The purpose of the GLWQA 2012 is to restore and maintain the chemical, physical and biological integrity of the Waters of the Great Lakes. It addresses water quality issues in the Great Lakes Basin and the portion of the St. Lawrence River that forms the Canada-U.S. border.

Over the years the Agreement has served as a forward-thinking document and a model for other international agreements to protect and restore environments elsewhere in the world. The GLWQA 2012 reflects the latest in environmental policy for the Great Lakes and updates the previous Agreement by:

- Strengthening binational programs and modernizing provisions related to issues such as chemicals, vessel discharges, and scientific research;
- Expanding the scope to address significant challenges such as the degradation of the nearshore environment, the threat of aquatic invasive species, the degradation of habitats and species, and the impacts of climate change;
- Adding a new focus on prevention and precaution;
- Streamlining and making the GLWQA 2012 more “user friendly”;
- Recognizing the important roles and contributions of government agencies, organizations and the public; and
- Improving accountability and continued International Joint Commission oversight.

The Government of Ontario is a key partner of the Government of Canada in implementing the GLWQA 2012 and in restoring, protecting and conserving water quality and ecosystem health in the Great Lakes. There is a long history of cooperation and collaboration, dating over 40 years, between the two levels of government. The first Canada-Ontario Agreement on the Great Lakes was signed in 1971 to provide a framework for the coordination of activities in support of the first Canada-United States Great Lakes Water Quality Agreement. The most recent Canada-Ontario Agreement expired on June 24, 2012 and a new Agreement is currently being negotiated.

APPENDIX 2 - REPORT ON THE CWS SITE VISIT TO THE DGR SITE AND ADJACENT SITE STUDY AREA ON APRIL 16TH, 2013

The purpose of this site visit was to assess two "wetland" areas for their potential to provide turtle habitat, and to gain a clear understanding of the location of Wetland 4 (located immediately northeast of the northeastern boundary of the DGR Site; Figure 1) in relation to the location of the proposed DGR Stormwater Management Pond (SWMP) and Forebay (located immediately southwest of the northeastern boundary of the DGR Site; Figure 2). The second "wetland", "Wetland 3", is located approximately in the center of the DGR Site (Figure 1). The main body of Wetland 4 (i.e., excluding the western 'finger') is referred to in the Terrestrial Environmental Technical Support Document as "the wetland located in the northeast corner of the Project Area." "Wetland 3" and the western 'finger' of Wetland 4 were not included in the Environmental Impact Statement (EIS) as they did not meet the strict definitions of wetlands based on the Ecological Land Classification (ELC) system (e.g., soil type, vegetation community composition). Rather the boundaries of "Wetland 3" and "Wetland 4" were defined for the purpose of a previous turtle habitat assessment in the spring of 2012, and a single Snapping Turtle was found in each of these "wetlands" during the targeted surveys conducted at that time.

The April 2013 site visit was attended by John Fischer (CWS EA coordinator), Rachel DeCatanzaro (CWS Recovery Biologist), Nicholle Smith (Golder Associates), Megan Rasmussen (turtle researcher), James Paterson (turtle expert), and the proponent, Diane Barker and Dylan Luhowy (NWMO). The relatively warm sunny conditions during the site visit, which occurred immediately following ice-off, were ideal for observing turtles, should they occur this year at these sites. "Wetland 3" will be entirely removed by the project and Wetland 4 is just outside of the DGR Site (as above). Since "Wetland 3" will be directly impacted by the project it was visited later in the day when afternoon air temperatures would be optimum for observing basking turtles, if present.

Wetland 4

The late-morning survey of Wetland 4 involved four individuals wading the entire boundary in waders beginning at the western edge and proceeding in a counterclockwise direction (Photo 1). Almost all of wetland was less than a meter deep, but slightly deeper areas in the center of the wetland were also surveyed. The wetland had heavy herbaceous vegetation in many areas, which can provide necessary frost protection for over-wintering turtles (Photo 2). There were also other important features which may be used as hibernacula such as submerged logs and overturned stumps, which create a lot of underwater structure and additional protection from frost (Photo 3). The turtle survey was conducted under conditions that were ideal for the target species. A single medium-sized adult Snapping Turtle was observed, captured (Photo 4), measured and immediately released (Photo 5).

One of the main reasons for visiting Wetland 4 was to determine how the proposed SWMP and Forebay, immediately to the west, may affect this wetland, in particular whether the western 'finger' of the wetland may intersect these proposed drainage features, potentially causing drawdown of the wetland. CWS observed that the water

level in the main body of Wetland 4 is partially controlled by outflow over a very narrow 'sill' between the main body of the wetland and the western 'finger', which results in the main body of the wetland being approximately 10 to 15 cm higher than it would be otherwise (Figure 3). Only a small volume of water was flowing over the sill on the day of the site visit, which occurred after a period of heavy rains (Photo 6), so the sole outflow of the main body of Wetland 4 could be described as intermittent.

The proponent installed several stakes to "roughly" delineate the eastern edge of the SWMP and Forebay for the purposes of the site visit (Figure 3). CWS later determined from GPS points (taken independently by CWS staff at these locations) that the stakes accurately represented the top of the slope where the SWMP and Forebay will be located (i.e., according to shapefiles provided by the proponent). The area that project consultant, Golder, classified as marsh based on Ecological Land Classification (ELC) (Figure 3; wetland outline traced from a map provided by the proponent during the site visit), is approximately 75 m from the proposed location of the SWMP.

In the imagery, the 'finger' of Wetland 4 extends to roughly 10 m from the "top of the slope" of the SWMP (Figure 3). The outlet of the western 'finger' of Wetland 4 is connected to a drainage ditch that continues west and then north into the footprint of the SWMP. CWS was informed, however, that there are no plans to channel the intermittent drainage from Wetland 4 to the SWMP. Instead a new Wetland 4 outlet channel will be created at the western boundary of the 'finger', and it will be located immediately parallel to the SWMP to convey the intermittent drainage from Wetland 4 along the eastern edge of the pond to the northwest. The water level in Wetland 4 will therefore remain unchanged unless the narrow sill (as described above) significantly erodes over time. The proposed SWMP will be approximately 3 m deep but there is no concern that it will drain Wetland 4 through subsurface drainage. CWS was informed at the beginning of the site visit that the DGR Site is underlain by 5 to 17 m of dense low-permeability glacial silt till. The fine texture of the soil was apparent in the field, and its infiltration rate has been conservatively estimated at 5 to 10 cm/yr, which is exceedingly low.

"Wetland 3"

While a Snapping Turtle was found in "Wetland 3" during a previous survey in 2012, this "wetland" is extremely small (40 m X 45 m). "Wetland 3" is located immediately south of an area where a large volume of infill has been dumped, and it consists of two areas separated by a narrow band of vegetation (Photo 7). The northern area is approximately rectangular in shape (Figure 4, Photo 8), and has a maximum depth of approximately 1 m. The southern area has been principally created by the tire ruts of heavy equipment and is much shallower throughout (Figure 4, Photos 9 and 10). Both areas of "Wetland 3" were waded and thoroughly searched by four individuals (Photos 8, 9 and 10), but no turtles were found. "Wetland 3" is thought to be suitable for spring and summer use by Snapping Turtles, but it is unlikely that they would attempt to overwinter there. Since "Wetland 3" will be removed by the project, efforts should be made to exclude Snapping Turtles that have over-wintered elsewhere from entering this "wetland" prior to site preparation and construction, and Snapping Turtles that happen to be foraging in "Wetland 3" (if any) should be trapped and moved to Wetland 4.

Photo 1: Wetland 4 - Wading in southern 'finger' (looking north)

Photo 2: Wetland 4 - Heavy herbaceous vegetation provides frost protection for overwintering turtles (looking south)

Photo 3: Wetland 4 - Logs and woody debris create underwater structure (looking east)

Photo 4: Wetland 4 - Snapping Turtle

Photo 5: Wetland 4 - Snapping Turtle being measured before release (looking south)

Photo 6: Wetland 4 - Narrow “sill” which controls water level in main body of wetland (looking east)

Photo 7: “Wetland 3” - Shallow area separated from deeper area by a narrow band of vegetation (looking north)

Photo 8: “Wetland 3” - Wading in the deeper area to the north (looking northwest)

Photo 9: “Wetland 3” - Southern shallow area (looking northwest)

Photo 10: “Wetland 3” – Wading in the shallow area to the south (looking southeast)

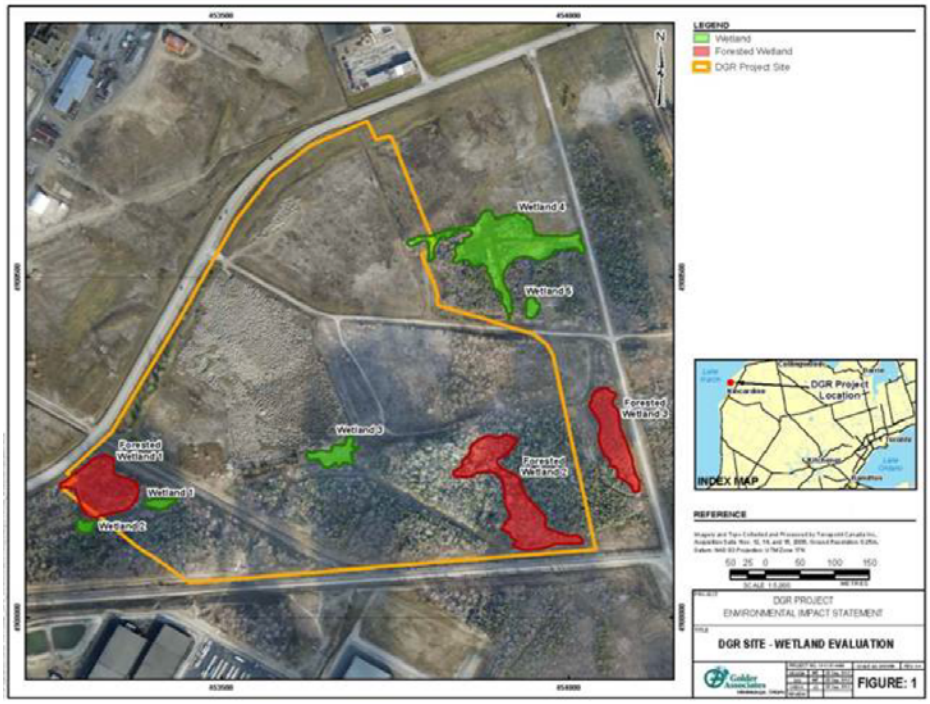

Figure 1: DGR Site Wetland Evaluation: Habitat units broadly identified in April 2012 as wetlands (ephemeral or permanent) or forested wetlands (are under tree canopy that may be seasonally or permanently moist to wet) on and adjacent to the DGR Project site

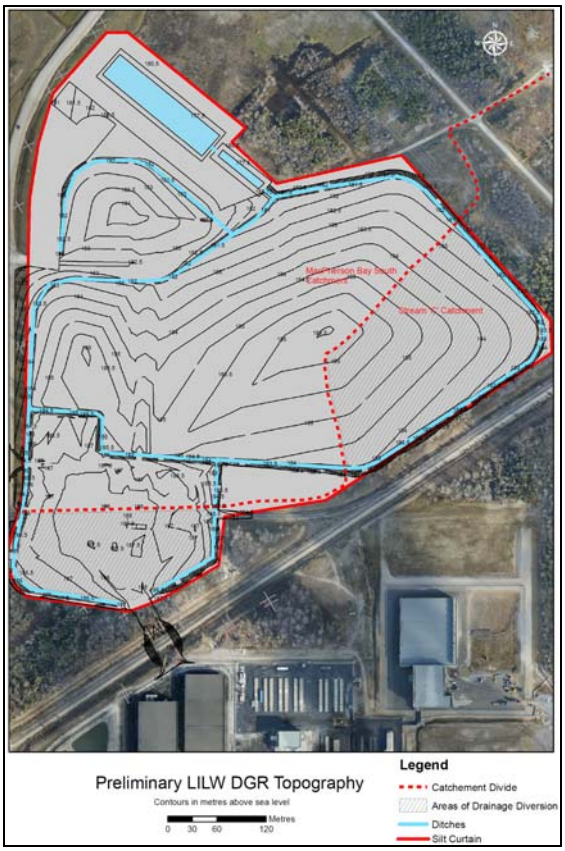

Figure 2: Preliminary DGR Topography showing Stormwater Management Pond with Forebay

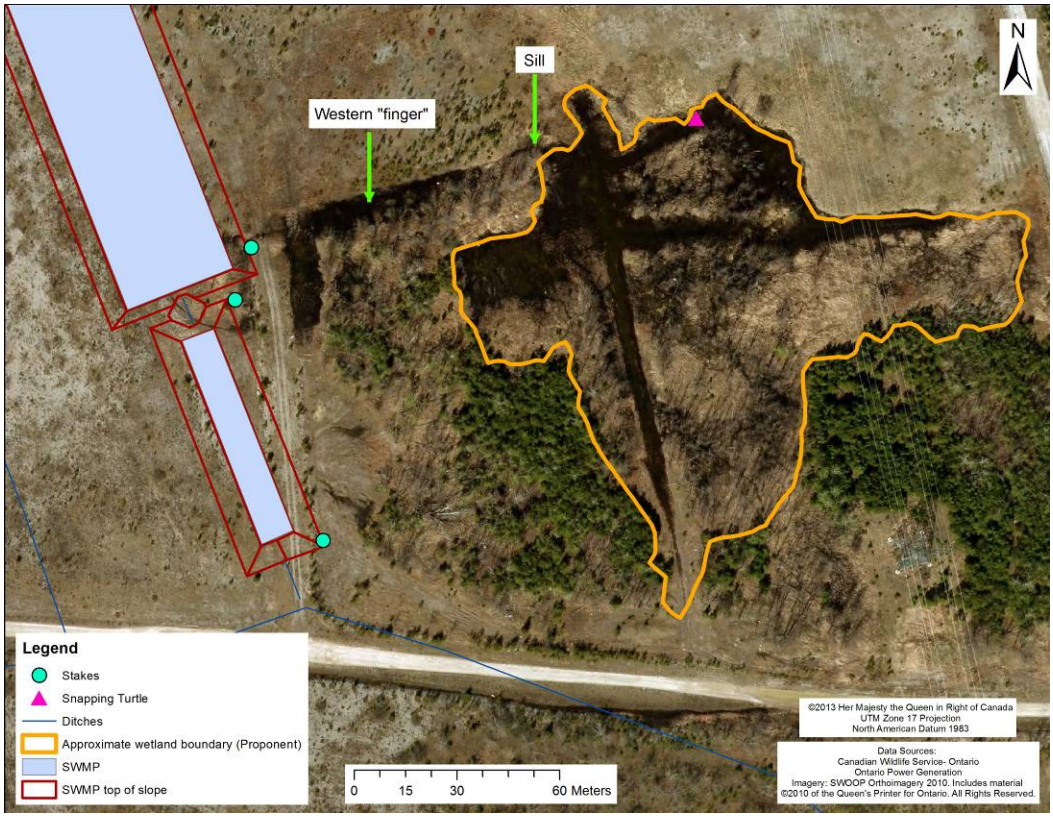

Figure 3: Wetland 4 with proposed Stormwater Management Pond and Forebay layout.

Figure 4: “Wetland 3” showing two areas separated by a narrow band of vegetation.

APPENDIX 3 – MEMORANDUM OF UNDERSTANDING (MOU) BETWEEN THE CANADIAN NUCLEAR SAFETY COMMISSION AND ENVIRONMENT CANADA

MEMORANDUM OF UNDERSTANDING (MOU) BETWEEN
THE CANADIAN NUCLEAR SAFETY COMMISSION
AND
ENVIRONMENT CANADA

WHEREAS the Canadian Nuclear Safety Commission (hereinafter, "the Commission") and Environment Canada (hereinafter, "the Department") have independent but related mandates in regard to the protection of the environment and activities carried out under their respective mandates have the potential to affect the programs and responsibilities of the other;

WHEREAS the Government of Canada requires that federal departments and agencies take full advantage of opportunities to coordinate their activities with each other;

WHEREAS the Commission regulates, pursuant to the *Nuclear Safety and Control Act* (NSCA), the development, production and use of nuclear energy and the production and use of nuclear substances, prescribed equipment and prescribed information in order to:

(i) prevent unreasonable risk to the environment, health and safety of persons, and national security and;
(ii) achieve conformity with measures of control and international obligations to which Canada has agreed.

WHEREAS the Department under the *Department of the Environment Act* has powers, duties and functions relating to the preservation and enhancement of the quality of the natural environment, including water, air and soil quality; renewable resources, including migratory birds and other non-domestic flora and fauna; water; meteorology; the enforcement of rules and regulations made by the International Joint Commission relating to boundary waters and questions arising between the United States and Canada in so far as they relate to the preservation and enhancement of environmental quality;

WHEREAS the Department, pursuant to the *Canadian Environmental Protection Act,* 1999 (CEPA 1999), has the mandate to:

(i) ensure that preventive and remedial measures are taken to protect the environment,
(ii) establish nationally consistent levels of environmental quality,
(iii) apply knowledge, science and technology to resolve environmental problems,
(iv) protect the environment from the release of toxic substances, and
(v) assess whether substances new to Canadian commerce or in use in Canada or present in or released to the Canadian environment are toxic or capable of becoming toxic;
(vi) enforce CEPA 1999 and associated regulations.

WHEREAS the Department has been assigned responsibility for the administration and enforcement of subsection 36(3) of the *Fisheries Act* (FA), which prohibits the deposit of a deleterious substance into water frequented by fish and subsections 38(4) and (5) of that Act, which mandate reporting and remedial measures in response to such a deposit;

WHEREAS the Department, pursuant to the *Migratory Birds Convention Act* 1994 (MBCA), has the mandate to enforce the prohibitions set out in section 5 of that Act for the purpose of preventing damage to migratory birds;

WHEREAS the Department pursuant to the *Species at Risk Act* (SARA), has the mandate to prevent wildlife species from becoming extinct and secure the necessary actions for their recovery (i.e. protecting their critical habitat); and

WHEREAS the Department and the Commission both must comply with the requirements under the *Canadian Environmental Assessment Act*, when applicable;

THEREFORE, the Commission and the Department (individually a "participant" or together "the participants") agree to consult and cooperate in accordance with the following sections of this Memorandum of Understanding in order to minimize regulatory duplication and to use government resources effectively.

I PRINCIPLES

1. The participants, in carrying out their respective mandates will cooperate and support each other, as appropriate, in meeting their responsibilities in relation to environmental conservation and protection and in other areas of mutual interest.

2. The participants will take all reasonable steps, consistent with their respective mandates, to see that their environmental protection policies and measures are complementary and designed to provide effective environmental protection.

3. The participants will provide each other the opportunity to advise on policies and programs that may affect the mandate of the other, in a manner that allows for timely and substantive advice.

4. The participants will foster strong working relations by establishing mechanisms and links to share information, taking into account legal constraints on the sharing of confidential business information.

5. This Memorandum is a declaration of intentions by the Participants, and will not create any binding legal obligations between the Participants.

II IMPLEMENTATION

The participants agree to:

1. Inform and advise each other on their current policies, programs, standards and regulations or legislation concerning the protection of the environment, and the management of toxic substances in relation to nuclear facilities and activities of concern to each other;

2. Provide the opportunity for each participant to provide guidance, information and advice prior to developing, amending or terminating the policies, programs, standards or regulations referred to in the above paragraph that may involve the use, release or management of substances designated as toxic under CEPA 1999 or identified/defined as hazardous under the NSCA and other contaminants of mutual environmental concern that may affect the facilities and activities regulated by the Commission;

3. Cooperate with each other on regulatory matters of mutual concern involving the nuclear industry, including:

    a) developing and managing programs and processes for the implementation of obligations pursuant to CEPA, FA, SARA, MBCA as they relate to facilities and activities regulated by the Commission under the *Nuclear Safety and Control Act* (NSCA) or as they relate to facilities and activities regulated by the Department;

    b) providing the Department, where appropriate, with the opportunity to consult with the Commission in the review of applications and associated environmental assessments before the Commission and providing the Commission advice on matters concerning the protection of the environment;

    c) providing the Commission, where appropriate, with the opportunity to consult with the Department in the review of assessments, including environmental assessments, programs and processes and provide advice on matters concerning the protection of the environment as they relate to nuclear facilities and activities;

    d) promoting awareness among licensees of the Commission of the Department's mandated requirements;

e) promoting awareness among the Department's program staff of the Commission's mandated requirements;

f) verifying licensee compliance with the regulatory requirements of either the Commission or the Department;

g) sharing environmental information with each other in support of the Department's and the Commission's activities including regulatory assessment activities;

h) providing each other with any relevant information to support any enforcement actions considered by the Department under CEPA 1999, FA, MBCA, and SARA or by the Commission under the NSCA;

i) the Commission providing the Department with the opportunity, on request and where appropriate, to participate in joint compliance inspections of facilities and activities licensed by the Commission;

j) informing each other of any inspection, investigation or assessment by a participant of an incident under its jurisdiction that may constitute a contravention of CEPA 1999, FA, MBCA or SARA that may have occurred at a facility or activity regulated by the Commission; and where appropriate, consulting and coordinating with each other prior to taking regulatory enforcement actions at facilities or on activities licensed by the Commission;

k) reporting by the Commission of any spill or incident of which it is aware that may constitute a contravention of CEPA 1999, FA, MBCA, or SARA to the Department's designated spills reporting centre. It should be noted that Commission communications with the Department under this MOU does not replace the licensee requirements to report incidents to the Department pursuant to CEPA 1999, FA, MBCA or SARA; and

l) reporting by the Department's designated spills reporting centre to the Commission any spill or incident of which it is aware from facilities or activities regulated by the Commission that may constitute a contravention of CEPA 1999, FA, MBCA or SARA. It should be noted that the Department's communications with the Commission under this MOU does not replace the licensee requirements to report incidents to the Commission pursuant to the NSCA.

4. Consult and cooperate with each other in the development of any national or international standard, agreement, convention, assessment or

commitment concerning protection of the environment that could affect the regulation of the nuclear industry by the Commission;

5. Cooperate with each other in matters of mutual interest related to nuclear emergency preparedness and response;

6. Cooperate in the sharing of key information and expertise where such activity would help each participant to better carry out its mandate, such as support in accessing the information to run atmospheric transport models and the enhancement of laboratory services;

7. Cooperate with each other where resources permit on the conduct of environmental studies, assessments or research projects of potential interest to the regulation of the nuclear industry, and in the sharing of expert assistance and financial resources for such purpose; and

8. Coordinate public communication and consultation activities with each other on matters of mutual interest and responsibility.

III TERMS OF THE MOU

1. The primary points of contact under this MOU, and responsible for its administration, are the Director-General, Directorate of Environmental and Radiation Protection and Assessment, Canadian Nuclear Safety Commission (CNSC), and the Director General, Environmental Protection Operations Division (EPOD) / Environmental Stewardship Branch (ESB), Environment Canada.

2. The points of contact named above will meet annually during the normal planning process. The operation of this MOU shall be reviewed annually by the participants at this meeting.

3. The participants will exchange and maintain appropriate lists of contacts at the working level(s) to facilitate the implementation of activities described in this MOU.

4. The participants will make every reasonable effort to resolve at the working level any conflicts that arise from this Memorandum of Understanding. Failing resolution at the working level, conflicts may be referred for resolution to the offices named pursuant to paragraph 1 above, or to the signatories to this Memorandum.

5. Subject to paragraph 6, the participants will provide or honour without charge to the other participant the services agreed to and the commitments made in this Memorandum of Understanding.

6. The participants recognize that the delivery of certain services agreed to in this Memorandum of Understanding, or the honouring of certain commitments made in this Memorandum, may be subject to cost recovery regulations or may require, on a case by case basis, financial arrangements between the Commission and the Department to offset, in whole or part, the associated costs. Where such arrangements are necessary, the participants agree to consult and cooperate to develop mutually satisfactory arrangements.

7. The participants agree to consult in advance concerning any significant changes in the level or nature of service that either participant may request, or intends to request, of the other participant pursuant to this Memorandum of Understanding.

8. The participants agree to collaborate on identifying opportunities for training and staff exchanges in areas of mutual interest.

9. The participants hereby mutually agree to terminate the *Memorandum of Understanding (MOU) Between the Canadian Nuclear Safety Commission (CNSC) and Environment Canada (EC)* signed in 2003 and the *Annex 1 to the Memorandum of Understanding (MOU) Between Environment Canada and the Canadian Nuclear Safety Commission - Risk Management Process for Radionuclides as Assessed Under the Canadian Environmental Protection Act, 1999* signed in 2004.

10. This Memorandum of Understanding becomes effective on the date of the last signature, and shall remain in effect until modified or withdrawn. The Memorandum may be revised by the mutual consent of the Department and the Commission. Either participant may withdraw from the agreement by providing at least six (6) months notice in writing to the other participant, specifying its intention to withdraw and the effective date of withdrawal.

11. The participants may develop further agreements as Annexes to this Memorandum of Understanding as deemed necessary to facilitate the implementation of the arrangements made herein as required or appropriate.

12. Annex 1 to this MOU, Environmental Occurrence Cooperation Protocol (attached), forms part of this MOU document and the participants agree to abide by its provisions.

Signed in duplicate in the English and French languages.

Signed on: _____

For the Canadian Nuclear Safety Commission:

_____
President

Signed on: _____

For Environment Canada:

_____
Deputy Minister

ANNEX 1 TO THE MEMORANDUM OF UNDERSTANDING (MOU)
BETWEEN
CANADIAN NUCLEAR SAFETY COMMISSION
AND
ENVIRONMENT CANADA

Environmental Occurrence Cooperation Protocol

Purpose

This Annex is governed by the understandings as described in the MOU between the Canadian Nuclear Safety Commission and Environment Canada.

Pursuant to paragraphs 3(j), (k) and (l) under section II (Implementation) and paragraph 11 under section III (Terms of the MOU) of the MOU between Environment Canada ("the Department") and the Canadian Nuclear Safety Commission ("the Commission") and under the terms of this Annex, the Department and the Commission (each a "participant" or jointly "the participants") agree to develop protocols for environmental occurrence cooperation. The purpose of the protocol is to ensure that both the Department and the Commission are aware of, and have current information, when an environmental occurrence or release of either nuclear substances or hazardous substances occurs at a Commission-licensed nuclear facility. This includes ongoing information exchange and collaboration on scientific needs arising as a result of emergency situations that have, or potentially will, impact the environment and / or human health.

Definitions

An “**environmental occurrence**” is a discharge into the natural environment, from or out of a structure, vehicle or other container that is abnormal in quality or quantity in light of all circumstances of the discharge or is out of the normal course of events.

Scope

This Annex will broadly apply to communication and cooperation concerning actual or potential environmental occurrence situations involving major nuclear facilities regulated under the *Nuclear Safety and Control Act* (NSCA) and which are located within all current operational regions of the Department as referenced in Table 1.

The roles and responsibilities of the Commission and of the Department relating to regulation of the nuclear industry, protection of the environment as well as the relevant legislation relating thereto are as contained in the MOU.

The *General Nuclear Safety and Control Regulations* include a requirement that every licensee “take all reasonable precautions to control the release of radioactive nuclear substances or hazardous substances within the site of the licensed activity and into the environment as a result of the licensed activity.” Also, every licensee that becomes aware of “a release, not authorized by the licence, of a quantity of radioactive nuclear substances into the environment” shall make a preliminary and full report to the Commission.

The Commission has implemented Regulatory Standard S-99, *Reporting Requirements for Operating Nuclear Power Plants*, which includes reporting requirements for releases and emergencies at Commission-licensed operating nuclear power plants.

As such, the Commission and the Department agree to consult and cooperate in accordance with the following protocols in order to maximize government response and protection of environment and human health, while minimizing regulatory duplication and resources.

Annex Protocols

Notification

The Department and the Commission agree that notification of environmental occurrences is critical for the protection of the environment and human health.

The Commission and the Department will each identify a point of contact (POC) to coordinate correspondence between the two organizations for environmental occurrences. These identified POCs will ensure that each party is aware of any environmental occurrences and will work together to ensure ongoing information

transfer during and after environmental occurrences. The Commission POC is the Commission Duty Officer. The Department's POC is the Environmental Emergencies Duty Officer for the region in which the incident occurs.

The Department and Commission will ensure POC and Duty Officer availability at all times (24 hours a day, 7 days a week). Each participant will ensure that up-to-date contact information for the Department POC and the Commission POC is made available to each other.

The Commission Duty Officer will contact a designated Commission responder, who will forward any received S-99 preliminary and detailed reports on an environmental occurrence to the Department POC.

The designated Commission responder will forward any information received from the Department to the appropriate Commission branch(es) and directorate(s).

Technical expertise required of either party will be requested through the POC as per this Annex. The Commission Duty Officer will contact an appropriate designated responder to provide the technical expertise.

The Department POC will notify the Commission Duty Officer when it becomes aware of an environmental occurrence at a Commission-licensed nuclear facility. The Commission Duty Officer will contact an appropriate designated responder.

Ongoing Information Exchange

The Department and the Commission:

(1) will cooperate in sharing ongoing information with each other at regular intervals to ensure both parties have current and up-to-date information concerning the status of incidents and/or projects of mutual interest. The participants will provide each other the opportunity to advise on legislation, policies, responsibilities, advice, science or other relevant information as they pertain to the mandate of each participant and the situation at hand;

(2) will work together on the assessment of the consequences of an environmental occurrence; and

(3) will work together to verify that the Commission-licensed facility has implemented adequate corrective actions.

Both participants agree to cooperate and share scientific and technical information in matters of mutual interest related to occurrences. Established points of contact, as outlined in the notification and ongoing information exchange sections of this Annex, shall be the route via which information and

collaboration is requested and exchanged. Where the Commission Duty Officer has contacted a designated responder, information requested and exchanged shall be between the designated responder and the Department POC.

The Commission has a responsibility for technical expertise on assessment of environmental and human health impacts for radionuclide and hazardous occurrences and will share this information with the Department.

The Department has a responsibility for technical expertise on the fate and effects of toxic substances and conventional chemicals, meteorological conditions and forecasts and the atmospheric transport of radioactive materials and will share this information with the Commission where applicable.

Table 1 – Types and Locations of Commission-Licensed Major Nuclear Facilities

Commission Licensee	Type of Nuclear Facility	Location
Cameco Corporation	Uranium Conversion	Port Hope, Ontario
Cameco Corporation	Uranium Refining	Blind River, Ontario
Cameco Corporation	Nuclear Fuel Manufacturing	Port Hope, Ontario
GE-Hitachi Nuclear Energy Canada inc.	Nuclear Fuel Manufacturing	Toronto, Ontario
GE-Hitachi Nuclear Energy Canada inc.	Nuclear Fuel Manufacturing	Peterborough, Ontario
SRB Technologies Inc. Pembroke	Nuclear Substance Processing (Tritium)	Pembroke, Ontario
Shield Source Inc. Peterborough	Nuclear Substance Processing (Tritium)	Peterborough, Ontario
MDS Nordion	Nuclear Substance Processing	Kanata, Ontario
McMaster University	Non-Power Reactor (McMaster Nuclear Reactor)	Hamilton, Ontario
Royal Military College	Non-Power Reactor (SLOWPOKE)	Kingston, Ontario
University of Alberta	Non-Power Reactor (SLOWPOKE)	Edmonton, Alberta
Saskatchewan Research Council	Non-Power Reactor (SLOWPOKE)	Saskatoon, Saskatchewan
Ecole Polytechnique	Non-Power Reactor (SLOWPOKE)	Montreal, Quebec
Dalhousie University	Non-Power Reactor (SLOWPOKE)	Halifax, Nova Scotia
Ecole Polytechnique	Sub-critical Assembly	Montreal, Quebec
TRIUMF Accelerators Inc.	Particle Accelerator	Vancouver, British Columbia
Canadian Light Source Inc.	Particle Accelerator	Saskatoon, Saskatchewan
OPG/Pickering A&B	Nuclear Power Plant	Pickering, Ontario
Bruce Power/Bruce A&B	Nuclear Power Plant	Tiverton, Ontario
OPG/Darlington	Nuclear Power Plant	Bowmanville, Ontario
Hydro-Québec/Gentilly-2	Nuclear Power Plant	Bécancour, Quebec

NB Power/Point Lepreau	Nuclear Power Plant	Maces Bay, New Brunswick
Cameco Corporation/Key Lake	Uranium Mine & Mill	Athabasca Basin, Saskatchewan
Cameco Corporation/Rabbit Lake	Uranium Mine & Mill	Athabasca Basin, Saskatchewan
Cameco Corporation/McArthur River	Uranium Mine	Athabasca Basin, Saskatchewan
Cameco Corporation/Cigar Lake	Uranium Mine	Athabasca Basin, Saskatchewan
AREVA/McClean Lake	Uranium Mine	Athabasca Basin, Saskatchewan
AECL/Chalk River Laboratories	Nuclear Research	Chalk River, Ontario
AECL/Whiteshell Laboratories	Nuclear Research	Pinawa, Manitoba