

# Joint Review Panel

## Environmental Assessment Report

Darlington New  
Nuclear Power  
Plant Project



August 2011



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## Environmental Assessment Report

### Darlington New Nuclear Power Plant Project

August 2011

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## Acknowledgements

The Joint Review Panel for the Darlington New Nuclear Power Plant Project thanks the proponent, the federal, provincial and municipal entities, Aboriginal groups, and the organizations and citizens that participated in and contributed to this environmental assessment. The Panel also thanks its Secretariat staff and Legal Advisors.

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*Darlington New Nuclear Power Plant Project  
Joint Review Panel*

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August 25, 2011

The Honourable Peter Kent, P.C, M.P.  
Minister of the Environment  
Les Terrasses de la Chaudière  
10 Wellington Street, 28th Floor  
Gatineau, Quebec  
K1A 0H3

Dear Minister:

The Joint Review Panel for the Darlington New Nuclear Power Plant Project has completed its environmental assessment of the Project in accordance with its mandate issued on October 30, 2009. The Panel hereby submits its report for the consideration of the Government of Canada.

Yours truly,



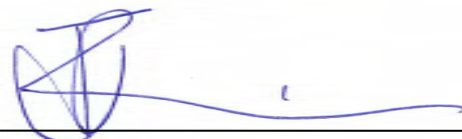
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Alan R. Graham, Chair



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Jocelyne Beaudet, Member



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Joseph Kenneth Pereira, Member



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## Report Summary

The Darlington New Nuclear Power Plant Project (the Project) is a proposal by Ontario Power Generation (OPG) for the site preparation, construction, operation, decommissioning and abandonment of up to four new nuclear reactors at its existing Darlington Nuclear site in the Municipality of Clarington, Ontario. The Project is expected to generate up to 4,800 megawatts of electricity for delivery to the Ontario grid with an initial need of 2,000 megawatts.

The Project includes the preparation of the site; construction of up to four new reactors and associated facilities; the operation and maintenance of the reactors and related facilities for approximately 60 years, including the management of conventional and radioactive waste; and the decommissioning and eventual abandonment of the nuclear reactors and associated facilities.

The Minister of the Environment and President of the Canadian Nuclear Safety Commission determined that a review of the Project by a joint review panel would ensure that the Project was subject to an effective and efficient environmental assessment and regulatory process. On October 30, 2009, the Minister and the President appointed a three-member Joint Review Panel (Panel) to consider the environmental assessment and the Application for a Licence to Prepare Site for the proposed Project.

The mandate of the Panel was to assess the environmental effects of the Project and to determine whether it is likely to cause significant adverse environmental effects taking into account the implementation of mitigation measures that are technically and economically feasible. The review of the Project was framed by the *Canadian Environmental Assessment Act* and the *Nuclear Safety and Control Act*. The Panel incorporated other federal, provincial and municipal policies and requirements, industry standards and best practices in its analysis and recommendations.

The components of the review included a public review and comment period, two technical review sessions, requests to OPG for additional information deemed necessary by the Panel, three open house information sessions at public

venues in the Project area, submissions from federal, provincial and municipal governments, Aboriginal groups and other interested parties, and a 17-day public hearing in the Municipality of Clarington.

The Panel concludes that the Project is not likely to cause significant adverse environmental effects, provided the mitigation measures proposed and commitments made by OPG during the review, and the Panel's recommendations are implemented.

The Panel directs recommendations to responsible authorities and federal authorities, as well as to the Government of Canada, the Government of Ontario, the Municipality of Clarington and OPG.

Following is a consolidation of the Panel's recommendations. Each recommendation is numbered chronologically as it appears in the text of the main report. The report section reference is provided for each recommendation.

## The Canadian Nuclear Safety Commission

### Prior to Site Preparation

#### **Recommendation # 2 (Section 4.5):**

The Panel recommends that prior to site preparation, the Canadian Nuclear Safety Commission require OPG to conduct a comprehensive soils characterization program. In particular, the potentially impacted soils in the areas OPG identifies as the spoils disposal area, cement plant area and asphalt storage area must be sampled to identify the nature and extent of potential contamination.

#### **Recommendation # 6 (Section 4.6):**

The Panel recommends that prior to site preparation, the Canadian Nuclear Safety Commission require OPG to update its preliminary decommissioning plan for site preparation in accordance with the requirements of Canadian Standards Association Standard N294-09. The OPG preliminary decommissioning plan for site preparation must incorporate the rehabilitation of the site to reflect

the existing biodiversity in the event that the Project does not proceed beyond the site preparation phase.

OPG shall prepare a detailed preliminary decommissioning plan once a reactor technology is chosen, to be updated as required by the Canadian Nuclear Safety Commission.

**Recommendation # 7 (Section 4.6):**

The Panel recommends that prior to site preparation, the Canadian Nuclear Safety Commission require that OPG establish a decommissioning financial guarantee to be reviewed as required by the Canadian Nuclear Safety Commission. Regarding the decommissioning financial guarantee for the site preparation stage, the Panel recommends that this financial guarantee contain sufficient funds for the rehabilitation of the site in the event the Project does not proceed beyond the site preparation stage.

**Recommendation # 8 (Section 5.1):**

The Panel recommends that prior to site preparation, the Canadian Nuclear Safety Commission require OPG to develop a follow-up and adaptive management program for air contaminants such as Acrolein, NO<sub>2</sub>, SO<sub>2</sub>, SPM, PM<sub>2.5</sub> and PM<sub>10</sub>, to the satisfaction of the Canadian Nuclear Safety Commission, Health Canada and Environment Canada. Additionally, the Canadian Nuclear Safety Commission must require OPG to develop an action plan acceptable to Health Canada for days when there are air quality or smog alerts.

**Recommendation # 9 (Section 5.1):**

The Panel recommends that the Canadian Nuclear Safety Commission, in collaboration with Health Canada, require OPG to develop and implement a detailed acoustic assessment for all scenarios evaluated. The predictions must be shared with potentially affected members of the public. The OPG Nuisance Effects Management Plan must include noise monitoring, a noise complaint response mechanism and best practices for activities that may occur outside of municipal noise curfew hours to reduce annoyance that the public may experience.

**Recommendation # 10 (Section 5.2):**

The Panel recommends that the Canadian Nuclear Safety Commission require OPG to undertake a detailed site geotechnical investigation prior to commencing site

preparation activities. The geologic elements of this investigation should include, but not be limited to:

- collecting site-wide information on soil physical properties;
- determining the mechanical and dynamic properties of overburden material across the site;
- mapping of geological structures to improve the understanding of the site geological structure model;
- confirming the lack of karstic features in the local bedrock at the site; and
- confirming the conclusions reached concerning the liquefaction potential in underlying granular materials.

**Recommendation # 12 (Section 5.3):**

The Panel recommends that before in-water works are initiated, the Canadian Nuclear Safety Commission require OPG to collect water and sediment quality data for any future embayment area that may be formed as a consequence of shoreline modifications in the vicinity of the outlet of Darlington Creek. This data should serve as the reference information for the proponent's post-construction commitment to conduct water and sediment quality monitoring of the embayment area.

**Recommendation # 13 (Section 5.3):**

The Panel recommends that the Canadian Nuclear Safety Commission require OPG to collect and assess water quality data for a comprehensive number of shoreline and off-shore locations in the site study area prior to commencing in-water works. This data should be used to establish a reference for follow-up monitoring.

**Recommendation # 20 (Section 5.5):**

The Panel recommends that the Canadian Nuclear Safety Commission require OPG to perform a thorough evaluation of site layout opportunities before site preparation activities begin, in order to minimize the overall effects on the terrestrial and aquatic environments and maximize the opportunity for quality terrestrial habitat rehabilitation.

**Recommendation #22 (Section 5.5):**

The Panel recommends that the Canadian Nuclear Safety Commission require OPG to develop a follow-up program for insects, amphibians and reptiles, and mammal species

and communities to ensure that proposed mitigation measures are effective.

**Recommendation # 25 (Section 5.5):**

The Panel recommends that the Canadian Nuclear Safety Commission require OPG to conduct more sampling to confirm the presence of Least Bittern before site preparation activities begin. The Panel recommends that the Canadian Nuclear Safety Commission require OPG to develop and implement a management plan for the species at risk that are known to occur on site. The plan should consider the resilience of some of the species and the possibility of off-site compensation.

**Recommendation # 38 (Section 5.9):**

The Panel recommends that the Canadian Nuclear Safety Commission require that the geotechnical and seismic hazard elements of the detailed site geotechnical investigation to be performed by OPG include, but not be limited to:

Prior to site preparation:

- demonstration that there are no undesirable subsurface conditions at the Project site. The overall site liquefaction potential shall be assessed with the site investigation data; and
- confirmation of the absence of paleoseismologic features at the site and, if present, further assessment to reduce the overall uncertainty in the seismic hazard assessment during the design of the Project must be conducted.

During site preparation and/or prior to construction:

- verification and confirmation of the absence of surface faulting in the overburden and bedrock at the site.

Prior to construction:

- verification of the stability of the cut slopes and dyke slopes under both static and dynamic loads with site/Project-specific data during the design of the cut slopes and dykes or before their construction;
- assessment of potential liquefaction of the northeast waste stockpile by using the data obtained from the pile itself upon completion of site preparation;
- measurement of the shear strength of the overburden materials and the dynamic properties of both overburden and sedimentary rocks to confirm the site

conditions and to perform soil-structure interaction analysis if necessary;

- assessment of the potential settlement in the quaternary deposits due to the groundwater drawdown caused by future St. Marys Cement quarry activities; and
- assessment of the effect of the potential settlement on buried infrastructures in the deposits during the design of these infrastructures.

Prior to operation:

- development and implementation of a monitoring program for the Phase 4 St. Marys Cement blasting operations to confirm that the maximum peak ground velocity at the boundary between the Darlington and St. Marys Cement properties is below the proposed limit of three millimetres per second (mm/s).

**Recommendation # 41 (Section 6.1):**

The Panel recommends that prior to site preparation, the Canadian Nuclear Safety Commission coordinate discussions with OPG and key stakeholders on the effects of the Project on housing supply and demand, community recreational facilities and programs, services and infrastructure as well as additional measures to help deal with the pressures on these community assets.

**Recommendation # 47 (Section 6.7):**

The Panel recommends that prior to site preparation, the Canadian Nuclear Safety Commission ensure the OPG Traffic Management Plan addresses the following:

- contingency plans to address the possibility that the assumed road improvements do not occur;
- consideration of the effect of truck traffic associated with excavated material disposal on traffic operations and safety;
- further analysis of queuing potential onto Highway 401; and
- consideration of a wider range of mitigation measures, such as transportation-demand management, transit service provisions and geometric improvements at the Highway 401/Waverley Road interchange.

**Recommendation # 48 (Section 6.7):**

In consideration of public safety, the Panel recommends that prior to site preparation, the Canadian Nuclear Safety Commission coordinate

a committee of federal, provincial and municipal transport authorities to review the need for road development and modifications.

During Site Preparation
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**Recommendation #5 (Section 4.6):**

To avoid any unnecessary environmental damage to the bluff at Raby Head and fish habitat, the Panel recommends that no bluff removal or lake infill occur during the site preparation stage, unless a reactor technology has been selected and there is certainty that the Project will proceed.

**Recommendation # 19 (Section 5.4):**

The Panel recommends that the Canadian Nuclear Safety Commission require OPG to expand the scope of the groundwater monitoring program to monitor transitions in groundwater flows that may arise as a consequence of grade changes during the site preparation and construction phases of the Project. The design of the grade changes should guide the determination of the required monitoring locations, frequency of monitoring and the required duration of the program for the period of transition to stable conditions following the completion of construction and the initial period of operation.

**Recommendation # 21 (Section 5.5):**

The Panel recommends that the Canadian Nuclear Safety Commission require OPG to compensate for the loss of ponds, like-for-like, preferably in the site study area. The Panel also recommends that the Canadian Nuclear Safety Commission require OPG to use best management practices to prevent or minimize the potential runoff of sediment and other contaminants into wildlife habitat associated with Coot's Pond during site preparation and construction phases.

Prior to Construction
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**Recommendation # 1 (Section 4.5):**

The Panel understands that prior to construction, the Canadian Nuclear Safety Commission will determine whether this environmental assessment is applicable to the reactor technology selected by the Government of Ontario for the Project. Nevertheless, if the selected reactor technology is fundamentally different from the specific reactor technologies

bounded by the plant parameter envelope, the Panel recommends that a new environmental assessment be conducted.

**Recommendation # 3 (Section 4.5):**

The Panel recommends that the Canadian Nuclear Safety Commission require that as part of the Application for a Licence to Construct a reactor, OPG must undertake a formal quantitative cost-benefit analysis for cooling tower and once-through condenser cooling water systems, applying the principle of best available technology economically achievable. This analysis must take into account the fact that lake infill should not go beyond the two-metre depth contour and should include cooling tower plume abatement technology.

**Recommendation # 14 (Section 5.3):**

The Panel recommends that following the selection of a reactor technology for the Project, the Canadian Nuclear Safety Commission require OPG to conduct a detailed assessment of predicted effluent releases from the Project. The assessment should include but not be limited to effluent quantity, concentration, points of release and a description of effluent treatment, including demonstration that the chosen option has been designed to achieve best available treatment technology and techniques economically achievable. The Canadian Nuclear Safety Commission shall also require OPG to conduct a risk assessment on the proposed residual releases to determine whether additional mitigation measures may be necessary.

**Recommendation # 16 (Section 5.3):**

The Panel recommends that prior to the start of construction, the Canadian Nuclear Safety Commission require the proponent to establish toxicity testing criteria and provide the test methodology and test frequency that will be used to confirm that stormwater discharges from the new nuclear site comply with requirements in the *Fisheries Act*.

**Recommendation # 17 (Section 5.4):**

The Panel recommends that the Canadian Nuclear Safety Commission require OPG to provide an assessment of the ingress and transport of contaminants in groundwater on site during successive phases of the Project as part of the Application for a Licence to Construct. This assessment shall include consideration of the impact of wet and dry deposition of all contaminants of potential concern and

radiological constituents, especially tritium, in gaseous emissions on groundwater quality. OPG shall conduct enhanced groundwater and contaminant transport modelling for the assessment and expand the modelling to cover the effects of future dewatering and expansion activities at the St. Marys Cement quarry on the Project.

**Recommendation # 26 (Section 5.5):**

The Panel recommends that the Canadian Nuclear Safety Commission require OPG to develop a comprehensive assessment of hazardous substance releases and the required management practices for hazardous chemicals on site, in accordance with the *Canadian Environmental Protection Act*, once a reactor technology has been chosen.

**Recommendation # 27 (Section 5.6):**

The Panel recommends that prior to any destruction of the Bank Swallow habitat, the Canadian Nuclear Safety Commission require OPG to implement all of its proposed Bank Swallow mitigation options, including:

- the acquisition of off-site nesting habitat;
- the construction of artificial Bank Swallow nest habitat with the capacity to maintain a population which is at least equal to the number of breeding pairs currently supported by the bluff and as close to the original bluff site as possible; and
- the implementation of an adaptive management approach in the Bank Swallow mitigation plan, with the inclusion of a threshold of loss to be established in consultation with all stakeholders before any habitat destruction takes place.

**Recommendation # 35 (Section 5.7):**

In the event that a once-through condenser cooling system is chosen for the Project, the Panel recommends that prior to operation, the Canadian Nuclear Safety Commission require OPG to include the following in the surface water risk assessment:

- the surface combined thermal and contaminant plume; and
- the physical displacement effect of altered lake currents as a hazardous pulse exposure to fish species whose larvae passively drift through the area, such as lake herring, lake whitefish, emerald shiner and yellow perch.

If the risk assessment result predicts a potential hazard then the Canadian Nuclear Safety

Commission shall convene a follow-up monitoring scoping workshop with Environment Canada, Fisheries and Oceans Canada and any other relevant authorities to develop an action plan.

**Recommendation # 37 (Section 5.7):**

In the event that a once-through condenser cooling system is chosen for the Project, the Panel recommends that prior to construction, the Canadian Nuclear Safety Commission require OPG to determine the total area of permanent aquatic effects from the following, to properly scale mitigation and scope follow-up monitoring:

- the thermal plume + 2° C above ambient temperature;
- the mixing zone and surface plume contaminants;
- physical displacements from altered lake currents; and
- infill and construction losses and modifications.

**Recommendation # 39 (Section 5.9):**

The Panel recommends that prior to construction, the Canadian Nuclear Safety Commission require OPG to prepare a contingency plan for the construction, operation and decommissioning Project stages to account for uncertainties associated with flooding and other extreme weather hazards.

OPG shall conduct localized climate change modelling to confirm its conclusion of a low impact of climate change. A margin/bound of changes to key parameters, such as intensity of extreme weather events, needs to be established to the satisfaction of the Canadian Nuclear Safety Commission. These parameters can be incorporated into hydrological designs leading up to an application to construct a reactor, as well as measures for flood protection.

OPG must also conduct a drought analysis and incorporate any additional required mitigation/design modifications, to the satisfaction of the Canadian Nuclear Safety Commission, as part of a Licence to Construct a reactor.

**Recommendation # 40 (Section 5.9):**

The Panel recommends that prior to construction, the Canadian Nuclear Safety Commission require OPG to:

- establish an adaptive management program for algal hazard to the Project cooling water

system intake that includes the setup of thresholds for further actions; and

- factor the algal hazard assessment into a more detailed biological evaluation of moving the intake and diffuser deeper offshore as part of the detailed siting studies and the cost-benefit analysis of the cooling system.

**Recommendation # 52 (Section 6.8):**

The Panel recommends that prior to construction, the Canadian Nuclear Safety Commission require OPG to make provisions for on-site storage of all used fuel for the duration of the Project, in the event that a suitable off-site solution for the long-term management for used fuel waste is not found.

**Recommendation # 53 (Section 6.8):**

The Panel recommends that prior to construction, the Canadian Nuclear Safety Commission require OPG to make provisions for on-site storage of all of low and intermediate-level radioactive waste for the duration of the Project, in the event that a suitable off-site solution for the long-term management for this waste is not approved.

**Recommendation # 57 (Section 7.2):**

The Panel recommends that prior to construction, the Canadian Nuclear Safety Commission require OPG to undertake an assessment of the off-site effects of a severe accident. The assessment should determine if the off-site health and environmental effects considered in this environmental assessment bound the effects that could arise in the case of the selected reactor technology.

**Recommendation # 58 (Section 7.2):**

The Panel recommends that prior to construction, the Canadian Nuclear Safety Commission confirm that dose acceptance criteria specified in RD-337 at the reactor site boundary—in the cases of design basis accidents for the Project's selected reactor technology—will be met.

**Recommendation # 63 (Section 8.1):**

The Panel recommends that prior to construction, the Canadian Nuclear Safety Commission require OPG to evaluate the cumulative effect of a common-cause severe accident involving all of the nuclear reactors in the site study area to determine if further emergency planning measures are required.

**During Operation**

**Recommendation # 15 (Section 5.3):**

The Panel recommends that following the start of operation of the reactors, the Canadian Nuclear Safety Commission require OPG to conduct monitoring of ambient water and sediment quality in the receiving waters to ensure that effects from effluent discharges are consistent with predictions made in the environmental impact statement and with those made during the detailed design phase.

**Recommendation # 18 (Section 5.4):**

The Panel recommends that based on the groundwater and contaminant transport modelling results, the Canadian Nuclear Safety Commission require OPG to expand the Radiological Environmental Monitoring Program. This program shall include relevant residential and private groundwater well quality data in the local study area that are not captured by the current program, especially where the modelling results identify potential critical groups based on current or future potential use of groundwater.

**Recommendation # 36 (Section 5.7):**

In the event that a once-through condenser cooling system is chosen for the Project the Panel recommends that during operation, the Canadian Nuclear Safety Commission require OPG to undertake adult fish monitoring of large-bodied and small-bodied fish to confirm the effectiveness of mitigation measures and verify the predictions of no adverse thermal and physical diffuser jet effects.

**Recommendation # 54 (Section 7.1):**

The Panel recommends that during operation, the Canadian Nuclear Safety Commission require OPG to implement measures to manage releases from the Project to avoid tritium in drinking water levels exceeding a running annual average of 20 Becquerels per litre at drinking water supply plants in the regional study area.

**Recommendation # 61 (Section 8.1):**

The Panel recommends that during operation, the Canadian Nuclear Safety Commission require OPG to monitor aquatic habitat and biota for potential cumulative effects from the thermal loading and contaminant plume of the discharge structures of the existing Darlington Nuclear Generating Station and the Project.

Over the Life of the Project

**Recommendation # 4 (Section 4.6):**

The Panel recommends that the Canadian Nuclear Safety Commission exercise regulatory oversight to ensure that OPG complies with all municipal and provincial requirements and standards over the life of the Project. This is of particular importance because the conclusions of the Panel are based on the assumption that OPG will follow applicable laws and regulations at all jurisdictional levels.

**Recommendation # 11 (Section 5.2):**

The Panel recommends that the Canadian Nuclear Safety Commission require OPG to develop and implement a follow-up program for soil quality during all stages of the Project.

**Recommendation # 43 (Section 6.2):**

The Panel recommends that the Canadian Nuclear Safety Commission engage appropriate stakeholders, including OPG, Emergency Management Ontario, municipal governments and the Government of Ontario to develop a policy for land use around nuclear generating stations.

**Recommendation # 56 (Section 7.1):**

The Panel recommends that over the life of the Project, the Canadian Nuclear Safety Commission require OPG to conduct ambient air monitoring in the local study area on an ongoing basis to ensure that air quality remains at levels that are not likely to cause adverse effects to human health.

## Fisheries and Oceans Canada

Prior to Construction

**Recommendation # 30 (Section 5.7):**

In the event that a once-through condenser cooling system is chosen for the Project, the Panel recommends that prior to the construction of in-water structures, Fisheries and Oceans Canada require OPG to conduct:

- additional impingement sampling at the existing Darlington Nuclear Generating Station to verify the 2007 results and deal with inter-year fish abundance variability and sample design inadequacies; and

- additional entrainment sampling at the existing Darlington Nuclear Generating Station to better establish the current conditions. The program should be designed to guard against a detection limit bias by including in the analysis of entrainment losses those fish species whose larvae and eggs are captured in larval tow surveys for the seasonal period of the year in which they occur. A statistical optimization analysis will be needed to determine if there is a cost-effective entrainment survey design for round whitefish larvae.

**Recommendation # 32 (Section 5.7):**

In the event that a once-through condenser cooling system is chosen for the Project, the Panel recommends that Fisheries and Oceans Canada require OPG to mitigate the risk of adverse effects from operation, including impingement, entrainment and thermal excursions and plumes, by locating the system intake and diffuser structures in water beyond the nearshore habitat zone. Furthermore, OPG must evaluate other mitigative technologies for the system intake, such as live fish return systems and acoustic deterrents.

During Construction

**Recommendation # 31 (Section 5.7):**

Irrespective of the condenser cooling system chosen for the Project, the Panel recommends that Fisheries and Oceans Canada not permit OPG to infill beyond the two-metre depth contour in Lake Ontario.

Over the Life of the Project

**Recommendation # 28 (Section 5.7):**

The Panel recommends that Fisheries and Oceans Canada require OPG to continue conducting adult fish community surveys in the site study area and reference locations on an ongoing basis. These surveys shall be used to confirm that the results of 2009 gillnetting and 1998 shoreline electrofishing reported by OPG, and the additional data collected in 2010 and 2011, are representative of existing conditions, taking into account natural year-to-year variability.

Specific attention should be paid to baseline gillnetting monitoring in spring to verify the findings on fish spatial distribution and relatively high native fish species abundance in the embayment area, such as white sucker and round whitefish. The shoreline electrofishing habitat use study is needed to establish the contemporary baseline for later use to test for effects of lake infill armouring, if employed, and the effectiveness of mitigation.

**Recommendation # 29 (Section 5.7):**

The Panel recommends that Fisheries and Oceans Canada require OPG to continue the research element of the proposed Round Whitefish Action Plan for the specific purpose of better defining the baseline condition, including the population structure, genome and geographic distribution of the round whitefish population as a basis from which to develop testable predictions of effects, including cumulative effects.

**Recommendation # 33 (Section 5.7):**

The Panel recommends that Fisheries and Oceans Canada require OPG to conduct an impingement and entrainment follow-up program at the existing Darlington Nuclear Generating Station and the Project site to confirm the prediction of adverse effects, including cumulative effects, and the effectiveness of mitigation. For future entrainment sampling for round whitefish, a statistical probability analysis will be needed to determine if unbiased and precise sample results can be produced.

## Transport Canada

Prior to Construction

**Recommendation # 49 (Section 6.7):**

The Panel recommends that prior to construction, Transport Canada ensure that OPG undertake additional quantitative analysis, including collision frequencies and rail crossing exposure indices, and monitor the potential effects and need for mitigation associated with the Project.

**Recommendation # 50 (Section 6.7):**

The Panel recommends that prior to construction, Transport Canada require OPG to conduct a risk assessment, jointly with Canadian National Railway, that includes:

- an assessment of the risks associated with a derailment or other rail incident that could affect the Project;
- an analysis of the risks associated with a security threat, such as a bomb being placed on a train running on the tracks that bisect the Project;
- a comparative evaluation of the effectiveness of various mitigation measures or combination of measures (e.g., blast wall, retaining wall, recessed tracks, berm and railway speed restrictions within the vicinity of the site);
- a determination of the design criteria necessary to ensure the effectiveness of these measures (e.g., the appropriate height, strength, material and design of a blast wall); and
- a critical analysis to confirm that these measures, when properly designed and implemented, would be sufficient to provide protection to the Project site in the event of a derailment at full speed or other adverse event.

**Recommendation # 51 (Section 6.7):**

In the event that a once-through condenser cooling system is chosen for the Project, the Panel recommends that prior to construction, Transport Canada work with OPG to develop a follow-up program to verify the accuracy of the prediction of no significant adverse effects to boating safety from the establishment of an increased prohibitive zone. OPG must also develop an adaptive management program, if required, to mitigate potential effects to small watercraft.

## Environment Canada

Prior to Site Preparation

**Recommendation # 62 (Section 8.1):**

The Panel recommends that prior to site preparation, Environment Canada evaluate the need for additional air quality monitoring stations in the local study area to monitor cumulative effects on air quality.



#### During Site Preparation

**Recommendation # 24 (Section 5.5):**

The Panel recommends that during the site preparation stage, Environment Canada shall ensure that OPG not undertake habitat destruction or disruption between the period of May 1 and July 31 of any year to minimize effects to breeding migratory birds.

#### Prior to Construction

**Recommendation # 34 (Section 5.7):**

In the event that a once-through condenser cooling system is chosen for the Project, the Panel recommends that prior to construction, Environment Canada ensure that enhanced resolution thermal plume modelling is conducted by OPG, taking into account possible future climate change effects. Fisheries and Oceans Canada shall ensure that the results of the modelling are incorporated into the design of the outfall diffuser and the evaluation of alternative locations for the placement of the intake and the diffuser of the proposed condenser cooling water system.

#### During Operation

**Recommendation # 23 (Section 5.5):**

The Panel recommends that Environment Canada collaborate with OPG to develop and implement a follow-up program to confirm the effectiveness of OPG's proposed mitigation measures for bird communities should natural draft cooling towers be chosen for the condenser cooling system.

### Health Canada

#### Over the Life of the Project

**Recommendation # 55 (Section 7.1):**

The Panel recommends that Health Canada and the Canadian Nuclear Safety Commission continue to participate in international studies seeking to identify long-term health effects of low-level radiation exposures, and to identify if there is a need for revision of limits specified in the Radiation Protection Regulations.

### The Canadian Environmental Assessment Agency

#### General

**Recommendation # 64 (Section 8.1):**

The Panel recommends that the Canadian Environmental Assessment Agency revise the Canadian Environmental Assessment Agency Cumulative Effects Practitioner's Guide to specifically include a consideration of accident and malfunction scenarios.

### The Government of Canada

#### Prior to Construction

**Recommendation # 60 (Section 7.3):**

The Panel recommends that prior to construction, the Government of Canada review the adequacy of the provisions for nuclear liability insurance. This review must include information from OPG and the Region of Durham regarding the likely economic effects of a severe accident at the Darlington Nuclear site where there is a requirement for relocation, restriction of use and remediation of a sector of the regional study area.

**Recommendation # 66 (Section 8.5):**

The Panel recommends that the Government of Canada update the *Nuclear Liability and Compensation Act* or its equivalent to reflect the consequences of a nuclear accident. The revisions must address damage from any ionizing radiation and from any initiating event and should be aligned with the polluter pays principle. The revised *Nuclear Liability and Compensation Act*, or its equivalent, must be in force before the Project can proceed to the construction phase.

#### Over the Life of the Project

**Recommendation # 65 (Section 8.5):**

The Panel recommends that the Government of Canada make it a priority to invest in developing solutions for long-term management of used nuclear fuel, including storage, disposal, re-processing and re-use.

General

**Recommendation # 67 (Section 8.5):**

The Panel recommends that the Government of Canada provide clear and practical direction on the application of sustainability assessment in environmental assessments for future nuclear projects.

## The Government of Ontario

Over the Life of the Project

**Recommendation # 44 (Section 6.2):**

The Panel recommends that the Government of Ontario take appropriate measures to prevent sensitive and residential development within three kilometres of the site boundary.

**Recommendation # 46 (Section 6.3):**

Given that a severe accident may have consequences beyond the three and 10-kilometre zones evaluated by OPG, the Panel recommends that the Government of Ontario, on an ongoing basis, review the emergency planning zones and the emergency preparedness and response measures, as defined in the Provincial Nuclear Emergency Response Plan (PNERP), to protect human health and safety.

## The Municipality of Clarington

Over the Life of the Project

**Recommendation # 45 (Section 6.2):**

The Panel recommends that the Municipality of Clarington prevent, for the lifetime of the nuclear facility, the establishment of sensitive public facilities such as school, hospitals and residences for vulnerable clientele within the three kilometre zone around the site boundary.

**Recommendation # 59 (Section 7.3):**

The Panel recommends that the Municipality of Clarington manage development in the vicinity of the Project site to ensure that there is no deterioration in the capacity to evacuate members of the public for the protection of human health and safety.

## Ontario Power Generation

Over the Life of the Project

**Recommendation # 42 (Section 6.1):**

The Panel recommends that on an ongoing basis, OPG pursue its strategy to ensure that Aboriginal students can benefit from the permanent job opportunities that will be available during the lifetime of the Project. In this regard, OPG should collaborate with various secondary and post-secondary education institutions as well as Aboriginal groups to ensure that such programs would be successful.

# Introduction

The Darlington New Nuclear Power Plant Project (the Project) is a proposal by Ontario Power Generation (OPG) for the site preparation, construction, operation, decommissioning and abandonment of up to four new nuclear reactors at its existing Darlington Nuclear site. The site is located in Bowmanville, Ontario, on the north shore of Lake Ontario, about 70 kilometres east of Toronto, in the Municipality of Clarington, within the Regional Municipality of Durham (Figure 1: Location of the Project). The Project is expected to generate up to 4,800 megawatts of electricity for delivery to the Ontario grid, with an initial need of 2,000 megawatts.

OPG is the owner of the Darlington Nuclear site, the operator of the existing Darlington Nuclear Generating Station on this site and the proponent for the proposed Project (Figure 2: Darlington Nuclear Site Plan).

The Ontario Minister of Energy, consistent with the Government of Ontario Long-Term Energy Plan and Supply Mix Directive, directed OPG to begin the federal approvals process, including an environmental assessment, for new nuclear units at an existing nuclear site. The Government of Ontario selected the existing Darlington Nuclear site as the preferred site for development of the Project.

The Project consists of up to four units, each comprising a reactor building that houses a reactor vessel, a fuel handling system, a heat transport system, a moderator system, reactivity control mechanisms and shut down systems inside a containment structure, and the turbine generator powerhouse, which includes the turbines, generators and related systems and structures that convert steam into electrical energy.

The Project also includes facilities shared between reactors, and condenser cooling systems and structures that remove residual heat from the steam that powers the turbines. The condenser cooling system may utilize either cooling towers or a once-through lakewater cooling system, and includes all of the associated submerged intake, forebay and discharge systems.

The Project includes a low and intermediate-level radioactive waste management facility for the interim storage of radioactive waste. Low and intermediate-level waste will either be managed on site at the Darlington Waste Management Facility or transported off site to be managed at an appropriate licensed facility.

The Project also includes a proposed used fuel dry storage facility for the interim storage of used fuel produced by the Project. This fuel waste will either be stored at the existing Darlington Waste Management Facility or at this new facility to be constructed on the Project site. OPG indicated that the Darlington Waste Management Facility could be expanded if necessary to accommodate storage of all used fuel produced over the lifetime of the Project.

Ancillary buildings would also be constructed as part of the Project, including administrative offices, parking and security-related facilities.

Three major phases were identified for the Project: the site preparation and construction phase, the operation and maintenance phase and the decommissioning and abandonment phase. The site preparation and construction phase is expected to be six to eight years for the first two reactors and an additional six to eight years for the remaining two reactors, should they be constructed. The operation and maintenance phase is expected to be 60 years for each reactor, including a mid-life refurbishment. The decommissioning and abandonment phase is expected to take place between 2100 and 2150.

The Joint Review Panel (the Panel) under the *Canadian Environmental Assessment Act* and the *Nuclear Safety and Control Act* was established by the Minister of the Environment and the President of the Canadian Nuclear Safety Commission on October 30, 2009 to undertake the review of the Project. The Panel Members are Mr. Alan R. Graham, Ms. Jocelyne Beaudet and Mr. Joseph Kenneth Pereira.

The Panel was established to carry out an environmental assessment of the Project and to review the Application for a Licence to Prepare

Site. Together, the environmental assessment and consideration of the licence application constitute the review. The Panel was to assess the environmental effects of the Project and determine whether it is likely to cause significant, adverse environmental effects, taking into consideration the implementation of mitigation measures.

This report sets out the rationale, conclusions and recommendations of the Panel relating to the environmental assessment of the Project, including any mitigation measures and follow-up program. It also includes a summary of comments received from the public in the course of the public hearing, as well as the Panel's views on matters raised throughout the review.

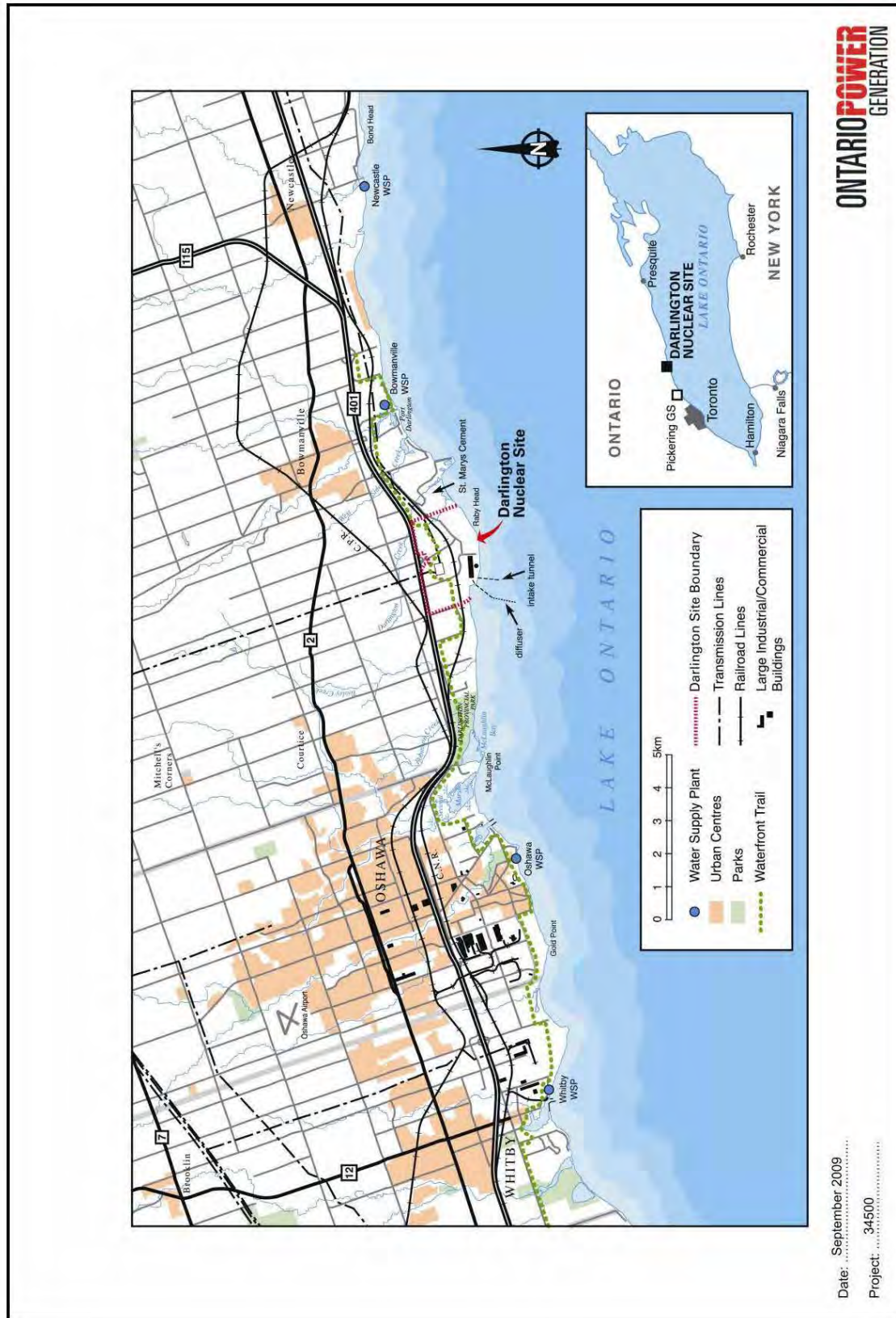


Figure 1: Location of the Project



Figure 2: Darlington Nuclear Site Plan



# Chapter 1 – The Joint Review Panel Process

This chapter outlines and describes the process for the Panel review of the proposed Project. This includes the legislative framework and requirements for the review, the review process including public participation, and a description of the environmental assessment methodology of the proponent.

## 1.1 Legislative Framework

The review process for the Project began on September 21, 2006 when OPG submitted an application for approval to prepare a site for the Project to the Canadian Nuclear Safety Commission. This Application for a Licence to Prepare Site, the first in a series of licences that would be required for the Project, initiated the process under subsection 24(2) of the *Nuclear Safety and Control Act* (S.C. 1997, c. 9).

Over the life of a new nuclear generation project, the following licences would be required under the *Nuclear Safety and Control Act*:

- Licence to Prepare Site;
- Licence to Construct;
- Licence to Operate;
- Licence to Decommission; and
- Licence to Abandon.

In June of 2006, the Canadian Nuclear Safety Commission determined that sufficient information was available to confirm that the licensing action for the Project is prescribed on the *Law List Regulations* (SOR/94-636), and required the application of the *Canadian Environmental Assessment Act* (S.C. 1992, c. 37) to the Project. The Canadian Nuclear Safety Commission therefore established that it was a responsible authority under the *Canadian Environmental Assessment Act* and that the Project was of a type described in the *Comprehensive Study List Regulations* (SOR/94-638).

The Canadian Nuclear Safety Commission circulated the Project information to other federal departments and agencies with a possible interest or responsibility under the *Canadian Environmental Assessment Act* in relation to the Project.

Fisheries and Oceans Canada declared that it would be a responsible authority because, at a minimum, the Project would likely require authorization under subsection 35(2) of the *Fisheries Act* (R.S.C., 1985, c. F-14) for the harmful alteration, disruption or destruction of fish habitat.

Transport Canada declared that it would be a responsible authority because the Project would likely require authorization under paragraph 5(1)(a) of the *Navigable Waters Protection Act* (R.S.C., 1985, c. N-22) for a work built or placed in, on, over, under, through or across a navigable water.

The Canadian Transportation Agency declared that it would be a responsible authority if the Project required construction of a railway line under subsection 98(2) of the *Canada Transportation Act* (S.C. 1996, c. 10).

Environment Canada, Health Canada and Natural Resources Canada declared that they would be federal authorities with expert information or knowledge to offer in relation to the Project.

The Ontario Ministry of the Environment indicated on April 5, 2007 that the Government of Ontario had no mandate to make nuclear facilities subject to the Ontario *Environmental Assessment Act* (R.S.O. 1990, c. E.18). The Project was excluded from a provincial environmental assessment because it was not a designated undertaking pursuant to the Ontario *Electricity Projects Regulations* (O. Reg. 116/01), which identify the electricity projects that are subject to the Ontario *Environmental Assessment Act*. Relevant provincial ministries did participate throughout the review process, however, by providing information and advice at the request of the Panel.

On March 20, 2008, following a request by the President of the Canadian Nuclear Safety Commission, the federal Minister of the Environment announced referral of the Project for an environmental assessment by a review panel pursuant to the *Canadian Environmental Assessment Act*. Given that both the environmental assessment review panel and the

Licence to Prepare Site process would involve the conduct of a public hearing, the Canadian Nuclear Safety Commission and the Canadian Environmental Assessment Agency pursued the opportunity for a joint environmental assessment and licence review process for the purpose of regulatory efficiency and improvement.

On September 5, 2008, the draft *Guidelines for the Preparation of the Environmental Impact Statement for the Ontario Power Generation Darlington New Nuclear Power Plant Project* (the EIS Guidelines) and a draft agreement to establish a Joint Review Panel for the Project (the Joint Review Panel Agreement) were made available by the Canadian Nuclear Safety Commission and the Canadian Environmental Assessment Agency for a 75-day public review and comment period. The draft EIS Guidelines outlined the minimum information requirements for the environmental impact statement (EIS) to be prepared by OPG to allow the detailed analysis of the potential environmental effects of the Project. The draft Guidelines also listed the requirements for the Licence to Prepare Site. The draft Joint Review Panel Agreement proposed how the panel would function and the terms of reference for conducting the environmental assessment and the consideration of the licence application.

Thirty-four submissions were received during the review and comment period on the draft documents. The EIS Guidelines and Joint Review Panel Agreement were amended by the Canadian Environmental Assessment Agency and the Canadian Nuclear Safety Commission following consideration of these comments, and were issued as final products by the Government of Canada on March 12, 2009.

OPG submitted the EIS and supporting technical documents as well as a revised Application for a Licence to Prepare Site to the Canadian Nuclear Safety Commission and federal departments and agencies on September 30, 2009.

The EIS, supporting documents, licence application and the records that were generated by the Panel or received in the course of the review were available on the Internet through the Canadian Environmental Assessment Registry (the public registry), reference number 07-05-29525.

## 1.2 Joint Review Panel Agreement

A copy of the Joint Review Panel Agreement between the Minister of the Environment and the President of the Canadian Nuclear Safety Commission is included in Appendix 1. The Agreement established a Panel that would:

- constitute a review panel pursuant to sections 40, 41 and 42 of the *Canadian Environmental Assessment Act* for the purposes of carrying out an environmental assessment of the Project; and
- constitute a panel of the Canadian Nuclear Safety Commission, created pursuant to section 22 of the *Nuclear Safety and Control Act*, for the purposes of the review of the licence application pursuant to section 24 of the Act.

Together, the environmental assessment and consideration of the licence application constitute the review.

It is the responsibility of the Minister of the Environment to define the scope of the Project and the factors to be considered in the environmental assessment. These parameters were laid out in the Terms of Reference that were attached to the Agreement.

The scope of the Project was defined as the site preparation, construction, operation, decommissioning and abandonment of up to four new nuclear power reactors. The scope included the management of all conventional and radioactive wastes and acknowledged that a range of reactor technologies for the Project were being considered by the Government of Ontario for the Project.

The factors to be considered in the review were defined as:

- a) the environmental effects of the Project, including the environmental effects of malfunctions, accidents or malevolent acts that may occur in connection with the Project and any cumulative environmental effects that are likely to result from the Project in combination with other projects or activities that have been or will be carried out;



- b) the significance of the effects referred to in (a);
- c) comments that are received during the review;
- d) measures that are technically and economically feasible and that would mitigate any significant adverse environmental effects of the Project;
- e) purpose of the Project;
- f) need for the Project;
- g) alternatives to the Project;
- h) alternative means of carrying out the Project that are technically and economically feasible and the environmental effects of any such alternative means;
- i) measures to enhance any beneficial environmental effects;
- j) the requirements of a follow-up program in respect of the Project;
- k) the capacity of renewable resources that are likely to be significantly affected by the Project to meet the needs of the present and those of the future; and
- l) consideration of community knowledge and Aboriginal traditional knowledge.

The Terms of Reference also outlined the scope of assessment of the Application for Licence to Prepare Site. This directed that the Panel must decide:

- a) whether the applicant is qualified to perform the activity to be licensed (preparation of the site); and
- b) whether in carrying out that activity, the applicant will make adequate provisions for the protection of the environment, the health and safety of persons and the maintenance of national security and measures required to implement international obligations to which Canada has agreed.

The Joint Review Panel Agreement also included the Panel constitution and appointment provisions and provided guidance regarding the conduct of the review.

### 1.3 The Review

The Panel under the *Canadian Environmental Assessment Act* and the *Nuclear Safety and Control Act* was established by the Minister of the Environment and the President of the Canadian Nuclear Safety Commission on October 30, 2009 to undertake the review of the Project. The role of the Panel was to evaluate

information related to the environmental assessment, as well as consider information submitted by OPG in support of its Application for a Licence to Prepare Site.

The Panel announced the start of the review and comment period on the EIS and documents in support of the Application for a Licence to Prepare Site on November 16, 2009. Subsequently, the Panel issued preliminary instructions for this step in the review. The review and comment period was to be a maximum of six months, excluding any time required by the proponent to respond to requests for additional information from the Panel.

The Panel toured the proposed Project site and the existing Darlington Nuclear Generating station on December 16, 2009. Panel Members were accompanied by the Panel Secretariat, a staff member of Canadian Nuclear Safety Commission who is assigned to the existing Darlington Nuclear Generating Station, and members of OPG staff.

The Panel held two technical review sessions at the Canadian Nuclear Safety Commission headquarters in Ottawa for information purposes. Both sessions were webcasted live via the Canadian Nuclear Safety Commission Web site, and transcripts of the proceedings were posted on the public registry for the Project. Only the Panel was permitted to ask questions at these sessions.

The first technical information session—on the topic of nuclear power plant technologies—was held on December 15, 2009. The objective of the session was to provide information on reactor technologies to help the Panel acquire an understanding of the principal design features, layouts, key operational parameters, overall normal operation, key safety systems, and the key similarities and differences of the reactor technologies. Canadian Nuclear Safety Commission staff (CNSC staff) made presentations on the reactor technologies proposed by OPG, condenser cooling technologies in general and waste management facilities.

The second technical session was held on June 22, 2010. The purpose of this session was for the Panel to pose questions to OPG to assist with its ongoing effort to collect the information required to determine if OPG had sufficiently responded to the EIS Guidelines for the Project. The Panel

identified and addressed subjects including the plant parameter envelope and site layout, atmospheric environment, groundwater, aquatic biota and habitat, malfunctions and accidents, waste management and environmental assessment methodology.

In the course of its review of the EIS and documents in support of the Application for a Licence to Prepare Site, the Panel requested specific information and opinion from the Pacific Northwest National Laboratory on water-cooling systems.

In the first week of June 2010, the Panel Secretariat held three open house information sessions at public venues in the Project area. The objective of the sessions was to provide members of the public, Aboriginal groups, governments and other interested parties an opportunity to hear about the review and how they may participate in the process, and to learn about the role and mandate of the Panel. The Secretariat made short presentations at each session and answered questions from the audience. The Panel Members did not attend these sessions.

On December 14, 2010, the Panel announced that it had obtained enough information to proceed to a public hearing for the Project. The hearing was held from March 21, 2011 until April 8, 2011 in the Municipality of Clarington, Ontario. On May 12, 2011, the Panel held a closed session at Canadian Nuclear Safety Commission headquarters in Ottawa to discuss security matters in relation to the proposed Project and the Application for a Licence to Prepare Site, which was attended only by the Panel Members, the Panel Secretariat, CNSC staff and OPG. The purpose of this session was for the Panel to examine measures proposed by OPG to ensure compliance with the *Nuclear Security Regulations* (SOR/2000-209).

On June 3, 2011, the Panel announced that it had obtained and made public all of the information that it needed to prepare its environmental assessment report and closed the record for the environmental assessment. As stipulated in the Joint Review Panel Agreement, the Panel then had a period of 90 days to complete and submit its report to the Government of Canada through the Minister of the Environment.

## 1.4 Participant Funding

On April 1, 2008, the Canadian Environmental Assessment Agency announced the establishment of a participant funding program pursuant to the *Canadian Environmental Assessment Act*. A total of \$75,000 was made available to facilitate the participation of eligible groups and individuals in the review of the draft EIS Guidelines and the draft Joint Review Panel Agreement. A Funding Review Committee, independent from the Panel, was established to review the funding applications and to recommend the allocation of funding to the President of the Canadian Environmental Assessment Agency. The Committee reviewed five applications requesting a total of \$121,650 and recommended all of the allocated \$75,000 for disbursement. The President of the Agency awarded \$75,000 to three of the five applicants—the Power Workers Union, Lake Ontario Waterkeeper and Greenpeace Canada—on June 4, 2008.

On June 9, 2008, the Canadian Environmental Assessment Agency approved up to \$100,000 to facilitate Aboriginal participation in the environmental assessment and related consultation activities. Information on the availability of funds was communicated to Aboriginal groups that could be affected by the Project. On August 19, 2009, the Funding Review Committee met to review the one application received under the Aboriginal Funding Envelope established by the Canadian Environmental Assessment in June 2008. The Committee recommended an award to the Métis Nation of Ontario.

On June 19, 2009, the Canadian Environmental Assessment Agency announced the availability of an additional \$150,000 to support public participation in the Project review. The activities eligible for funding included review of the EIS prepared by OPG and preparation for and participation in the public hearing to be conducted by the Panel. The Funding Review Committee reviewed eight applications requesting a total of \$314,242.48 in funding and recommended that funds be awarded to five of the applicants. On November 2, 2009, the President of the Agency awarded a total of \$155,927 in participant funding to Lake Ontario Waterkeeper, the Clarington Board of Trade, Northwatch, Safe and Green Energy Peterborough and Mouvement Vert Mauricie.

## 1.5 OPG Environmental Assessment Methodology

OPG maintained that the methodology applied in the assessment of environmental effects was consistent with the requirements of the *Canadian Environmental Assessment Act* and related guidance, and the EIS Guidelines.

### 1.5.1 Spatial Boundaries

The EIS Guidelines required that the geographic study areas for the environmental assessment encompass the areas that could reasonably be expected to be affected by the Project, or which could be relevant to the cumulative environmental effects assessment.

OPG confirmed that it followed the EIS Guidelines requirement for the site study area to include the facilities, buildings and infrastructure at the Darlington Nuclear site, including the existing licensed exclusion zone for the site on land and within Lake Ontario, and particularly the property where the Project would be located.

The EIS Guidelines required that the local study area extend beyond the site study area where there is a reasonable potential for the Project to cause environmental effects through normal activities or from accidents or malfunctions. The local study area was to include the Darlington Nuclear site, the lands within the Municipality of Clarington closest to the Project and the area of Lake Ontario adjacent to the Project. OPG asserted that it expanded the local study area substantially beyond the area suggested in the EIS Guidelines to include all of the Municipality of Clarington and the easterly urbanized portion of the City of Oshawa. This local study area generally coincides with the primary zone for emergency response as identified by Emergency Measures Ontario.

The EIS Guidelines prescribed that the regional study area was to encompass the area where there is the potential for cumulative biophysical and socio-economic effects. OPG defined that the regional study area extended approximately 40 kilometres east and west of the Darlington Nuclear site—to the Durham Region boundary to the west and the town of Cobourg to the east—thereby including both the Pickering Nuclear Generating Station and the town of Port Hope historic low-level radioactive waste sites. To the north, the regional study area included the Oak

Ridges Moraine and the nearby provincially-designated greenbelt area.

OPG stated that it adjusted the study areas as appropriate for individual environmental assessment studies conducted for each environmental component.

### 1.5.2 Valued Ecosystem Components

For each environmental component the baseline characterization included identification of the valued ecosystem components considered relevant for that environmental component. Valued ecosystem components are features of the environment selected to be the focus of the environmental assessment because of their ecological, social, cultural or economic value and their potential vulnerability to effects of the Project. The selected valued ecosystem components and their corresponding environmental components are summarized in Table 1: Environmental Components and Valued Ecosystem Components.

The preliminary list of valued ecosystem components was provided in the EIS Guidelines. OPG stated that its final selection of valued ecosystem components included input from the public and other stakeholders.

### 1.5.3 Follow-up Programs

OPG provided information regarding its preliminary follow-up and monitoring program. OPG explained that the purpose of a follow-up program under the *Canadian Environmental Assessment Act* is to verify the accuracy of the environmental assessment of a project and to determine the effectiveness of any measures taken to mitigate the adverse environmental effects of a project. OPG noted that in practice, these objectives are typically expanded to also confirm whether assumptions made during the environmental assessment remain accurate, that mitigation measures have been implemented and are effective and to assist in identifying new mitigation strategies that may be implemented in the event that applied mitigation measures are not completely effective in ameliorating adverse effects.

Following a request from the Panel for more information, OPG further elaborated on follow-up measures and commitments.

Table 1: Environmental Components and Valued Ecosystem Components (VECs).

Environmental Components	Relevant VECs
Atmospheric Environment	<ul style="list-style-type: none"> <li>• Pathway to human health</li> <li>• Pathway to non-human biota health</li> <li>• Pathway to VECs in other environmental components</li> </ul>
Surface Water Environment	<ul style="list-style-type: none"> <li>• Pathway to human health</li> <li>• Pathway to non-human biota health</li> <li>• Pathway to VECs in other environmental components</li> </ul>
Aquatic Environment	<ul style="list-style-type: none"> <li>• Darlington Creek and intermittent tributary to Darlington Creek</li> <li>• Lake Ontario nearshore</li> <li>• Forage species</li> <li>• Benthivorous fish</li> <li>• Predatory fish</li> </ul>
Terrestrial Environment	<ul style="list-style-type: none"> <li>• Cultural Meadow and Thicket Ecosystem</li> <li>• Shrub Bluff Ecosystem</li> <li>• Wetland Ecosystem</li> <li>• Woodland Ecosystem</li> <li>• Dragonflies and damselflies</li> <li>• Migrant butterfly stopover area</li> <li>• Breeding birds</li> <li>• Migrant songbirds and their habitat</li> <li>• Waterfowl staging areas and winter habitat</li> <li>• Migrant songbirds and their habitat</li> <li>• Winter raptor feeding and roosting areas</li> <li>• Breeding and key summer habitat (amphibians and reptiles)</li> <li>• Breeding mammals</li> <li>• Wildlife corridors</li> </ul>
Geological & Hydrogeological Environment	<ul style="list-style-type: none"> <li>• Pathway to human health</li> <li>• Pathway to non-human biota health</li> <li>• Pathway to VECs in other environmental components</li> </ul>
Radiation & Radioactivity	<ul style="list-style-type: none"> <li>• Pathway to human health</li> <li>• Pathway to non-human biota health</li> </ul>
Land Use Environment	<ul style="list-style-type: none"> <li>• Land use planning regime in local study area</li> <li>• Visual aesthetics</li> </ul>
Traffic & Transportation	<ul style="list-style-type: none"> <li>• Transportation system operations (road, rail, marine)</li> <li>• Transportation system safety (road, rail, marine)</li> </ul>
Physical & Cultural Heritage Resources	<ul style="list-style-type: none"> <li>• Aboriginal archaeological resources</li> <li>• Euro-Canadian archaeological resources</li> <li>• Euro-Canadian built heritage resources</li> <li>• Euro-Canadian cultural landscape resources</li> </ul>
Socio-Economic Environment	<ul style="list-style-type: none"> <li>• Local and regional population</li> <li>• Education</li> <li>• Health and safety services</li> <li>• Local and regional economic development</li> <li>• Agriculture</li> <li>• Residential property values</li> <li>• Municipal revenues and financial status</li> <li>• Housing</li> <li>• Community character and image</li> <li>• Municipal infrastructure and services</li> <li>• Community and recreational facilities and services</li> <li>• Ability to use and enjoy property</li> <li>• Community cohesion</li> </ul>
Aboriginal Interests	<ul style="list-style-type: none"> <li>• Community characteristics</li> <li>• Hunting and fishing for subsistence</li> <li>• Fishing, trapping and traditional harvesting and collecting for sustenance, recreational and economic purposes</li> </ul>
Health – Humans	<ul style="list-style-type: none"> <li>• Members of the public</li> <li>• Workers on the Darlington New Nuclear Power Plant Project</li> </ul>
Health – Non-human Biota	<ul style="list-style-type: none"> <li>• Terrestrial vegetation</li> <li>• Insects and invertebrates</li> <li>• Birds and waterfowl</li> <li>• Mammals</li> <li>• Amphibians and reptiles</li> <li>• Benthic invertebrates</li> <li>• Aquatic vegetation</li> <li>• Fish</li> </ul>

## Chapter 2 – Project Description

This chapter provides a description of the Project for the purpose of the environmental assessment. This includes a description of the reactor technologies used by OPG to develop the bounding envelope for the Project, site layout scenarios, the phases of the Project, the alternative means of carrying out the Project, the description of the management of conventional and hazardous wastes, security and safety programs and cost estimates for the Project.

### 2.1 Multiple Technology Approach

A number of vendors and reactor technologies were considered in the procurement process initiated by the Government of Ontario. No decision was made on the choice of a reactor technology prior to the start of the environmental assessment. For this reason, OPG chose to use a multiple-technology approach to describe the Project for the purpose of the environmental assessment. This approach led to the development of a plant parameter envelope to encompass the range of reactor technologies under consideration. The plant parameter envelope is a set of data derived from available vendor information for multiple reactor technologies, and provides a bounding envelope of plant design and site parameter values for use in the Application for a Licence to Prepare Site and environmental assessment.

OPG explained that the plant parameter envelope identified a set of design parameters and associated limiting values, such as a worst-case scenario, from the multiple technologies that are used to describe the bounding features of the Project. OPG stated that this approach is consistent with *Canadian Nuclear Safety Commission Information Guide INFO-0756, Rev 1, Licensing Process for New Nuclear Power Plants in Canada* (May 2008), which provides an overview of the process for licensing new nuclear power plants in Canada, taking into consideration the requirements of the *Nuclear Safety and Control Act* and associated regulations, as well as an environmental assessment.

The bounding plant parameter envelope used in the assessment of effects is based on the limiting values for parameters either from:

- the reactor technology examples;
- the reactor class, such as pressurized water reactor, pressurized heavy and light water hybrid reactor and pressurized heavy water reactor; or
- the site itself.

OPG explained that the framework bounded by the plant parameter envelope was established to ensure that the potential adverse effects of any of the reactor types currently under consideration by the Government of Ontario are included for the purposes of the effects analysis. As such, the significance of the potential adverse effects of any reactor technology that is bounded by the analysis has been considered.

If the Project is to go forward, the reactor technology selected by the Government of Ontario must be demonstrated to conform to the plant parameter envelope and regulatory requirements, and must be consistent with the assumptions, conclusions and recommendations of the environmental assessment and the details of the Government response to this Joint Review Panel Environmental Assessment Report. This evaluation will be required to be performed by the responsible authorities once a reactor technology is selected and will be required to be demonstrated as part of the licence process for an Application for a Licence to Construct.

### 2.2 Reactor Designs

The following reactor technologies formed the basis of the plant parameter envelope:

- ACR 1000 by Atomic Energy of Canada Limited;
- EPR by AREVA;
- AP 1000 by Westinghouse; and
- Enhanced CANDU 6 (EC6) by Atomic Energy of Canada Limited.

For environmental assessment purposes, the number of reactors that would represent full build-out of the Project for each reactor type was adopted to consider the potential effects during the operation and maintenance phase of the Project. The scope of the Project includes the maximum potential development of the site within the upper limit of 4,800 megawatts. This

means that the number of units of each reactor type that would be required to achieve the upper limit of 4,800 megawatts of electrical power generation will vary, depending on the reactor technology, as follows:

- 4 ACR 1000 to achieve approximately 4,300 megawatts;
- 3 EPR to achieve approximately 4,700 megawatts;
- 4 AP 1000 to achieve approximately 4,200 megawatts; and
- 4 EC6 to achieve approximately 2,960 megawatts.

During the review and comment period, CNSC staff recommended to the Panel that OPG should update the plant parameter envelope for the Project to include the EC6 reactor technology by Atomic Energy of Canada Limited. The basis for the CNSC staff recommendation was that the procurement process for the Government of Ontario reactor selection had been suspended and no reactor had yet been selected. CNSC staff expressed the view that the EC6 technology was a possible technology choice for the Project, and as such, it should be encompassed by the plant parameter envelope. CNSC staff noted that in the interest of regulatory efficiency and to minimize the likelihood that another environmental assessment would be required should the EC6 reactor technology be put forth as the technology to be constructed on the Darlington Nuclear site, it would be prudent to also consider this technology option within the current review process being conducted by the Panel.

OPG responded that the plant parameter envelope for the Project was sufficiently broad to include other alternative technologies that are commercially available that may be selected by the Government of Ontario, including boiling water reactors and the EC6 reactor technology. OPG was of the view that the conclusions of the environmental assessment would not change should an alternative reactor technology be selected.

In consideration of the CNSC staff recommendation and the OPG response, the Panel directed OPG to provide a description of the elements of those technologies that could be outside the plant parameter envelope defined in the EIS. OPG was to provide details on how this could change the potential effects of the Project on components of the environment and any other

aspects of the environmental assessment, and any required changes to the responses to information requests that OPG had already provided to the Panel.

OPG responded to this request by providing an update to the plant parameter envelope and responses to information requests, taking the EC6 reactor technology into consideration. Following further requests for information from the Panel, a revised version of the plant parameter envelope was submitted by OPG on November 30, 2010. OPG noted that a similar assessment was not performed for a boiling water reactor as insufficient information was available to allow OPG to do so. OPG noted that should the Government of Ontario decide to include boiling water-type reactors in its procurement process, the plant parameter envelope would be updated accordingly.

Furthermore, OPG stated that although some plant parameter envelope values changed as a result of the EC6 consideration and other considerations, no additional environmental effects were anticipated and no additional mitigation measures would be required.

## 2.3 Site Layout Scenarios

OPG developed several model plant layout scenarios for environmental assessment purposes. OPG explained that these layouts depicted the maximum extent of development from different planning perspectives for each of the reactor technologies and cooling technologies. OPG stated that the site layouts represented a bounding configuration for overall site development, and that each layout scenario depicted possible locations for reactors, cooling towers, parking and construction laydown areas, the soil stockpile and lake infill areas, and any other overall layout features of the Project.

OPG stated that to create a bounding site development layout, three separate model plant layout scenarios were conceptualized with each one representing the reasonable maximum extent for key parameters of the Project. The three plant layouts represented maximum power generation, land area development and excavation. The three layouts were combined to create a single bounding layout that represented the maximum values among the three scenarios for relevant parameters. This maximum value for each

relevant parameter was used in the OPG assessment of effects.

OPG explained that the model plant layout scenarios were developed on the basis of conceptual design, considering the characteristics of the Darlington Nuclear site, the fundamental Project design elements, and opportunities to accommodate the design elements within the site. OPG noted that when the final Project layout has been designed, it will be confirmed to be enveloped within the bounding site development layout for the environmental assessment and the conclusions of the environmental assessment.

As the review proceeded, OPG provided updated and alternative site layouts, including scenarios for a reduced amount of lake infill and different cooling technologies.

## 2.4 Project Phases

This section describes the three Project phases. These phases include the site preparation and construction phase, the operation and maintenance phase and the decommissioning and abandonment phase.

### 2.4.1 Site Preparation and Construction

OPG stated that the site preparation and construction phase includes all activities needed to prepare the site for construction, followed by the construction of the nuclear reactors and associated buildings, structures and systems. OPG stated that the first two reactors would be constructed over a period of about six to eight years with the possibility of the construction of two more reactors—for a total of four—over an additional eight years.

OPG stated that the following works and activities are expected to be undertaken during the site preparation:

- mobilization and preparatory works, including clearing and grubbing, services and utilities, and on-site roads and related infrastructure;
- excavation and grading, including on-land earthmoving and grading, rock excavation, and development of construction laydown areas;
- marine and shoreline works, including lake infilling, shoreline protection, wharf construction, and some minor lake bottom dredging; and

- development of administration and physical support facilities.

These activities would be comprised of:

- construction and enhancing of on-site roads, which would connect to local roads and provincial Highway 401 as appropriate, to provide access to the site;
- re-establishment of a rail line spur if required;
- construction of a wharf if required;
- construction of parking lots and laydown areas;
- construction site fencing;
- removal of existing trees and vegetation if necessary;
- shoreline stabilization and lake infilling, coffer dam construction;
- realignment of intermittent stream channels and draining of some wet areas across site;
- earthmoving activities, including cutting, filling, grading construction areas, creating berms and stockpiles;
- installation of necessary infrastructure such as power, water main, sewage systems, surface water drainage, storm water sewers; and
- bedrock excavation for building foundations.

The following works and activities are expected to be undertaken during construction:

- the power block, including reactor buildings, turbine-generator buildings, and related structures;
- station cooling facilities and the associated water intake and discharge structures;
- ancillary facilities, including blow-down ponds for the cooling tower options and expansion of the existing switchyard; and
- on-site interim nuclear waste management facilities, including facilities for dry storage of used fuel and facilities for storage of low and intermediate-level radioactive waste.

These activities would be comprised of:

- installation of bedrock piles;
- expansion of the switchyard;
- receipt and management of materials and components for installation;
- installation of the intake and outfall to Lake Ontario;
- construction of cooling towers if required;

- construction of the reactors, power house buildings, structures and systems;
- removal of construction debris to a licensed facility, including any hazardous waste created during construction;
- testing and commissioning of systems and structures;
- landscaping; and
- final-site fencing and security system installation.

OPG noted that the following works and activities are common to both site preparation and construction:

- management of stormwater, including a system of ditches, swales and ponds;
- supply of construction equipment, material and plant operating components;
- management of construction waste, hazardous materials, fuels and lubricants; and
- workforce, payroll and purchasing including an estimated 100 workers during site preparation, up to 3,500 during construction plus a Project team of approximately 300 supervisory and oversight staff.

OPG confirmed that no low and intermediate-level waste or used nuclear fuel would be generated during site preparation and construction.

With respect to the management of waste, OPG assumes that any legacy contamination within the Project site would be remediated prior to the start of site preparation activities.

OPG stated that because the reactor type has not been identified, details concerning the manner in which the Project site would be developed could not be determined. For this reason, works and activities associated with site preparation and construction were defined in the plant parameter envelope.

#### 2.4.2 Operation and Maintenance

The operation and maintenance phase of the Project would commence with the receipt of the first load of fuel for the reactor and end when the reactor has been defuelled in preparation for decommissioning. The operation and maintenance phase includes all of the works and activities that occur on site during routine operation and maintenance of the nuclear reactors and associated buildings, such as turbine

generators, condenser cooling structures and systems, nuclear waste and used fuel storage facilities. OPG expects that the operation and maintenance phase would be approximately 60 operating years for each reactor, including mid-life refurbishment.

This phase includes the operation and maintenance of the following systems:

- the reactor core, including startup, reactivity control/operation and shutdown activities;
- primary heat transport and moderator systems, including management of heavy water with the CANDU-based reactor option;
- active ventilation and radioactive liquid waste management systems;
- safety and related systems such that fundamental safety functions are ensured;
- fuel and fuel handling systems, including receipt and secure storage of new fuel, fuelling/refuelling the reactors and, transfer of used fuel from the reactors to a fuel bay for initial wet storage;
- secondary heat transport systems and turbine-generators, including secondary side of steam generators, main steam system, turbines, condensers and generators;
- condenser cooling and service water systems, involving a once-through lakewater cooling system, similar to the existing Darlington Nuclear Generating Station system, or natural draft, mechanical or fan-assisted natural draft cooling tower alternatives; and
- electrical power systems, including main transformers, and emergency/standby power facilities, site services and utilities.

Other activities included in the operation and maintenance phase include:

- wet storage of used fuel for approximately 10 years in fuel bays within the reactor buildings, followed by dry storage of used fuel at a separately licensed on-site facility, pending eventual transfer to a long-term management facility;
- management and transportation of operational low and intermediate-level waste, pending eventual transfer to a long-term management facility;
- management of conventional non-radioactive wastes, including reuse and recycling;
- maintenance, upgrading and replacement of equipment and systems throughout the



operating life of the station, including possible mid-life refurbishment of major components such as reactor components and steam generators; and

- administration, payroll and purchasing, including an initial operation and maintenance workforce estimated at up to 1,400 for the first two units and up to 2,800, assuming two more units are added later.

As outlined in the EIS Guidelines, the commissioning of a new nuclear power plant consists of the following general activities:

- verification and qualification of systems;
- pressure testing of vessels;
- fuelling of reactor;
- pressure testing of containment building;
- approach to criticality;
- approach to full power;
- testing of the reactor core physics;
- verification of control systems;
- connection to the grid;
- operational testing; and
- full power operation.

Following commissioning, the activities during operation and maintenance would include:

- operation of equipment for production of electricity;
- verification, sampling, testing and maintenance during operation at power;
- maintenance, repairs, cleaning and decontamination during planned shutdowns and outages;
- on-site transportation and handling of fuel, including defuelling and refuelling of the reactor;
- management of low and intermediate waste and spent fuel waste within the reactor building, and the transfer of waste and used fuel for interim or long-term storage;
- management of hazardous substances and hazardous waste;
- activities relating to environmental protection and radiation protection programs; and
- activities required to achieve a safe state of closure prior to decommissioning.

The EIS Guidelines state that during this phase, the assessment would include consideration of the effects associated with mid-life refurbishment for CANDU-type reactors as well as the effects relating to outages to refuel or

refurbish boiling water and pressurized water-type reactors.

The general forms of maintenance performed would include preventative maintenance, corrective maintenance and improvement or upgrade activities. Some maintenance can be performed with the reactor units at power, while other maintenance requires a unit outage. In addition to maintenance, routine surveillance and testing is required to ensure safe and efficient operation of the units.

For each reactor technology example presented, the proponent described the reactor core, heat transport system, and safety and related systems. OPG stated that because the reactor type has not been determined, details concerning the manner in which the Project facility would be operated could also not be determined. For this reason, works and activities associated with operations were defined in the plant parameter envelope.

#### Modification/Refurbishment

For environmental assessment bounding purposes, OPG assumed that during the 60-year operating life of the reactor, components and steam generators would likely require replacement. Each of these activities would require the reactors to be removed from service for a period of up to two years.

Replacement of reactor components would take place within the reactor containment structure. Some reactor components may require decontamination using a chemical process prior to replacement. Shielding and automated tooling would be used where feasible to reduce worker dose.

OPG would use volume reduction techniques such as cutting and crushing for pressure tubes, calandria tubes and feeder piping prior to placement in appropriate containers and storage in the low and intermediate-level waste storage facilities. Steam generators may eventually need to be segmented for off-site shipment by OPG.

All low and intermediate-level waste from refurbishment would be stored in a purpose-built facility on site until the station is decommissioned. However, low and intermediate-level waste from refurbishment may also be transported to an off-site licensed facility. When the site is decommissioned, any on-site

refurbishment waste would be transported off site to a suitable licensed repository.

#### 2.4.3 Decommissioning and Abandonment

The environmental assessment includes the preliminary plan for major activities associated with decommissioning and eventual abandonment that would make the site available for other uses. Decommissioning would begin after a decision has been made to permanently end the operation of the reactor units, and would take approximately 50 years to safely complete. OPG prefers a decommissioning strategy of deferred dismantling, which would involve three main steps:

- Step 1 - preparation for safe storage;
- Step 2 - safe storage and monitoring; and
- Step 3 - dismantling, disposal and site restoration.

The preliminary decommissioning plan provides a breakdown of each of the decommissioning works, with a description of the main activities within each step.

The end-state for the Project, following the decommissioning and abandonment phase, is an unlicensed state. The objective for the end-state for the site is for all radioactive contamination and other hazardous materials to be reduced to established clearance levels as defined in Canadian Nuclear Safety Commission Regulatory Guide G-219, *Decommissioning Planning for Licensed Activities* (June 2000) or to be removed from the site and for all station systems to be dismantled and all buildings to be demolished.

During the decommissioning, all subsurface structures would be drained, de-energized, decontaminated, removed to a nominal depth and capped. OPG expects that the site would be remediated and restored to a state suitable for other OPG uses and for meeting the criteria for an unlicensed state established by the Canadian Nuclear Safety Commission.

Decommissioning activities would commence after the last reactor has permanently ceased operation, all fuel has been transferred out of the reactor to storage and the reactor has been drained and dried. Once this has occurred, the decommissioning begins with safe storage activities. OPG explained that decommissioning activities would include the following:

- transferring fuel and associated wastes to interim storage;
- decontaminating the plant;
- flush purging equipment and systems;
- removing surface decontamination from facilities or equipment;
- dismantling and removing equipment and systems;
- demolishing buildings; and
- restoring the site.

OPG stated that once the decommissioning activities are complete, it would provide the results of the decommissioning and environmental monitoring programs to the Canadian Nuclear Safety Commission to demonstrate that the decommissioned site can be made available for re-use and would no longer be subject to regulatory control under the *Nuclear Safety and Control Act*.

## 2.5 Alternative Means of Carrying out the Project

This section presents an overview of the alternate means of carrying out the Project. These include the options for the condenser cooling systems, the management of excavated material and lake infill, and waste.

### 2.5.1 Condenser Cooling Systems

Several condenser cooling water options are being considered for providing cold or cooled water to the condensers. The options include once-through or open-loop lakewater cooling, natural draft cooling towers, mechanical draft cooling towers, fan-assisted natural draft cooling towers and hybrid wet/dry cooling towers.

OPG provided an overview of the cooling technologies in the EIS. Once-through lakewater cooling would involve the withdrawal of water from Lake Ontario, its circulation through the condensers and its return to the lake through an open-loop intake and discharge system. For environmental assessment purposes, the once-through cooling water intake and diffuser structures were assumed to be similar to the existing structures at Darlington Nuclear Generating Station, although appropriately sized to accommodate the associated water flow rates of the Project. This intake structure is embedded in the lake bottom with a network of porous and non-porous concrete modules covering the intake shaft. In contrast to an open pipe intake, the

increased surface area of the modules through which the water is drawn reduces the velocity of the intake flow, with consequential reduction in fish impingement. The discharge pipe includes a series of diffusers where the water is discharged to promote rapid thermal mixing in the lake.

Natural draft cooling towers use a closed-loop system whereby water is drawn from the cooling tower, circulated through the condensers and returned to the towers to be cooled. The warmer water from the condensers is sprayed into the tower interior as outside air is introduced to the tower near its base. Heat is transferred from the falling water by convection and evaporation and the air warms. The principle of buoyancy creates a chimney effect, and the warm moist air will rise naturally, due to the density differential with the dry cooler outside air. Natural draft cooling towers are typified by a traditional hyperbolic shape and extend to approximately 150 metres above finished grade. The evaporative effect results in a plume of moisture-laden air exiting the cooling tower. The visibility of the plume is largely dependent upon weather conditions.

Mechanical draft cooling towers generally involve the same principle as natural draft towers where water is cycled between the condensers and the tower. However, in the case of mechanical draft towers, fans are used to force air through a fan at the bottom of a tower or to draw air through a fan at the top of a tower to promote the cooling process. Mechanical draft towers are typically much shorter—approximately 20 metres in height—than natural draft towers but require a much larger land area and use more energy to operate the fans. The water is cooled by the same heat transfer principles of convection and evaporation. The evaporative effect associated with mechanical draft cooling also results in a vapour plume.

Fan-assisted natural draft cooling towers operate on a combination of the principles of natural and mechanical draft cooling towers. These towers have a slightly larger base dimension than the natural draft cooling towers and have fans placed around the base of the tower to increase the air flow rate. The towers have a hyperbolic shape generally similar to a traditional natural draft tower but are only about one-third the height. The footprint falls between those of natural and mechanical draft towers. Fan assisted natural draft cooling towers are a variation of the mechanical draft and natural draft cooling

towers, and their physical characteristics and potential interfaces with the environment are considered to be bounded by the other cooling tower options addressed in the environmental assessment.

Following an information request from the Panel, OPG provided information on hybrid cooling towers. Hybrid wet-dry cooling towers employ both a wet section and a dry section within the tower. Cooling within the tower is accomplished by using normal evaporative processes in the wet section or lower portion of the tower, but heat is also transferred to the atmosphere in the dry section or upper portion. Hybrid towers are designed to consume less water where cooling water is limited. In the most common version of wet-dry hybrid, hot water from the condenser flows through pipes located in the cooling tower. Cascading water in the tower cools the water in the pipes. The water that falls downward is collected and recirculated. Air is also forced up through the cascading water. As the air moves upward, heat is removed from the cascading water causing the production of suspended water droplets which enter the dry section of the tower. Within the dry section, fans and heaters are used to promote evaporation of the suspended water droplets, thereby reducing the visibility of the vapour plume as it exits the tower.

## 2.5.2 Excavated Material Management and Lake Infill

OPG stated that site preparation would involve excavating and handling up to 12 million cubic metres of soil and rock. OPG indicated that it intends to manage as much of the soil and rock on site as possible. For environmental assessment planning purposes, OPG estimated that up to 5 million cubic metres of soil may be placed in the northeast quadrant of the Darlington Nuclear site and that up to 3 million cubic metres may be used as lake infill, increasing the lake frontage of the Darlington Nuclear site by up to 40 hectares. OPG noted that the excavated material that cannot be accommodated on site as part of the final landscaping and grading would be transported off site.

Any surplus excavated material would be transported to disposal at an off-site location(s) using highway-licensed vehicles at an estimated rate of 200 trips per day during site preparation. OPG stated that the destinations for this material have not yet been determined and that the

transport routes for the material would depend on the receiving destinations ultimately selected. OPG stated that it expects that east-west routing will use Highway 401, and that Holt Road has been identified as the likely northbound route. OPG noted that the material may be used to rehabilitate extraction pits and quarries or other development sites, or for similar beneficial use. OPG stated that it would also explore opportunities for use of this material on other construction projects, such as the construction of Highway 407 and its east link to Highway 401.

### 2.5.3 Waste Management

The proponent proposed alternatives for waste management, including alternatives for the management of used fuel and the management of low and intermediate-level radioactive waste.

#### Used Fuel

OPG provided an overview of used fuel management practices for the Project. OPG explained that used fuel is managed in a two-stage process: wet storage in the reactor building, which allows for initial cooling, and dry storage in a separate on-site facility for longer interim storage. Both wet and dry on-site used nuclear fuel storage facilities would be part of each of the reactor designs considered. Used nuclear fuel would be stored in the used nuclear fuel bay for approximately 10 years after being removed from the reactors. After this initial decay period, the used nuclear fuel would be moved to dry storage containers that would be processed and stored in a used fuel dry storage building developed within the Darlington Nuclear site.

For the bounding scenario for used nuclear fuel, the estimated volume for the lifetime generation per unit from each reactor type is the EC6 technology at 7,860 tonnes of uranium, or 393,000 bundles per reactor for a total of 31,440 tonnes of uranium or 1,572,000 bundles for 4 reactors.

The fuel from the reactors being considered (other than EC6) would have higher uranium enrichment than the fuel for the existing OPG CANDU reactors. This introduces elements of criticality control requirements for storage as well as potential heat load issues for dry storage and eventual long-term management. Some processing modifications may be required, depending on the reactor technology to be chosen, due to new fuel dimensions, higher burn-up and heat load. Processing of used nuclear fuel

refers to preparation for dry storage, which typically involves drying the fuel, sealing the dry storage container by welding or bolting, backfilling with inert gas, decontaminating the container and transferring it from the fuel bay or process area to the storage area.

OPG stated that the interim on-site storage options that were considered for the Project are directly related to the different reactor technologies (see Table 2: Projected On-site Used Nuclear Fuel Storage Needs During Operation). OPG explained that the chosen option will depend on the reactor technology selected by the Government of Ontario. OPG stated that its existing dry storage containers or the Atomic Energy of Canada Limited MACSTOR system would be used for the fuel for the ACR-1000 and EC6, and that metal casks, concrete canisters or concrete modules would be used for the EPR and AP1000 fuel. OPG noted that the specific containers selected for dry storage of used nuclear fuel for the Project would be selected to suit the chosen reactor technology and licensed for their function prior to use.

The proponent indicated that the evaluation of alternative on-site locations for the used fuel dry storage facility is considered in the framework of the bounding site development. The preference of the proponent is to expand the current Darlington Waste Management Facility, which is currently located at the existing Darlington Nuclear site. OPG has stated that should there be a requirement for the used fuel dry storage buildings to be located north of the Canadian National rail line that bisects the site or for any waste processing or storage building to be located closer than 150 metres to the site perimeter fence, OPG would commit to updating the safety assessment for this location as part of a separate licensing process for the used fuel dry storage facility.

One planning assumption in the OPG assessment is that only 50 percent of the fuel requires interim storage on site. The long-term management of used nuclear fuel in Canada is the responsibility of the Nuclear Waste Management Office. For planning purposes, OPG assumed that a long-term used nuclear fuel repository will be in service by about 2035. Accordingly, OPG estimated that all used nuclear fuel will be removed from the Darlington Waste Management Facility to the repository by 2064.

Table 2: Projected On-site Used Nuclear Fuel Storage Needs During Operation

Activity	Storage Requirement	Storage Specifications
Used fuel storage	4 dry storage buildings	70 m x 76 m each - 21,300 m <sup>2</sup> total
Used fuel processing	1 dry storage processing building	40 m x 50 m - 2,000 m <sup>2</sup> total

The main technical points that would need to be addressed for used nuclear fuels from the Project reactors in the Nuclear Waste Management Office repository are the effect of different physical configuration, the effect of higher burn-up, the effect of higher initial enrichment and the capacity of the repository to handle the additional fuel.

OPG has noted that there would be sufficient space on the Darlington site to store all of the used fuel from the Project in perpetuity, should the long-term used nuclear fuel repository not be in service.

#### Low and Intermediate-Level Radioactive Waste

The operation and maintenance activities for the selected reactor would produce quantities of low and intermediate-level waste. The type and activity levels of the waste can be expected to be similar to that currently produced at the existing Darlington Nuclear Generating Station and in other existing OPG reactors. Low and intermediate-level waste would be managed in a similar manner regardless of the reactor selected.

OPG described its practices for the management of low and intermediate-level waste; it explained that low-level radioactive waste includes materials such as mop heads, rags and protective clothing, and that intermediate-level radioactive waste includes materials such as worn out reactor components and resins and filters that are used to sustain reactor systems during reactor operation.

OPG stated that for the Project, two alternative means of managing low and intermediate-level waste were considered: management on site and management off site. OPG explained that the management of the waste on the Project site would be in a new low and intermediate-level waste management facility, and for off-site waste management, the low and intermediate-level

waste would be transported to an appropriately licensed facility.

For environmental assessment purposes, OPG assumed that three storage buildings—two for low-level waste and one for intermediate-level waste—would be required on site, depending on the reactor type (see Table 3: Projected On-site Low and Intermediate-level Waste Storage Needs). Future storage buildings might be located separately on site from the current Darlington Waste Management Facility. For low-level waste, on-site storage was assumed to be in standard low-level storage buildings, similar to the several low-level storage buildings that have been used at the Western Waste Management Facility on the Bruce Nuclear site near Kincardine, Ontario. Each low-level storage building would have a segregated area for the intermediate-level waste. Intermediate-level waste would be stored in self-shielded packaging and interim storage in a modular storage building on the Darlington Nuclear site.

Two processing scenarios were considered for low and intermediate-level waste generated through operation: on-site processing, consisting of compaction and storage; and transport to an off-site facility. Off-site processing can further reduce volumes by the use of incineration.

The bounding scenario for the volume of low and intermediate-level waste generated during the operating life of the Project was approximately 38,700 m<sup>3</sup> of low-level waste and approximately 2,752 m<sup>3</sup> of intermediate-level waste.

The bounding scenario for off-site shipment of low and intermediate-level waste assumed that all of the generated radioactive waste would be shipped off site for processing and storage. This bounding scenario would require approximately

Table 3: Projected On-site Low and Intermediate-level Waste Storage Needs

Project Stage	Waste Type	Storage Requirements	Storage Specifications
Operation	Low-level and intermediate-level waste	2 storage buildings for low-level and 1 storage building for intermediate-level waste	30 m x 50 m each – 4,500 m <sup>2</sup> total
	Steam Generators	1 steam generator storage building	65 m x 70 m – 4,550 m <sup>2</sup> total
Modification/ Refurbishment	Low-level and intermediate-level refurbishment waste	1 refurbishment waste storage building	45 m x 70 m – 3,150 m <sup>2</sup> total

1,935 truck shipments of 20 m<sup>3</sup> of low-level waste over a 60-year period, or about two to three truck shipments per month. For intermediate-level waste, the bounding scenario would also result in two to three truck shipments per month during the operating period. OPG stated that the peak shipping rates may be higher during reactor maintenance outages, but the lifetime average shipping rate would still be very low. OPG noted that other shipments of radioactive materials, contaminated equipment and contaminated clothing would also periodically occur.

OPG noted that the transportation of low and intermediate-level waste to a licensed facility and transportation of other radioactive materials, such as tritiated heavy water, would be carried out in accordance with the *Nuclear Safety and Control Act* and its Regulations and other applicable regulations. Transportation and packaging requirements for nuclear substances are covered by the *Transportation of Dangerous Goods Act, 1992* (S.C. 1992, c. 34) and the *Packaging and Transport of Nuclear Substances Regulations* (SOR/2000-208), which are based on the International Atomic Energy Agency *Regulations for the Safe Transport of Radioactive Material, 1996 Edition (Revised)* (2000). These Regulations are the basis for regulating the packaging and transporting of radioactive materials worldwide.

OPG stated its preference to transport low and intermediate-level waste resulting from the

Project operation to its operating Western Waste Management Facility, although some larger components, such as steam generators resulting from mid-life refurbishment, would likely require on-site storage and management. If the low and intermediate-level waste is transferred to Western Waste Management Facility, it is likely that no additional storage buildings would need to be constructed at the Western Waste Management Facility because the bulk of the waste would be generated after 2018 when the proposed Deep Geologic Repository for Low and Intermediate-level Radioactive Waste is assumed to be in operation at the Bruce Nuclear site in the Municipality of Kincardine, Ontario.

OPG noted that the processing and storage of the low and intermediate-level waste at an off-site facility was not an element of the Project since that facility would be subject to its own approval process with an environmental assessment under the *Canadian Environmental Assessment Act* and a licensing process under the *Nuclear Safety and Control Act*.

OPG proposed two options for the long-term management of low and intermediate-level waste, which includes radioactive waste from refurbishment and decommissioning. The first option was to revisit the hosting agreement for the Deep Geologic Repository that has been proposed at the OPG Western Waste Management Facility within the Bruce Nuclear site. For example, if not all existing OPG Nuclear Power Plants are refurbished and life-

extended, there could be room in the OPG Deep Geologic Repository for the Project low and intermediate-level waste. The second option was to maintain waste in interim storage at the Darlington Waste Management Facility or Western Waste Management Facility until a decommissioning waste repository or other facility is available.

## 2.6 Management of Conventional and Hazardous Waste

Chemical usage at the Project facility during operation and maintenance would be largely related to water treatment chemicals with small quantities of chemicals used in laboratories, cleaning and maintenance activities. In most cases, the types of chemicals used at nuclear power plants are similar regardless of the reactor technology selected. Specific chemicals required for the Project will be identified once a reactor technology has been selected.

According to the proponent, procedural controls would be in place to ensure the safe transport, storage and handling of conventional and hazardous waste. Hazardous chemicals would be managed using the Workplace Hazardous Materials Information System principles. Hazardous materials would be disposed of as per regulatory requirements and transported to an appropriately licensed facility where applicable.

Another waste stream from Canadian power reactors is related to the boric acid system used for reactivity control in light water reactors and criticality control in the used nuclear fuel bays. OPG intends to take special precautions to ensure that the wastes would be neutralized and packaged in suitable containers since boric acid is highly corrosive to carbon steel.

OPG did not provide a bounding scenario for the release of hazardous substances for the proposed Project. OPG explained that it has no plan to do so until a reactor technology is selected for the site.

## 2.7 Security, Safety and Environmental Programs

OPG stated that the following security and safety programs would be in place over the lifetime of the Project:

- radiation protection;
- safety and health management system;
- fire protection and emergency response systems;
- nuclear emergency plan; and
- environmental programs.

As a Class 1 Nuclear Facility, the Project will include appropriate security systems to comply with Canadian Nuclear Safety Commission security requirements. OPG has existing protection and emergency response plans and capability in place at the Darlington Nuclear site. OPG stated that other programs already established by OPG—such as radiation protection, occupational health and safety, and environmental programs—will be applied to the Project. OPG noted that it has also developed an environmental management system to manage environmental aspects consistent with elements of the ISO 14001 Standard.

## 2.8 Cost Estimates

OPG provided a summary of the Project cost estimates in 2010 dollars, including capital investment, operating costs, decommissioning, accident and malfunction costs, and all phases that make up the lifetime of the Project. In addition, OPG provided information regarding the manner in which the costs related to accidents and malfunctions would be covered.

OPG explained that although a definitive estimate of the potential costs of the Project was not available, cost ranges were available in the environmental assessment documents and the Application for a Licence to Prepare Site sufficient for the purpose of the undertaken studies.

The September 30, 2009 OPG Application for a Licence to Prepare Site included a detailed preliminary decommissioning plan and cost estimate for the activities contemplated in the licence application. The restoration work was intended to restore the site to a brownfield state rather than returning the Project site to its pre-existing condition. The proposed restoration activities were intended to be triggered if a decision was made not to construct a new nuclear station at the site, and were estimated to cost \$86.2 million in 2009 dollars, including a 30 percent contingency.

The proponent subsequently revised its proposed financial guarantee to zero dollars, having concluded that the proposed Licence to Prepare Site activities would require no decommissioning work should the Project be cancelled. OPG noted that the Project site would be maintained in the condition to which it had been prepared and used in support of the existing licensed facilities.

Consequently, there would be no costs associated with decommissioning.

On September 24, 2010, OPG provided a range of costs in the Table 4 to illustrate the costs of initial capital investment (construction), operating costs, decommissioning and accident and malfunction costs.

Table 4: Ontario Power Generation Cost Estimates for the Project

Cost Element	Range (in 2010 dollars)	Comment
Capital Investment (Construction)	Overnight Capital costs of \$4,500 to \$6,500 (US) per kilowatt	<ul style="list-style-type: none"> <li>Based on publicly reported values for nuclear power plants being considered in the United States.</li> <li>It is difficult to determine what is included in these public values as not all the pertinent information is disclosed</li> <li>These publicly reported costs may not fully align to the scope of the Darlington New Nuclear Power Plant project compared to a project which starts from "Greenfield", i.e. not previously used as an industrial or nuclear site.</li> </ul>
Operating & Maintenance Costs	Publicly available estimates place annual cost at \$59 (US) per kilowatt per 1,000 megawatts of installed capacity (source: MIT)	<ul style="list-style-type: none"> <li>Annual operating and maintenance costs are normally modelled to be constant over the economic lifetime of the plant which has been assumed as 60 years.</li> <li>Different public sources site different values for operating and maintenance costs.</li> </ul>
Decommissioning Costs at the end of life	\$700 million (US) per 1,000 megawatts of installed capacity (source: MIT)	<ul style="list-style-type: none"> <li>Decommissioning costs are determined by two aspects, the costs of dismantling and the cost of long-term used fuel storage.</li> <li>Dismantling costs for the reactor technologies included in the environmental assessment are not publicly available.</li> <li>The used fuel cost depends on the amount of used fuel produced and the cost associated with its long term storage. As indicated in the OPG Nuclear Waste Management Technical Support Document, four ACR 1000 units would be expected to produce approximately 1.04 million fuel bundles over the assumed 60 year operating period. The PWR type designs produce reduced volumes of used fuel.</li> </ul>
Accidents and Malfunctions	\$75 - \$650 million (CDN)	<ul style="list-style-type: none"> <li>The project costs associated with accident and malfunctions is limited by the <i>Nuclear Liability Act</i>. Currently under this Act, liability for a nuclear operator is limited to \$75 million. Under proposed revisions to the Act, this limit would be increased to \$650 million.</li> <li>The analysis performed in the environmental assessment indicates that the radiological effects of an accident and malfunction will be substantively limited to the site itself.</li> </ul>

Reference: MIT, *Update of the MIT 2003 Future of Nuclear Power Study* (May 2009)



## Chapter 3 – Public Participation in the Review

Opportunities for public participation were provided throughout the review process. The public registry for the Project allowed for Internet access to all documents associated with the environmental assessment and comments from the public.

Prior to the appointment of the Panel, the Canadian Environmental Assessment Agency and the Canadian Nuclear Safety Commission held a public comment period to gain input on the draft Joint Review Panel Agreement and draft EIS Guidelines. Other opportunities to be heard were available during the public review and comment period and at the public hearing.

The Panel received and considered hundreds of documents that contained valuable and relevant information during the EIS review phase, in connection with the public hearing, and in the written final comments. Although it would be difficult to make direct references to all of this information, this chapter presents a summary of the information received from the public. This information, even if not always specifically referred to in the Panel's assessment, was considered and evaluated as part of the analytical review of the Project and in the formulation of the conclusions and recommendations which are found in the following chapters.

A list of organizations and individuals that participated in the review is included in Appendix 2 of this report.

### 3.1 Public Review and Comment Period

The public review and comment period on the EIS and Application for a Licence to Prepare Site began on November 16, 2009, when the Panel issued preliminary instructions for the review of these documents. In accordance with the Joint Review Panel Agreement, the public review and comment period was to be a maximum of six months for review of the EIS, technical support documents, the licence application and any additional information submitted by OPG during the public review and comment period. The time required by the proponent to respond to information requests from the Panel was not included in the six-month time limit. Following

the public review and comment period, the Panel was allowed an additional month for the consideration of the information to determine whether it was sufficient to proceed to the public hearing phase of the review.

Over the course of the public review and comment period, the Panel received more than 400 proposed information requests from federal government departments, Aboriginal groups, members of the public, non-governmental organizations and municipal and provincial governments. Each proposed information request was carefully considered by the Panel. The Panel issued information requests to OPG throughout the public review and comment period. By the end of the public review and comment period, 284 information requests had been issued to OPG, which covered various subject areas including, but not limited to:

- Aboriginal interests;
- accidents and malfunctions;
- adaptive management;
- air quality;
- alternative means of carrying out the Project;
- alternatives to the Project;
- ambient radioactivity;
- aquatic effects;
- aquatic environment;
- archaeology;
- construction and operations;
- costs;
- cumulative effects;
- decommissioning;
- emissions;
- follow-up programs;
- geology;
- groundwater;
- health concerns;
- hydrogeology;
- land use;
- mitigation measures;
- noise;
- nuclear and conventional waste management;
- purpose of the Project;
- radiological emissions;
- site preparation;
- socio-economic effects;
- surface water;

- sustainable development; and
- terrestrial environment.

In addition to the proposed information requests, the Panel received letters from various groups and individuals. These letters included opinions on the Project and suggestions for hearing procedures and the inclusion of the EC6 reactor technology within the framework of the plant parameter envelope. Where the Panel felt it was appropriate in a few instances, it responded directly to these letters and posted the responses on the public registry for the Project for the benefit of all review participants. Throughout the process, submissions were always brought to the attention of and were considered by the Panel.

On December 14, 2010, the Panel announced that it had received sufficient information to proceed with the public hearing stage of the review. For the purpose of the public hearing, the Panel noted that it required certain details from OPG on the potential effects of the thermal discharge on round whitefish. OPG provided this information in a letter to the Panel on January 14, 2011.

### 3.2 Public Hearing

This section presents an overview of the public hearing held for the Project. This includes descriptions of hearing logistics, the procedural matters presented at the hearing, the manner in which the hearing unfolded, undertakings and final comments.

#### 3.2.1 Hearing Logistics

The Panel announced the public hearing and issued hearing procedures on December 14, 2010. Members of the public, Aboriginal groups, other interested parties and government organizations that wished to participate in the public hearing were required to register with the Panel Secretariat by January 13, 2011, as detailed in the procedures. The Panel directed or invited some government organizations to participate.

The public hearing was to provide opportunities for the proponent to explain the Project and to respond to concerns and questions from the Panel, individuals, organizations, Aboriginal groups and government departments and agencies, and for participants to provide their views on the implications of the proposed Project. Furthermore, the public hearing allowed

the Panel to seek information and advice that would help it complete its assessment of the environmental effects of the Project and its review of the Application for a Licence to Prepare Site.

The hearing took place from March 21, 2011 to April 8, 2011 at the Hope Fellowship Church in Courtice, Ontario. The Panel sat six days a week for two hearing sessions per day (morning/afternoon or afternoon/evening). The hearing was accessible via a live Web cast through the Canadian Nuclear Safety Commission Web site for those who could not attend; two toll-free telephone numbers were also provided for people to listen to the proceedings. Simultaneous translation was provided at all hearing sessions. Written transcripts and audio recordings were made available on the public registry for the Project as quickly as possible—the following day in most cases.

Registered participants had the option of intervening by making an oral presentation of up to 30 minutes in addition to a written submission or through a written submission only, or by making an oral statement of up to 10 minutes. Those who did not register with the Panel Secretariat by January 13, 2011 were permitted to register to make an oral statement at the public hearing whenever the hearing schedule allowed. Intervenor had the opportunity to pose questions to the Panel Chair for other presenters throughout the hearing, where the schedule allowed.

Government organizations and OPG were required to provide written hearing submissions to the Panel by January 31, 2011, and intervenors were required to provide written submissions by February 21, 2011. Participants who wanted to use presentation materials were required to submit them by March 9, 2011.

#### 3.2.2 Procedural Matters

The Panel requested that submissions regarding procedural matters be provided by March 14, 2011. The Panel received submissions from Lake Ontario Waterkeeper, the Canadian Environmental Law Association and Northwatch, and heard presentations on these matters on the afternoon of March 21, 2011.

Lake Ontario Waterkeeper requested that the hearing be adjourned for the following reasons: the record for the Project was not complete and

more time was needed to review information on the EC6 reactor technology and its incorporation into the plant parameter envelope, the Fukushima Daiichi nuclear accident, and the report from Pacific Northwest National Laboratory.

The Canadian Environmental Law Association requested an adjournment because of the Fukushima Daiichi nuclear accident. The Association was of the view that lessons learned from this accident needed to be incorporated into the review of the Project and that more information was needed regarding the consequences of beyond design basis accidents. It also expressed concerns regarding the inclusion of the EC6 reactor technology in the plant parameter envelope. The Association made several requests regarding the hearing logistics, including public transit to and from the hearing venue, direction regarding questions during the hearing, sworn evidence, the availability of hearing documentation and the translation of all written and visual material and transcripts into French.

Northwatch requested an adjournment due to the Fukushima Daiichi nuclear accident. It expressed reservations regarding a Canadian Nuclear Safety Commission notice on March 16, 2011 that indicated that the hearing was a venue for lessons learned from this accident. Northwatch felt that the event had occurred recently and not all of the information would be available for the hearing. Northwatch was also of the view that more time was needed to review information on the EC6 reactor technology and its incorporation into the plant parameter envelope. Further, Northwatch requested that participants be granted the opportunity to make final comments and noted that all presenters should be treated equally. Northwatch was concerned that there may be inequitable treatment of one participant at the hearing with respect to questioning.

OPG responded orally to these procedural matters and expressed the view that the hearing should go ahead.

The Panel conferred following the procedural matters session and announced its decision prior to the start of the first scheduled hearing session on the evening of March 21, 2011. Regarding the requests to adjourn the hearing due to the Fukushima Daiichi nuclear accident, the need for more information and the inclusion of the EC6 reactor technology in the plant parameter

envelope, the Panel announced that the hearing would proceed because the purpose of the hearing was, in any case, to gather any new information needed.

Regarding the requests for public transit to the hearing venue, the Panel decided not to make any additional arrangements, noting that the hearing was also accessible via Web cast and teleconference. Regarding the request for sworn evidence, the Panel decided that this would not be necessary for the purpose of the hearing. Regarding the request for the translation of documents, the Panel announced that this request would not be accommodated, noting that the transcripts represent the language spoken at the hearing.

Regarding the request for clarification about questioning at the hearing, the Panel stated that questions would follow the presentations and confirmed that all registered presenters would be treated equally within the parameters of the *Public Hearing Procedures*. The Panel further stated that documentation pertaining to the hearing, including transcripts, would be available on the public registry for the Project, usually within 24 hours of a session. With respect to the request for final comments, the Panel decided that the opportunity to submit written final comments would be provided. A copy of the Panel decision is included in this report as Appendix 3.

### 3.2.3 Hearing Summary

Fourteen government departments and 72 intervenors registered to provide an oral presentation with a written hearing submission. There were 158 intervenors that filed written-only submissions. There were 34 people that made oral statements to the Panel. The Panel received 278 contributions in total.

The Panel heard from federal, provincial and municipal government organizations, elected government representatives, including Members of Parliament and Members of the Provincial Legislature, as well as candidates from political parties. It also heard from Aboriginal peoples, local organizations and businesses, non-governmental organizations, professional organizations, educational groups and the general public.

OPG presented information on the Project, the environmental assessment and the Application for a Licence to Prepare Site. At the request of the Panel, OPG made specific presentations on emissions, waste management, human health and safety, the aquatic environment, Aboriginal interests and accidents and malfunctions.

In addition to the subject-specific presentations by OPG, the Panel requested that information be presented regarding the Fukushima Daiichi nuclear accident. CNSC staff made a presentation on the implications of the accident (including the earthquake and tsunami) for the Project, and the Geological Survey of Canada made a presentation on earthquakes in Canada. OPG also made a presentation on the seismic hazard assessment of the Project.

### 3.2.4 Undertakings

Throughout the hearing, the Panel required that additional information be provided in an efficient and timely manner. The Panel issued undertakings where the information it required was not immediately available. Over the course of the hearing, 78 undertakings were issued by the Panel, covering a variety of subjects. The completed undertakings were posted to the public registry for the Project once they were received. The Panel requested further clarification on two undertakings.

### 3.2.5 Final Comments

During the submission of procedural and preliminary matters, intervenors requested an opportunity to make final comments at the close of the hearing. The Panel accepted this request and released directions for written final comments, which were revised on April 8, 2011. The Panel issued a notice on April 27, 2011 to indicate that registered intervenors had until May 17, 2011 to provide final comments and OPG had until May 23, 2011. Written final comments were to briefly summarize the position and/or the opinions of the participant on the Project and any aspect of the review.

## 3.3 Overview of Public Comments at the Hearing

The Panel acknowledges the high level of interest in the Project that was expressed through the hearing and notes the divergence of views expressed for and against the Project. In this respect, the most recurring themes in support of the Project were:

- safe performance of OPG;
- positive economic impact for the municipality, region, Ontario and Canada;
- community support for OPG;
- purpose and need for the Project;
- Ontario energy policy; and
- land use.

The most recurring concerns in relation to the Project were:

- purpose and need of the Project;
- alternatives such as renewable energy and energy conservation;
- Ontario energy policy;
- long-term waste management and transportation;
- cost;
- radiation risks to human health;
- effects of uranium mining and consideration of cradle-to-grave pollution producing greenhouse gas emissions;
- accidents, mainly in relation to the consequences of the Fukushima Daiichi nuclear accident;
- terrorism/security/safeguards;
- choice of reactor technology and bounding envelope approach to the assessment;
- radioactive emissions to air, surface and groundwater, including tritium;
- use of the precautionary principle;
- nuclear liability;
- effects in Lake Ontario, including fish biota and habitat, water quality for drinking and recreation, and boating safety; and
- employment opportunities for Aboriginal peoples.

While most of the participants at the hearing were adults, the Panel recognizes the contributions and involvement of youth and young adults at the hearing, including an oral statement on April 8 that included a presentation of a petition from youth of Toronto in opposition to the Project, as well as the presentation from North American Young Generation in Nuclear in support of the Project.

The Panel also acknowledges the peaceful protest staged by Greenpeace on March 22, 2011 in opposition to the Project and the decision of the Panel to continue the public hearing despite requests for postponement. The Panel recognizes that the Fukushima Daiichi nuclear accident did have an effect on the hearing. Many participants

referred to the recent events in Japan with expressions of sympathy, and cited it as an example of what could happen if a beyond design basis accident were to occur at the Project site.

In the following sections, the Panel presents a summary of the themes brought forward at the hearing.

### 3.3.1 Purpose and Need for the Project

Several participants noted that the Ontario energy demand has been falling in recent years, and expressed the view that the Ontario energy policy is flawed. Participants felt that Ontario should phase out nuclear power as it has with coal generation, and that an energy mix with more renewable energy—including wind and solar, imported hydroelectric power from Quebec, combined heat and power, natural gas, conservation and the implementation of smart grid technology—could meet the future energy needs of Ontario. Some participants felt that the environmental assessment for the Project was premature as the Ontario Supply Mix Directive had not yet been approved by the Ontario Power Authority, and the Integrated Power System Plan had not been approved by the Ontario Energy Board.

Some participants felt that OPG had not properly addressed the requirements of the EIS Guidelines regarding the purpose and need for the Project and alternatives to the Project. Participants were of the view that a directive from the Ontario Ministry of Energy does not constitute a need for the Project, and that OPG should consider alternatives to the Project.

On the other hand, some participants were of the view that nuclear power should continue to be part of the Ontario energy mix, along with renewable energy like wind and solar, hydroelectric generation, natural gas, biomass and conservation, because they felt that nuclear power would provide reliable baseload power that alternatives such as wind and solar could not. Participants noted that the Ontario government is phasing out coal generation plants with a goal of reducing greenhouse gas emissions, and they felt that continued nuclear generation would contribute to reaching this target because nuclear generation has lower greenhouse gas emissions than coal and natural gas.

Some participants expressed the view that the energy demand in Ontario would continue to increase in the future and that the Project would be necessary in order to replace the loss of electricity generation from OPG Pickering Nuclear Generating Station when it goes offline.

### 3.3.2 Long-term Waste Management

Many participants expressed concerns regarding the long-term management of the nuclear waste generated by the Project, used fuel in particular. Participants were of the view that OPG had not adequately addressed many of the issues related to long-term fuel waste management, and noted that a proven solution for the disposal of used fuel had not yet been developed by the nuclear industry. Participants expressed the view that no further nuclear waste should be created until a proper solution is found.

Many participants were of the view that used fuel would be a burden on future generations as it will require long-term storage and monitoring for the duration of its life as a hazardous substance, which could be for thousands of years. In this regard, participants felt that long-term storage of used fuel on the Project site had not been properly assessed.

Participants noted that although the responsibility for the long-term management of used nuclear fuel waste in Canada had been assigned to the Nuclear Waste Management Organization by the federal government through the *Nuclear Fuel Waste Act* (S.C. 2002, c. 23), the Organization's Adaptive Phased Management approach was developed for application to the existing fleet of nuclear reactors and does not include consideration of used fuel from new reactors.

Participants also expressed concerns about the safety and radiation risk associated with the transport of nuclear waste. Participants noted that there has already been public opposition to shipments of radioactive waste in Canada. A participant was of the view that OPG should not take for granted that low and intermediate-level nuclear waste generated from the Project could be stored at off-site facilities. It was recommended that OPG should be required to demonstrate the capacity to store all of this waste on site over the life of the Project.

Contrary to these views, some participants were of the opinion that OPG has demonstrated that used fuel waste has been safely managed at its existing waste management facilities and were hopeful that a solution for waste would eventually be found. Other participants were of the view that used fuel could be reprocessed for use as fuel by future generations in new reactor technologies.

### 3.3.3 Health Effects/Radiation Risk

Many participants expressed concerns regarding the health effects and risks associated with exposure to radiation. Participants stated that exposure to radiation can result in adverse health effects, including cancer, and a common sentiment expressed was that there is no safe dose of radiation. Participants stated that because low levels of radiation are cumulative and have a latent period, the risk of health effects from the operation of the reactors would increase over time. Participants expressed particular concerns regarding the effects of radiation exposure on developing fetuses and young children. In this regard, participants felt that the Canadian public dose limit of one millisievert per year is too high. In addition, participants were concerned that there could be severe health-related consequences in the event of a nuclear accident. Participants felt that the Project should not be allowed to proceed because the risk to human health posed by the operation of the proposed Project would be too great.

Some participants cited health studies to support their views that low levels of radiation are harmful to human health. Participants noted that some health studies show increased incidence of cancer and other health effects in regions around nuclear power plants. Some participants also expressed a belief that the advice given to the Panel from CNSC staff on this topic was out of date and based on data and health studies that are controlled by the nuclear industry and the International Atomic Energy Agency. Participants felt that even though health studies have been inconclusive in finding a causal relationship between incidence of cancer and exposures to radiation from nuclear power plants, the Panel should err on the side of caution and follow the precautionary principle in making its recommendation to the federal government.

On the other hand, some participants expressed the view that there is a low risk of adverse health effects associated with the operation of nuclear

power plants. Participants noted that the dose to members of the public from the releases from the Project is expected to be approximately 0.005 millisieverts per year, which is much lower than the regulatory dose limit. Participants further noted that the health studies conducted in Durham Region have shown that there is no evidence of increased risk of cancer around the currently-operating nuclear facilities. Participants also expressed the view that workers in nuclear facilities are monitored and tested to ensure that no worker receives a dose in excess of the nuclear energy worker dose limits, and that studies have shown that nuclear energy workers are healthy.

### Radioactive Emissions

Many participants had concerns regarding radioactive emissions from the Project and tritium in particular. Participants also had concerns regarding releases of Iodine-131 and Cesium-137. They felt that the radioactive releases would accumulate in biota and the environment over time and cause adverse health effects.

Participants were concerned that the Project would release tritium into the air, groundwater and surface water. Many participants had concerns regarding tritium, noting that the body takes it in as water. It was noted that in 2009, the Ontario Drinking Water Advisory Council recommended that Ontario reduce the limit for tritium in drinking water from the Health Canada guideline of 7,000 Becquerels per litre to 20 Becquerels per litre. Some participants supported this recommendation and questioned why it was not yet in force. Participants also expressed concern for the safety of workers and questioned how they are protected from tritium and monitored for its intake.

Participants further noted that CANDU reactor designs release more tritium than pressurized water reactor designs. Participants were concerned that tritium levels in Lake Ontario are already elevated above background levels because of the existing operating OPG CANDU reactors, and that the emissions from the proposed Project would have a cumulative effect in this regard.

On the other hand, some participants expressed the view that releases to the environment would be monitored and, based on the operating performance of OPG at other nuclear facilities,

kept well below the regulatory limits set by the Canadian Nuclear Safety Commission. Participants noted that releases must be kept as low as reasonably achievable and that doses to workers and the public from radioactive emissions from nuclear facilities are well below the regulatory limits.

#### 3.3.4 Accidents and Malfunctions

Many participants expressed concerns regarding accidents and malfunctions. They felt that OPG had not adequately addressed major accidents in the review, and that the safety analysis was flawed. Participants explained that they felt that the OPG safety analysis was probabilistic and not deterministic or realistic enough. They felt that worst-case beyond design basis accidents were not fully considered, despite the fact that nuclear accidents can and do happen, such as at Three-Mile Island (1979), Chernobyl (1986) and Fukushima Daiichi (2011). Participants noted that accidents could be caused by a combination of factors, including human error, severe weather, equipment failure and improper design. Participants felt that even if the probability of an accident is low, the consequences would be unacceptable should one occur.

Participants also had concerns regarding the effects of other accidents that could occur throughout the lifetime of the Project, including unplanned releases and spills of hazardous materials. Participants felt that releases of contaminants into the environment could have a negative effect on Lake Ontario, the health of the public, and the environment, especially if they were to accumulate over time.

Some participants had general comments regarding the design of nuclear generating stations. They noted that reliability and structural integrity must be maintained over the lifetime of the Project to ensure safe operation, and that OPG has a program to ensure the management of the Project facilities as they age.

Some participants had concerns regarding the design, operation and maintenance of computer systems over the lifetime of the Project, noting that hardware or software errors could lead to accidents.

#### Emergency Planning

Several participants had concerns regarding emergency response planning in Durham Region. They felt that the designated emergency planning

zone of 10 kilometres around the Project facility (which is the Primary Zone used for emergency evacuation purposes) would not be large enough to protect the public from radioactive releases from an accident on the scale of those at Chernobyl or Fukushima Daiichi. Some participants also felt that the OPG evacuation analysis was not realistic and should have taken worst-case scenarios for traffic and weather into account, in addition to requirements for emergency actions further away from the Project facility. Participants felt that with a growing population in the region, evacuation would become more difficult over time.

Participants were also critical of the fact that a simulated evacuation practice for greater than 30 kilometres from the Project facility had not been performed. They were of the view that the public should be informed and educated on how to respond in the event of a nuclear emergency. Some participants felt that the emergency planning should extend to the City of Toronto, which is 70 kilometres west of the proposed Project.

Other intervenors felt that the polluter pays principle should apply to nuclear facilities as it does to other industries. They explained that this means that nuclear operators would be solely liable to pay for the consequences of a major accident rather than the Canadian taxpayers.

#### Nuclear Liability

Some participants expressed concern that the current Canadian legislation regarding nuclear liability, the *Nuclear Liability Act* (R.S.C., 1985, c. N-28) does not provide enough coverage to pay for the consequences of a major nuclear accident. Participants noted that the Canadian government has yet to adopt new legislation amending the amount of nuclear liability coverage.

#### 3.3.5 Terrorism, Security and Safeguards

Many participants expressed concerns regarding the possibility of a malevolent act, such as a terrorist attack, on the Project facility. Some participants felt that nuclear generating stations and used fuel storage facilities may be at risk in the event of terrorist attacks. They felt that OPG had not adequately addressed a worst-case terrorist attack and that nuclear generating stations may not be designed to withstand such an attack.

Some participants expressed the view that nuclear generating stations may be at risk in the event of terrorist attacks due to the storage of radioactive waste, including used fuel. They felt that radioactive waste could be a target for theft from those who wish to create weapons to disperse radioactive material in a harmful manner. Some participants were of the view that the operation of nuclear generating stations may result in the production of radioactive material that could be diverted to non-peaceful purposes.

Some participants had concerns regarding the safety and security of Project computer systems. They noted that the safe operation of the reactors relies on computer systems, which could be targeted in an attack. Participants were concerned about the safety of computer systems from computer hacking and malicious software such as viruses and spyware.

On the other hand, some participants expressed the view that OPG has implemented robust security measures and complies with International Atomic Energy Agency requirements to secure the nuclear materials stored on site and ensure that they are not diverted to non-peaceful purposes.

### 3.3.6 Uranium Mining/Nuclear Fuel Cycle and Greenhouse Gas Emissions

Many participants were of the view that the environmental assessment should have covered the nuclear fuel cycle from cradle to grave. They felt that because the Project would result in an increased demand for nuclear fuel, the Project would have environmental effects beyond the regional study area due to the need to mine and process uranium, fabricate the fuel for the operation of the reactors and dispose of it.

In this regard, some participants were of the opinion that the nuclear industry has misled the public regarding the amount of greenhouse gas emissions related to nuclear electricity generation. They explained that although there may be low greenhouse gas emissions during the operation of the reactors, many greenhouse gases are emitted throughout the lifecycle of a nuclear generating station due to the mining, processing and fabrication of the fuel, as well as during site preparation and construction.

Other participants expressed the view that although there are various greenhouse gas emissions when the entire lifecycle of a nuclear

generating station is taken into account, these emissions are lower than other baseload energy sources like coal and natural gas and are comparable to wind and solar generation on a per kilowatt-hour basis.

### 3.3.7 Cost and Economic Effects

Many participants expressed the view that building new nuclear power plants is prohibitively expensive. They were concerned that the nuclear industry has a history of going over-time and over-budget on new build projects, including the existing Darlington Nuclear Generating Station. They expressed the view that nuclear energy is more expensive than alternatives on a per-kilowatt-hour-basis, and as such, suggested that the Province of Ontario reallocate the funds for the Project to conservation and less expensive, alternative means of energy production. Some participants felt that Project costs would likely increase as a result of the need to incorporate lessons learned from the Fukushima Daiichi nuclear accident.

Participants also had concerns regarding the potential costs in the event of an accident at the Project facility. Participants felt that if an accident were to happen it would be expensive to clean up and the costs would have to be covered by the federal government.

Some participants were of the view that the costs regarding decommissioning and waste storage would have to be borne by future generations at the time of decommissioning.

On the other hand, some participants expressed the view that nuclear energy is cheaper than alternatives on a per kilowatt-hour basis.

Many participants felt that the Project would have positive economic effects on Durham Region, Ontario and Canada. On a municipal level, many felt that the Project would result in long-term employment opportunities for local residents, including full-time, highly skilled jobs, as well as provide an influx of temporary or contract workers for the site preparation and construction phases of the Project. In addition, they felt that the Project would result in spin-off economic benefits that would support local businesses. Participants expressed the view that the Project would also promote post-secondary education opportunities in the region.



On a provincial level, the feeling was that the Project would have a positive effect on the nuclear industry while supporting other industries, such as parts manufacturing and construction. It was also felt that the Project would have positive effects on the nuclear industry nationally.

### 3.3.8 Operating Performance and Community Support for OPG

Several participants stated that based on the operating performance at the Pickering and existing Darlington Nuclear Generating Stations, OPG has demonstrated that it can safely operate nuclear power plants. Some participants felt that OPG has a positive safety culture and is committed to the protection of the environment.

Several participants indicated their belief that there is considerable community support for OPG. Participants felt that OPG is a good corporate citizen, as demonstrated by its support of local activities and charitable organizations. They underlined the fact that OPG employees also live in Durham Region, and noted that they are comfortable with nuclear generating stations operating in their community.

### 3.3.9 Sustainable Development

Some participants expressed the view that the OPG assessment of the sustainability of the Project was not adequate and that the Project should have been considered within a broader sustainability framework. Participants felt that the cost of the Project, including decommissioning, and the legacy of nuclear waste, including used fuel, would be a burden for future generations and therefore would contradict the definition of sustainable development. Participants also felt that the Project and the provincial reliance on nuclear electricity generation would prevent present and future generations from developing more sustainable, alternative, renewable energy sources.

Conversely, other participants felt that the Project would provide for a sustainable society. They said that the Project would have a positive effect on the economy, stimulate growth, create jobs and provide a reliable source of electricity. Participants also noted that the existing Darlington nuclear generating station had a positive effect on the local biodiversity. Some participants felt that another aspect of the sustainable nature of the Project was that used

nuclear fuel could be stored and used as fuel by future generations.

### 3.3.10 Environmental Assessment Remarks

Many participants expressed their views on different aspects of the review process, its context and the effectiveness of the proponent in the preparation of the EIS.

#### Reactor Technology and the Plant Parameter Envelope

Many participants disagreed with the bounding approach taken by OPG to assess the environmental effects of the Project. They were of the view that there was not enough information available for a thorough environmental assessment because a reactor technology had not been selected for the Project. They felt that the use of a plant parameter envelope prevented meaningful analysis of specific design details, and as such, did not include enough information or details regarding the environmental effects of the Project. Participants also felt that the public would not be able to analyze the details if they are put off to future Canadian Nuclear Safety Commission licensing stages under the *Nuclear Safety and Control Act*.

Some participants held that the EC6 reactor technology was added to the bounding scenario and incorporated into the plant parameter envelope too late in the environmental assessment process to allow comprehensive analysis of that technology. Some participants stated that they needed more time and/or funding to complete the review in this regard.

In addition to these views, some participants felt that the reactor technologies on which the plant parameter envelope was based differed with respect to safety. They felt that they could not complete a proper comparative analysis without a selected reactor technology. Some participants noted potential flaws in the reactor safety systems and heat transport systems of some of the proposed reactors. Participants believed that the safest technology should be selected by the Government of Ontario and not based on which is the least expensive.

Conversely, some participants agreed with the use of the plant parameter envelope and felt that it provided adequate information for the environmental assessment stage of the process. They were of the view that the detailed design

information would be appropriately addressed at later licensing stages.

Some participants suggested that the Government of Ontario should select a CANDU reactor technology for the Project because it would be safer than other potential reactor designs.

#### Public Consultation

Several participants maintained that OPG had adequately consulted the public and the municipality. They indicated that OPG provided many opportunities for the public to comment on and ask questions about the Project.

Contrary to this, some participants expressed concerns that they were not consulted; some intervenors felt that OPG did not adequately consult the residents of Toronto. Some young participants stated that they were not consulted on the Project by OPG and requested that the proponent consult with youth in schools and communities. Participants stressed the importance of consultation and felt that OPG should continue to consult the public and Aboriginal people as the Project evolves.

#### Environmental Assessment Transparency

Some participants believed that the environmental assessment lacked transparency. They felt that the EIS Guidelines and Joint Review Panel Agreement that directed the review were written behind closed doors and disregarded the input of the public. Other intervenors felt that the lack of design details and source term information—as well as the lack of details regarding mitigation measures and follow-up and monitoring programs—meant that the public could not scrutinize the Project and make a meaningful contribution.

#### Cumulative Effects Assessment

Some participants were of the view that the cumulative effects assessment undertaken by OPG was not sufficient. They noted that there are several projects in the local and regional study areas that may not have been adequately assessed by OPG, including St. Marys Cement, the other nuclear plants on Lake Ontario in both Canada and the United States and the proposed Durham Region energy from waste incinerator, as well as traffic and smog.

On the other hand, some participants felt that OPG appropriately considered cumulative effects

across the regional study area. It was noted that the Port Hope area was considered in the cumulative effects assessment.

#### Political Context

Some participants were of the opinion that the nuclear industry in Canada is politically driven at both the federal and provincial level. They felt that the governments would subsidize and support the nuclear industry despite any potential environmental effects that may result from the operation of nuclear facilities.

Some participants were of the opinion that the Project, which was based on a directive from the Government of Ontario in relation to the Ontario energy policy, should be subject to an Ontario environmental assessment.

#### 3.3.11 Effects on Lake Ontario

Several participants expressed concerns about the effects of the Project on Lake Ontario. These concerns ranged from the effect of the condenser cooling system on fish and fish habitat to water quality to the effect on navigation and recreational boating.

#### Fish and Fish Habitat

Regarding the cooling technology, participants were concerned that once-through cooling, the technology preferred by OPG for condenser cooling, would be the most destructive to fish populations in the vicinity of the Project. Participants disagreed with the OPG conclusion that the effects of the Project on fish populations would be minimal; they argued that once-through cooling technology would have a severe effect on fish from impingement and entrainment losses in the intake and diffuser and from the thermal plume from discharge water. Participants were further concerned that once-through cooling would result in a deleterious substance in the form of a thermal plume being deposited in an area frequented by fish. Participants believed that the effects of the Project on round whitefish—the most thermally sensitive species of fish in the vicinity of the Project—would be a significant adverse environmental effect.

Participants also believed that the effects of the proposed lake infill on fish habitat would be significant. They maintained that the infill would permanently remove productive nearshore fish habitat from the lake. As such, some participants expressed a preference for no lake infill. Participants further noted that should the once-

through cooling technology be used, there would be habitat loss at the site of the intake and diffuser.

Participants also had concerns regarding OPG's plans to mitigate the effects on fish and fish habitat. Some participants felt that OPG should implement acoustic deterrents to prevent fish from approaching the intake and diffuser. Participants also felt that compensation, such as creating new habitat elsewhere on the shoreline to replace habitat loss in the vicinity of the Project, would not be a preferable form of mitigation, and it should only be used as a last-resort.

#### Water Quality

Participants noted concerns regarding the effects of the Project on water quality, and stated that the thermal plume from the cooling technology would have an adverse effect on water quality because it would encourage the growth of bacteria and undesirable algae. Participants further felt that the Project could result in contaminants, including radioactive emissions, hazardous substances or chemicals, stormwater and wastewater being deposited into the lake. Participants expressed the belief that it was difficult to evaluate the effects of these releases because a reactor technology had not been chosen.

Participants noted that stormwater and wastewater management are an important aspect of managing releases that could end up in Lake Ontario. Participants felt that OPG had not adequately assessed these issues during the environmental assessment. Participants were of the view that effective water quality monitoring plans, including stormwater quality, were not provided by OPG during the course of the environmental assessment, and they noted that appropriate plans would be necessary to prevent an effect on water quality in Lake Ontario.

#### Boating and Navigation

Participants expressed concerns regarding effects of the Project on navigation. Participants noted that the intake and diffuser for the condenser cooling technology would require a prohibitive zone, which would affect the amount of surface area on the lake in which boating can occur. It was further noted that the longer the intake and diffuser, the larger the prohibitive zone would be, thereby forcing small watercraft further offshore.

### 3.3.12 Atmospheric Environment

Some participants expressed views regarding the effect of the Project on the atmospheric environment, which includes air quality and noise.

#### Air Quality

Several participants expressed concerns regarding air quality, particularly during the site preparation and construction phase of the Project, due to the operation of heavy equipment and machinery on the site. They noted that the air quality in the region was already poor, particularly due to the proximity of Highway 401, and that there could be cumulative effects with traffic emissions and smog. They felt that OPG should take care not to negatively affect the local population who may have respiratory difficulties. Some participants noted and agreed with the Health Canada recommendation that OPG should take precautions not to perform activities on days when there are smog alerts in the region.

In addition, some participants had concerns regarding dust that would be generated by the Project. Participants were concerned that the dust may contain radioactive particles from the site if the soil were contaminated and felt that OPG should not perform activities that may release these into the air.

Some participants noted that effects such as shoreline fumigation and plume trapping along the shore of the lake could result in releases to the air from the Project being concentrated in an area closer to the facility rather than dispersing over a wider area. They felt that OPG would need to address these phenomena in its air modelling.

Participants also indicated that it was difficult to evaluate the effects of emissions because a reactor technology had not been chosen.

#### Noise

Some concerns were raised regarding the noise that would be generated during site preparation and construction from the operation of heavy equipment and machinery. Participants felt that OPG should take care not to negatively affect the local population in this regard.

#### Transboundary Effects

A participant stated that it would petition the Minister of the Environment and the Minister of

Foreign Affairs to assess the transboundary effects of the Project under the transboundary provisions of the *Canadian Environmental Assessment Act*. The participant further expressed the view that until a reactor technology is chosen, it would be impossible to adequately evaluate discharges to surface water and emissions to air of conventional and radioactive contaminants that could have transboundary environmental and human health effects.

### 3.3.13 Effects of the Environment on the Project

Some participants expressed views regarding the effects of the environment on the Project—including climate change and seismicity and other geological considerations—and how those effects could result in significant effects on the environment.

#### Climate Change

Some participants noted that climate change considerations would be important for determining the effects of the environment on the Project. Participants were of the view that climate change could result in more severe weather conditions than may currently be anticipated. Participants noted natural disasters such as tornadoes, hurricanes, floods and ice storms as potential hazards that may increase in severity and frequency as a consequence of climate change.

#### Seismicity/Geology

Following the Fukushima Daiichi nuclear accident, there was an added level of interest in seismicity with respect to the Project. Several intervenors expressed concern that the Darlington site is in an active seismic area. Some participants noted that there are fault lines and lineaments in the area, such as along the Rouge River and in the region of the historic Lake Iroquois. Some participants were concerned that the Project buildings may not be able to withstand a major earthquake and raised questions regarding the peak ground acceleration and building codes.

A few participants questioned whether OPG adequately assessed the issue of induced seismicity from St. Marys Cement, which is a quarry that neighbours the Project site and performs blasting as part of its operations. It was noted that the effect of Project infill on St. Marys Cement operations would also need to be

mitigated. A participant also questioned whether karstification was adequately covered during the environmental assessment and whether this could have an effect on the Project.

### 3.3.14 Other Components of the Biophysical Environment

Some participants presented views on aspects of the biophysical environment, including wildlife, species at risk and soil quality.

#### Wildlife and Species at Risk

Some participants expressed concerns regarding wildlife and species at risk, including migratory birds, which currently inhabit or use the Project site. Participants felt that OPG should ensure that it does not permanently remove the habitat for these species.

A few participants noted that Bank Swallow colonies currently nest on the shoreline bluffs that may be removed as part of the Project. Participants believed that OPG should limit any damage to this habitat and ensure that mitigation measures, such as artificial habitat, are in place to prevent losses to the Bank Swallow colonies.

On the other hand, some participants thought that the environment on the Project site is diverse and has improved since the existing Darlington Nuclear Generating Station was built. They felt that OPG has operated in a manner that has allowed it to maintain a diverse ecosystem on the property, and they expect this practice would continue for the proposed Project.

#### Soil Quality

Some participants were concerned about the quality of the soil to be excavated from the site. They questioned whether the soil may have been contaminated with radionuclides or chemicals due to the operations at the existing Darlington Nuclear Generating Station and whether it would be suitable for use as lake infill. They also questioned whether the soil would meet regulations regarding its disposal in landfills.

### 3.3.15 Other Components of the Human Environment

Some participants expressed views regarding components of the human environment including land use, the visual effects of the Project, traffic and transportation, and cultural and heritage resources.

#### Site Selection and Land Use

Participants expressed concerns regarding the proposed site for the Project. They felt that the site was too small to accommodate the full scale of the proposed development, citing OPG's desire to build 40 hectares of infill in Lake Ontario in order to accommodate the footprint of the Project.

Participants were also worried about the proximity of the site to Lake Ontario and populated areas, including the city of Toronto. Participants noted that the future population growth in the Municipality of Clarington and Durham Region may result in residential communities and sensitive installations such as schools being located inappropriately close to the Project. Participants were concerned that this could result in an unmanageable situation in the event of an emergency.

In contrast, some participants found the proposed site for the Project suitable, noting that an existing nuclear power plant is already operating there. Some participants also felt that a nuclear generating station has less of a physical footprint than alternative energy sources, such as wind or solar.

#### Visual Effects

Some participants expressed concerns regarding the visual effects associated with the possible use of cooling towers for the Project. Participants felt that cooling towers have a stigma associated with them that would have a negative socio-economic impact on Durham Region. Participants explained that cooling towers and the associated vapour plumes would dominate the landscape and serve as a constant reminder of the nuclear generating station at the site. Participants further stated that there are misconceptions regarding the

emissions from cooling towers and the public may misinterpret the vapour plume to be radioactive releases. Participants noted that while the local community is comfortable living in the region despite the presence of a nuclear generating station, the visual effects of cooling towers could discourage tourism, growth and economic development in the region and could adversely affect property values.

In addition, some participants felt that the vapour plume from cooling towers could have an effect on driving visibility on Highway 401 due to fogging.

#### Transportation - Traffic

Some participants expressed concerns regarding the effects of the Project on local traffic, noting that the site preparation and construction phase of the Project would result in increased truck traffic on local roads, including Highway 401 and local interchanges at Holt Road and Waverly Road. Participants indicated that while there have been plans to expand roadways in the Project area, this work had not yet begun.

#### Cultural and Heritage Resources

Some participants held that Lake Ontario is a cultural and heritage resource for the people of Ontario, while others maintained that the recreational paths surrounding the Project site should continue to be available for public use.

Some participants stressed the importance of the OPG archaeological assessment of the Project site, and some expressed the view that OPG should consult with Aboriginal peoples regarding archaeological findings, taking care to ensure that Aboriginal cultural artifacts are properly identified.



## Chapter 4 – Considerations for the Review

Prior to presenting its assessment of the environmental effects of the Project, the Panel finds it necessary to present its position on a number of fundamental aspects of the review.

In this chapter, the Panel presents its approach to the review of the Project, including Aboriginal consultation efforts, the application of the precautionary approach, sustainable development and the need and purpose of the Project and its alternatives.

The Panel also presents its evaluation of alternative means to carry out the Project with respect to reactor technologies, excavated materials management and condenser cooling water systems.

Finally, the Panel presents its examination of alternatives to the Project as well as parameters of the Project, including cost estimates, site layout, regulatory requirements at the different licensing phases and financial guarantees.

### 4.1 Analytical Framework

The Panel considered all of the information gathered since the beginning of the review until the closure of the record on June 3, 2011 in its assessment of the Project. In this report, the Panel presents its conclusions, views and recommendations on the environmental assessment to the Government of Canada. The Panel incorporated federal, provincial and municipal policies and requirements as well as industry standards and best practices in its analysis and recommendations. The Panel applied a precautionary approach and considered the principles of sustainable development in its review.

The *Canadian Environmental Assessment Act* and the *Nuclear Safety and Control Act* framed the review of the Project, as stipulated in the Joint Review Panel Agreement. The mandate of the Panel was to assess the environmental effects of the Project and determine whether it is likely to cause significant adverse environmental effects, taking into account the implementation of mitigation measures. The Panel also reviewed the OPG submissions for consistency with the *Nuclear Safety and Control Act*, its Regulations,

and licensing guidance documents from the Canadian Nuclear Safety Commission.

Numerous participants suggested that the Ontario energy policy should be part of the review. While submissions and interventions were received on this matter, the mandate of the Panel did not include a review of the Ontario Long-Term Energy Plan or the Ontario Cabinet-approved Supply Mix Directive. The Long-Term Energy Plan was released by the Ontario Ministry of Energy in November 2010. In February 2011, the Ontario Minister of Energy issued the Supply Mix Directive to the Ontario Power Authority. This Directive must be used by the Ontario Power Authority to develop a proposed Integrated Power System Plan that will subsequently be submitted to the Ontario Energy Board for public review.

#### 4.1.1 The Precautionary Approach

OPG described how it applied the precautionary principle in the preparation of the EIS, as required by the EIS Guidelines and based on the Canadian Privy Council Office document *A Framework for the Application of Precaution in Science-based Decision Making About Risk* (Government of Canada, 2003). OPG stated that it considered this principle in the design of the Project and in its assessment of environmental effects.

The Panel notes that the application of the precautionary principle according to the Canadian Privy Council Office framework is not necessarily in line with the wishes of some of the participants in the review and that different interpretations of the concept were put forward.

One of the purposes of the *Canadian Environmental Assessment Act* is to ensure that projects are considered in a careful and precautionary manner so that they do not cause significant adverse environmental effects. In the administration of the Act, the Government of Canada, the Minister of the Environment, the Canadian Environmental Assessment Agency and all federal and responsible authorities are required to exercise their powers in a manner that protects the environment and human health and that applies the precautionary principle. The Panel notes that the Canadian Privy Council

Office framework was issued to improve the predictability, credibility and consistency of the federal government's application of precaution to ensure adequate, reasonable and cost-effective decisions.

The framework outlines five guiding principles for the application of precaution to science-based decision making in areas of federal regulatory activity for the protection of health and safety and the environment and the conservation of natural resources. They are:

1. The application of precaution is a legitimate and distinctive decision-making approach within risk management;
2. It is legitimate that decisions be guided by society's chosen level of protection against risk;
3. Sound scientific information and its evaluation must be the basis for applying precautions; the scientific information base and responsibility for producing it may shift as knowledge evolves;
4. Mechanisms should exist for re-evaluating the basis for decision and for providing a transparent process for further consideration; and
5. A high degree of transparency, clear accountability and meaningful public involvement are appropriate.

The Panel agrees with these guiding principles for the application of science-based decision making but highlights the importance of defining the affected society when considering the concept of society's level of tolerance for risk. The Panel notes that people in Durham Region are the group with the highest potential to be affected by the Project but, in general, are also more accepting of the risks of or potential for environmental effects. Neighbouring populations around Lake Ontario, including the Greater Toronto Area, could also be affected by the Project, but, anecdotally have less tolerance for project-associated risks.

The framework also outlines the five following principles for precautionary measures:

1. Precautionary measures should be subject to reconsideration on the basis of the evolution of science, technology and society's chosen level of protection;

2. Precautionary measures should be proportional to the potential severity of the risk being addressed and to society's chosen level of protection;
3. Precautionary measures should be non-discriminatory and consistent with measures taken in similar circumstances;
4. Precautionary measures should be cost-effective, with the goal of generating (i) an overall net benefit for society at least cost, and (ii) efficiency in the choice of measures; and
5. Where more than one option reasonably meets the above characteristics, then the least trade-restrictive measure would be applied.

In consideration of the Project and the five principles for precautionary measures, the Panel notes that for principle 2, the required measures could be extensive if proportional to the severity of the risk. Furthermore, where there are threats of serious or irreversible damage, the Panel is of the view that the federal government should be proactive and not wait for scientific certainty or occurrence of an incident to take action, as for instance with a severe nuclear accident or events resulting from climate change. Because of the potential for high magnitude effects as a result of nuclear projects, the Panel believes that the precautionary principle should be applied to prevent environmental degradation and protect citizens in the context of society's chosen level of protection.

With respect to principles 3 and 5, the Panel acknowledges that the nuclear industry is continually adjusting to new circumstances. Security systems and environmental protection measures have to evolve with each malfunction or accident. The Panel is of the view that the protection of citizens and physical environmental components may require the development of new or improved measures that do not necessarily have similar circumstances, or are least-trade restrictive.

In considering principle 4, the Panel emphasizes that while cost is a consideration, safety and security must always take precedence.

The Panel therefore underlines the need to identify and recommend measures beyond existing standards and practices, when appropriate, to protect the public and the environment.



#### 4.1.2 Sustainable Development

The *Canadian Environmental Assessment Act* defines sustainable development as development that meets the needs of the present, without compromising the ability of future generations to meet their own needs. Similarly, the Act requires a Review Panel to give consideration to the capacity of renewable resources that are likely to be significantly affected by the Project to meet the needs of the present and those of the future. The purpose of the Act highlights the aim of the Government of Canada to promote sustainable development and achieve a healthy environment and economy.

The Panel notes that, in general, the analysis of whether a project respects sustainable development objectives is concentrated on the assessment of its effects on biodiversity and the capacity of renewable resources. The Panel is of the view that equitable socio-economic objectives, such as liability and legacy, are also important considerations that should be included in the review of future nuclear projects. As such, the Panel has considered these issues in its review.

#### 4.1.3 Assessment of Environmental Effects

The first major task of the Panel was to review the proponent's assessment of the environmental effects of the Project. The Panel found that the assessment of potential environmental effects was qualitative in many respects because it was conducted without specific knowledge of potential releases. OPG explained that certain parameters of the bounding scenario, such as hazardous substance emissions and on-site chemical inventories, could not be developed until a specific reactor technology has been selected by the Government of Ontario. Where information specific to the chosen reactor technology is required, the Panel recommends that certain actions be taken before the Project can proceed.

The Panel is responsible for determining the likelihood that the Project will cause significant adverse environmental effects, taking into account the implementation of any mitigation measures that it considers appropriate. In this matter, the Panel followed the Canadian Environmental Assessment Agency reference guide entitled *Determining Whether a Project is*

*Likely to Cause Significant Adverse Environmental Effects* (November 1994).

The Panel first determined whether an environmental effect would be adverse by comparing the quality of the existing environment with the predicted quality once the Project is in place. When an effect was determined to be adverse, the Panel proceeded to determine its significance. In this regard, the Panel considered the magnitude, geographic extent, duration and frequency, reversibility, and ecological context, as applicable, of the effect. Finally, the Panel determined whether the significant adverse effect is likely to occur. Two criteria are considered when determining the likelihood: the probability of occurrence and scientific uncertainty, which is often referred to as confidence limits.

Contrary to the 1994 guide, OPG included likelihood as a parameter in the assessment of significance. To ensure that the application of mitigation measures or follow-up programs is carefully considered, the Panel believes that the significance of an effect should be determined before assessing its likelihood. For instance, to ensure that mitigation is developed for a severe nuclear accident, the significance of the effects of the accident should be determined before concluding that its likelihood is so remote that its effects are not significant. The Panel believes that a prudent approach should be taken in this situation to identify appropriate mitigation measures despite the remote likelihood of occurrence.

The Panel considered technically and economically feasible measures to mitigate any significant adverse environmental effects of the Project and alternative means to undertaking the Project. OPG provided a number of mitigation measures and plans, and indicated that details would be forthcoming at later stages of the Project, such as following the Government of Ontario selection of a reactor technology.

To address the absence of detailed mitigation plans, CNSC staff have recommended to the Panel that a condition of the Licence to Prepare Site be that OPG shall have the requisite plans accepted by the Canadian Nuclear Safety Commission or CNSC staff prior to commencing applicable licensed activities. The Panel accepts this recommendation and adds that the

monitoring program and compensation plans should be treated in the same manner.

Finally, the Panel notes the distinction between monitoring and follow-up programs, as well as between mitigation measures and compensation plans. The Panel regards monitoring to be observation and the acquisition of knowledge, whereas follow-up is specifically developed to confirm predictions from the environmental assessment and the effectiveness of mitigation. The Panel is of the view that adaptive management, a systematic process for the continuous improvement of environmental management practices, should only be applied in cases where thresholds can be defined. Adaptive management should not be used to overcome a situation where there is a lack of scientific data or certainty.

## 4.2 Aboriginal Rights and Title

This section presents the Panel's consideration of the potential effects of the Project on Aboriginal rights and title. This includes Aboriginal consultation efforts by the proponent and the responsible authorities.

### 4.2.1 Proponent Assessment

OPG documented the asserted and established Aboriginal rights, Aboriginal title and treaty rights through a description of the content and background of the *Williams Treaties* (1923), including extinguishment of rights. OPG also described the *Nanfan Treaty* (1701), indicating that the boundaries of the Treaty fall outside of the regional study area and that the Treaty represented a surrender of title. OPG did not identify any Métis communities in the regional study area or Métis persons who are currently harvesting within this area, although it is understood that Métis persons reside within the environmental assessment study areas.

The initial findings of OPG did not suggest that the Project would affect Aboriginal rights, Aboriginal title or treaty rights within the areas comprising the site and local and regional study areas.

OPG summarized its Aboriginal consultation efforts and provided details regarding its consultation and engagement strategy, which included providing up-to-date information, involving Aboriginal peoples in how information is delivered and explaining the results of the EIS

in a clear and direct manner. OPG stated that, as a result of its consultation with identified First Nations, Métis councils and organizations, no Project-specific impacts were identified for lands or resources used by Aboriginal peoples for traditional purposes or Aboriginal and treaty rights.

OPG also provided a detailed overview of its prediction of potential impacts of the Project on asserted or established Aboriginal rights and/or title, and stated that there would be no measurable change to the environment, specifically with regards to Aboriginal interests.

OPG committed to continuing to engage Aboriginal groups throughout the life of the Project.

### 4.2.2 Panel Assessment

CNSC staff stated that OPG provided detailed evidence and outcomes of engagement of a wide range of Aboriginal groups which could have an interest in the Project. CNSC staff indicated that OPG had met with, or attempted to meet with, all of the identified Aboriginal groups and noted that OPG provided examples of communications material used in such meetings. CNSC staff also provided information regarding the contributions of Aboriginal groups during the public review and comment period.

The Panel received both the Métis Nation of Ontario technical review of the EIS and the traditional plant use study.

The Panel notes that the Alderville First Nation did not consider the OPG consultation process to be full consultation despite the accuracy of the information in the EIS regarding Aboriginal interests. The Panel further notes that the Alderville First Nation recommended that the consultation process continue.

Both the Métis Nation of Ontario and the Alderville First Nation participated as intervenors at the public hearing.

CNSC staff expressed the view that OPG made best efforts to engage Aboriginal communities that may be impacted by the Project in a manner that is in keeping with the key elements of meaningful public participation, as described in the EIS Guidelines.

CNSC staff also provided information regarding Crown consultation efforts, including letters, emails, telephone calls and meetings during key points in the process. CNSC staff encouraged groups to submit information to the Panel and to participate in the public hearing.

The Panel notes that during the public hearing, two groups stated that they did not recognize the Williams Treaty. The Panel notes that its mandate does not include consideration of the validity of Aboriginal rights or title as asserted by Aboriginal groups, or the strength of those claims. The Panel further notes that its mandate for the purposes of the environmental assessment does not include a determination on the scope of the duty of the Crown to consult Aboriginal groups and whether Canada has met its duty to consult and accommodate any infringement on Aboriginal rights or title.

### 4.3 The Need and Purpose of the Project

This section presents the Panel's consideration of the need for and purpose of the Project in accordance with the EIS Guidelines.

#### 4.3.1 Proponent Assessment

OPG explained that the purpose of the Project is to fulfill its responsibilities under the June 2006 directive from the Government of Ontario to undertake the approval process for new nuclear units. In March 2008 the Ontario Government announced that the new units would be located at the Darlington site and operated by OPG. In the November 2010 Long-Term Energy Plan, the Ontario Government reaffirmed the provincial need for at least 2,000 megawatts from new nuclear units at Darlington. OPG explained that the Project would fulfill its responsibility to the Government of Ontario to assist in maintaining the baseload of nuclear generation capacity of 14,000 megawatts through the construction of new nuclear units at Darlington. OPG stated that the need for the Project has been determined by the Government of Ontario in its Long-Term Energy Plan and Supply Mix Directive.

Following a request from the Panel to elaborate on the need for the Project, OPG responded that the EIS Guidelines state that provincial energy policy is not within the Panel's terms of reference. OPG further responded that the public consultation process carried out by the Government of Ontario to establish the basis for

the policy decision to build new nuclear facilities at the Darlington Nuclear site is a matter of provincial jurisdiction, and is performed in accordance with provincial requirements.

#### 4.3.2 Panel Assessment

The Ontario Ministry of Energy submitted information for the public hearing regarding the Government of Ontario energy policies and framework. It discussed the Ontario Long-Term Energy Plan, the Cabinet-approved Supply Mix Directive, and the Ontario Power Authority draft Integrated Power System Plan. In its submission, the Ministry stated that under the Long-Term Energy Plan, nuclear power will continue to provide approximately 50 percent of the provincial electricity supply. The Ministry noted that in order to meet this objective, 10,000 megawatts of existing nuclear capacity at the Darlington and Bruce Nuclear Generating Stations will be refurbished, and at least 2,000 megawatts of the nuclear capacity will be provided by the Project. The Ministry stated that the 2,000 megawatts would replace the capacity at the Pickering A and B stations, which will be permanently shut down after 2020. Although there was a decrease in demand for electricity in 2008 and 2009 in Ontario, the Ministry noted that the Project calls for up to 4,800 megawatts in order to allow flexibility for future electricity planning needs.

The Ontario Ministry of Energy noted that coal generation will be phased-out in Ontario by the end of 2014 for health and environmental reasons, and that natural gas will be used to meet peak demand requirements. Additionally, the Government of Ontario is committed to reducing carbon dioxide emissions to meet its greenhouse gas reduction target.

During the public hearing, the Panel asked the Ontario Ministry of Energy to outline the strategic considerations that formed the basis of the Government of Ontario Long-Term Energy Plan. In response, the Ministry outlined the expected peak demand and annual consumption of power until 2030 and provided the Government expectations regarding installed generation capacity to meet the energy demand and to provide a contingency margin. The Ministry stated that it is committed to the proposed Project and fully supports OPG in the environmental assessment and licensing processes.

Many participants expressed concerns regarding the purpose and need for the Project. Participants questioned the reliance of the Province on nuclear energy and the target of providing 50 percent of the baseload from nuclear. They argued that future demand could be met through other means of electricity generation, including renewable resources and smart grid technology, imports of hydroelectricity from Quebec and Manitoba, natural gas-fired combined heat and power, and conservation and energy efficiency.

The Panel is of the view that the Ontario Ministry of Energy has explained the need for the Project and the rationale behind the Ontario Government direction to OPG. The Panel further notes that the Ontario Government posted the draft Supply Mix Directive to the Ontario Environmental Registry for a 45-day public review before Cabinet approved the final Directive in February 2011. Further, the Ontario Power Authority consulted the public in May and June 2011 on its draft Integrated Power System Plan and is expected to submit the plan to the Ontario Energy Board for public review later in 2011. In accordance with his authority granted under the *Electricity Act, 1998* (O. Reg. 164/99), the Minister of Energy has directed the Ontario Energy Board to review the proposed Integrated Power System Plan at public hearings, no later than 12 months after the Ontario Power Authority submits it. The Panel believes that these public consultation opportunities are the proper venues for the public to express their views regarding Ontario energy policy.

## 4.4 Alternatives to the Project

This section presents the Panel's consideration of the alternatives to the Project.

### 4.4.1 Proponent Assessment

For the proponent, alternatives to the Project are different ways of achieving the purpose and need of the Project that are within its control and/or interest. In interpreting the EIS Guidelines, OPG considered the following four alternatives:

- do nothing;
- seek approval for a modified Project with a generation capacity of less than 4,800 megawatts;
- seek approval for the Project at a different location; and
- seek approval for a non-nuclear option.

OPG considered each of these alternatives unacceptable for different reasons. OPG stated that alternatives 1 and 4 are unacceptable because they would be contrary to direction from the Government of Ontario. OPG explained that alternative 2 would be inconsistent with the objective of the Government to have flexibility in long-term planning decisions and that alternative 3 would be inconsistent with the direction of the Government to build a new nuclear plant at the existing Darlington site. OPG further stated that the Darlington site is the only existing nuclear site that is exclusively within the control of OPG and that has the potential for new nuclear reactor development.

The Panel requested that OPG provide additional information on alternatives to the Project. OPG's response included Table 5: OPG Alternatives Analysis, which summarized its proposed alternatives and the different constraints placed on each.

OPG concluded that there were no reasonable alternatives to the Project that were both within its interest and control, and consistent with the direction and clarification provided by the Government of Ontario.

### 4.4.2 Panel Assessment

In setting the scope of factors for the environmental assessment, the Minister of the Environment directed the Panel to consider the need for, purpose of, alternatives to and alternatives means of undertaking the Project.

The EIS Guidelines stipulated that the analysis of alternatives to the Project must describe functionally different ways to meet the need and achieve the purpose of the Project from the perspective of the proponent. The Guidelines required the identification of technically and economically feasible methods of producing electricity that are within the control and/or interests of OPG. The Guidelines further stated that because an assessment of provincial energy policy is not within the Panel's terms of reference, the alternatives to the Project need not include alternatives that are contrary to Ontario's formal plans or directives. It was required, however, that the proponent explain where this rationale had been applied to exclude consideration of possible alternatives to the Project.

Table 5: OPG Alternatives Analysis

Electricity Generating Alternative	Capable of generating a minimum of 2,000 and up to 4,800 megawatts (MW) of additional baseload electricity	Consistent within the mandate provided to OPG	Consistent with Provincial Policy	Capable of being sited on the existing Darlington site	Decision
Natural Gas	<p>YES</p> <p>Natural gas can provide baseload supply however it will have higher greenhouse gas emissions and will be provided on the basis of a fluctuating cost.</p>	<p>NO</p> <p>OPG has received directives from the Province of Ontario to consider the potential transition of the selected coal fuelled generating facilities to natural gas. It has not been directed to otherwise consider natural gas.</p>	<p>NO</p> <p>The Supply Mix Directive indicates that natural gas is to play a strategic role in facilitating development of renewable generation, meeting peak demand, and off-setting temporary reductions in nuclear generation.</p>	<p>YES</p> <p>Assuming suitable supply of natural gas could be provided to the Darlington site, the area available would accommodate between 2,000 MW and 4,800 MW of natural gas generation.</p>	<p>This alternative is not available to OPG</p>
Biomass	<p>NO</p> <p>Biomass is not currently viable for baseload electricity due to lack of supply of biomass fuel.</p>	<p>NO</p> <p>OPG has only been directed to transition its Atikokan generating station to use biomass and to consider co-firing biomass with natural gas at Thunder Bay and Nanticoke generating stations. This additional production is already included in the biomass portion of the Long-Term Energy Plan, and is not available to replace new nuclear generation.</p>	<p>YES</p> <p>The Supply Mix Directive indicates 10,700 MW are to be supplied by renewables, where cost-effective opportunities are identified.</p>	<p>YES</p> <p>Assuming suitable supply of biomass could be provided to the Darlington site, the area available would accommodate between 2,000 MW and 4,800 MW of biomass generation.</p>	<p>This alternative is not available to OPG</p>
Water	<p>NO</p> <p>Additional hydroelectric generation resources capable of 2000 – 4800 MW baseload generation are not available beyond that currently committed in the Supply Mix Directive.</p>	<p>YES</p> <p>The Memorandum of Agreement with the Province allows OPG to develop additional hydroelectric generation. This additional production is already included in the hydroelectric portion of the Long-Term Energy Plan, and is not available to replace new nuclear generation.</p>	<p>YES</p> <p>The Supply Mix Directive calls for the exploration of additional hydroelectric generation above that which is already under development.</p>	<p>NO</p> <p>Additional hydroelectric generation cannot be constructed at the Darlington site.</p>	<p>This alternative is not available to OPG</p>
Nuclear	<p>YES</p> <p>The reactor technologies under consideration can provide between 2,000 and 4,800 MW of additional baseload electricity</p>	<p>YES</p> <p>OPG was directed to begin the federal approvals process for new nuclear generation.</p>	<p>YES</p> <p>The Supply Mix Directive requires nuclear generation to be sustained at approximately 50 percent of the demand.</p>	<p>YES</p> <p>The Darlington site has sufficient area available to accommodate between 2,000 and 4,800 MW of additional nuclear generation.</p>	<p>This alternative is available to OPG</p>

In providing further direction, the EIS Guidelines detailed that for each identified alternative to the Project that is within the control and/or interests of OPG, the proponent must explain how it developed the criteria to identify the major environmental, economic and technical costs and benefits of that alternative, and how it identified the preferred Project based on the relative consideration of these factors. This was to be done to a level of detail which would allow the Panel and the public to compare the Project with its alternatives.

CNSC staff agreed that OPG's decision to assess the alternatives to the Project within the constraints of the Ontario energy policy was reasonable and acceptable in light of the procedural guidance provided in the Canadian Environmental Assessment Agency Operational Policy Statement *Addressing Need for, Purpose of, Alternatives to and Alternatives Means under the Canadian Environmental Assessment Act* (November 2007).

Numerous participants in the review were of the opinion that reasonable alternatives to the Project were not considered. Certain participants stated that the assessment did not comply with the requirements of the *Canadian Environmental Assessment Act* in the consideration of alternatives to the Project. Participants presented options as to how 4,800 megawatts could be replaced with a combination of wind, solar and hydro power, biomass, biogas from landfill, combined heat and power and additional conservation and demand management.

The Ontario Ministry of Energy provided an overview of alternatives and considerations that led to the proposed supply mix in the Long-Term Energy Plan. In its final comments, the Ministry presented a summary of the need for a balanced supply mix and the options considered.

The Panel understands the constraints preventing OPG from considering the development of other forms of energy. The Ontario Government Long-Term Energy Plan and Supply Mix Directive dictate the projects the proponent shall pursue. However, if at a later date the Ontario Government revises the current energy supply mix and reduces the nuclear baseload capacity, it would be possible to develop a different portfolio within the competence of OPG. While the Panel acknowledges the public consultation to date on the Ontario Government energy policy, it regrets

the fact that the new Darlington Project is being evaluated before the Ontario Energy Board hearings on the Integrated Power System Plan are completed.

The Panel also notes that the Long-Term Energy Plan and Supply Mix Directive were developed before the Fukushima Daiichi nuclear accident. Since this accident, more concerns have been raised about nuclear power generation globally. The Panel understands the challenges the Ontario Government faces as it proceeds with phasing out coal to reduce greenhouse gas emissions and permanently shutting down the Pickering Nuclear Generating Station. However, the Panel wishes to acknowledge the desire expressed by many participants for a re-examination of the Ontario energy alignment.

## 4.5 Alternative Means of Carrying Out the Project

This section presents the Panel's consideration of the alternative means of carrying out the Project.

### 4.5.1 Alternative Reactor Technologies

The selection of a reactor technology is not an alternative means of carrying out the Project that is within the control of OPG. As such, the proponent was not required to undertake an assessment of this factor. However, in consideration of the interest in and importance of this matter, the Panel reviewed information submitted on alternative reactor technologies.

#### Proponent Assessment

OPG considered alternative designs through the adoption of a plant parameter envelope approach for the environmental assessment. The plant parameter envelope comprises bounding design parameters from four reactor technologies under consideration for the Project. This approach enables consideration of potential adverse effects of a range of reactor designs in the review.

OPG used the four reactor technologies described below to set the boundaries of the plant parameter envelope.

The Atomic Energy of Canada Limited Advanced CANDU Reactor ACR-1000 is a hybrid reactor that uses light water to cool the fuel and heavy water in the moderator. The reactor has a net electrical output of 1,085 megawatts per unit. It operates with low enriched uranium fuel (enrichment up to 2.5 percent).

The AREVA US EPR is a pressurized light-water reactor with a rated net electrical power of 1,580 megawatts per unit. It uses light water as the moderator and to cool the fuel. The reactor operates with enriched uranium fuel (enrichment up to 5 percent).

The Westinghouse AP1000 Reactor is a pressurized light-water reactor and has a net electrical output of 1,037 megawatts per unit. It uses light water as the moderator and to cool the fuel, and operates with enriched uranium fuel (enrichment up to 4.5 percent).

The Atomic Energy of Canada Limited EC6 Reactor is a pressurized heavy water reactor that uses heavy water as both the coolant and the moderator. It uses natural uranium fuel, and the net electrical output is 686 megawatts.

OPG's use of the plant parameter envelope approach was intended to allow for the assessment of the potential adverse environmental effects associated with the Project, without specifying a reactor technology. OPG stated that the selection of a reactor technology that is not bound by the plant parameter envelope could require adjustments to the environmental assessment to take into account any substantial changes to the environment, the circumstances of the Project and new information of relevance to the assessment of effects of the Project.

#### Panel Assessment

According to CNSC staff, the reactor designs that were assessed as bounded by the plant parameter envelope are all enhancements of designs of currently-operating reactors. These designs incorporate characteristics that provide improvements in safety from previous designs. Among the changes is the incorporation of passive safety features, such as the capability to continue to maintain safety functions, even in instances of loss of power. CNSC staff stated that the designs provide overlapping redundant measures for the prevention and mitigation of effects from reactor malfunctions and accidents and that all of these alternative designs have robust containment structures.

CNSC staff noted that much of the design and safety information considered for the reactor designs covered in the plant parameter envelope is preliminary information that may be accepted for the purposes of the environmental

assessment. CNSC staff indicated that final detailed design information and safety analyses will be required to confirm compliance with regulatory requirements at the time of an Application for a Licence to Construct a reactor.

CNSC staff concluded that the plant parameter envelope approach allowed for the assessment of the potential adverse effects of a reasonable range of reactor designs in accordance with the EIS Guidelines.

The Panel accepts the use of a plant parameter envelope for environmental assessment purposes as an approach that allows the prediction of adverse environmental effects for a select group of reactor technologies. The Panel recognizes, however, that this is a departure from a more standard approach where the major components of a project are defined in advance of an environmental assessment.

Additionally, the Panel notes that aspects of the plant parameter envelope were based on preliminary design information. As such, there will be a need for ongoing verification of the conclusions reached on the significance of adverse environmental effects.

The selection of a reactor technology that is not one of the four designs considered will require careful review to confirm the continued applicability of the assumptions and conclusions of this environmental assessment. A determination of the applicability of this environmental assessment will be made by the responsible authorities when a reactor technology for the Project is selected by the Government of Ontario.

It is noted that, of the four reactor designs described in the EIS, only the Atomic Energy of Canada Limited EC6 has entered operational service and has environmental performance data from operating plants. However, with respect to technology safety and expected environmental performance, all of these reactors incorporate passive safety features and are designed to mitigate the effects of malfunctions and accidents. The safety features provide defence-in-depth and systems to control and cool the reactor and to contain radioactivity in the plant. These attributes are common features of modern reactor designs.

**Recommendation # 1:**

*The Panel understands that prior to construction, the Canadian Nuclear Safety Commission will determine whether this environmental assessment is applicable to the reactor technology selected by the Government of Ontario for the Project. Nevertheless, if the selected reactor technology is fundamentally different from the specific reactor technologies bounded by the plant parameter envelope, the Panel recommends that a new environmental assessment be conducted.*

**4.5.2 Excavated Material Management**

The Panel's consideration of alternative means of carrying out the Project included consideration of alternative means of managing excavated material. Excavated material includes soil and rock.

Proponent Assessment

OPG examined three scenarios with respect to excavation. In all three scenarios the volume of excavated material to be managed on site in the northwest landfill, northeast landfill and proposed lake infill was similar. The scenarios varied, however, in the volumes to be disposed of off site.

OPG used the scenario that produced the maximum quantity of excavated material in its assessment of environmental effects. In response to a Panel information request, OPG indicated that two excavated material management alternatives were examined: on-site use and disposal, and transport of material off site for disposal. OPG compared the predicted effects of the two options across the different environmental components and sub-components. OPG concluded that no significant environmental effects would result from either alternative, but that on-site management of excavated material was preferred as it would minimize the nuisance effects of trucking the material off site.

OPG indicated the need for or the extent of lake infilling was not considered an alternative means; however, it stated that one of the purposes for lake infill was the disposal of excavated material. In its *Aquatic Environment Compensation Report*, submitted to the Panel in August 2010, OPG examined the following lake infill alternatives:

Maximum lake infill:

- Option 1 - bounding scenario (40-hectare lake infill).

No lake infill:

- Option 2 - off site on-land disposal;
- Option 3 - offshore deepwater disposal; and
- Option 4 - Canadian National Rail realignment.

Minimum lake infill:

- Option 5 - alternative staging and delivery;
- Option 6 - temporary lake infill; and
- Option 7 - relocation of existing Darlington Nuclear Generating Station buildings and facilities.

Panel Assessment

CNSC staff stated that the OPG assessment of excavated material management alternatives was somewhat unclear. CNSC staff indicated that OPG appears to have characterized and contrasted effects based on on-site management of all excavated materials versus off-site disposal of all excavated material, but that OPG did not consider off-site disposal of all excavated material as an alternative.

CNSC staff concluded that the on-site effects would be expected to be similar across the three excavated materials management scenarios. The nature of the off-site effects would be expected to be greater as the amount of off-site disposal increases.

CNSC staff stated that OPG captured the range of possible effects with respect to excavated materials management, but that OPG did not consider technical or economic criteria.

With respect to the consideration of lake infill alternatives in the *Aquatic Environment Compensation Report*, CNSC staff stated that it would prefer options to reduce the size of the infill over the bounding scenario, given the potential importance of the habitat for round whitefish. CNSC staff expressed a preference for Option 5, which calls for alternative staging and delivery, as it would reduce the size of the proposed lake infill while allowing some lake infill to accommodate elements of the Project.

With respect to the soil quality of excavated materials, the Panel notes that OPG collected soil samples as a component of the existing



conditions site characterization program. Analytical results were compared to *Environmental Protection Act* (R.S.O. 1990, c. E.19) standards with respect to industrial/commercial land use in a non-potable groundwater setting, which is appropriate for the Darlington site as it is industrial, with no potable groundwater between the site and the point of groundwater discharge.

The Panel notes that a minority of soil samples contained beryllium in concentrations above the standard. However OPG stated that these results were representative of natural conditions of the overburden of the site because all of the soil samples contained at least some beryllium, including samples from areas where native soils had not been disturbed.

The Panel also notes that OPG indicated, based on visual observations, that there are potentially contaminated soils in three locations at the site: the spoils disposal area, cement plant area and asphalt storage area.

Some possible off-site disposal solutions were discussed during the review:

- OPG suggested that the excavated material may be used in road construction, but the Ontario Ministry of Transportation indicated that there was no agreement yet in place for such an arrangement.
- The Municipality of Clarington and the Region of Durham suggested that a new commercial fill site could be created in a rural area, but warned that this may result in the loss of agricultural land.
- The Panel suggested that the excavated material may be used as daily cover in domestic landfill sites. The Ontario Ministry of the Environment supported this idea as a viable option.

The Panel acknowledges that OPG must seek specific provincial or municipal approvals before disposing of excavated materials off site. High concentrations of beryllium or other contaminants may limit the options of OPG for off-site disposal.

The Ontario Ministry of the Environment *Fill Quality Guide and Good Management Practices for Shore Infilling in Ontario* (March 2011) contains guidelines and best practices to protect aquatic ecosystems by protecting the quality of

the sediment and water in areas adjacent to shore-infilling activities. According to the Ministry, the intent of the Guide and Good Management Practices is to suggest to other agencies and proponents ways of assessing the suitability of the quality of fill so that the goal of protecting aquatic ecosystems is attained. The Ministry notes that any lake filling or construction on the bed of Lake Ontario would require approvals from the Ministry of Natural Resources, Fisheries and Oceans Canada and/or Conservation Authorities.

The Panel notes that the analytical data provided by OPG did not indicate the presence of any contaminate in concentrations above those listed in Table C-1: Confined Fill Guide Parameter List in the Guide. The Guide, however, states that confined fill must be placed within the confine of a structure, such as a dyke, which is capable of withstanding the waves of a one-in-one-hundred year storm.

Unconfined fill may be placed directly in open water. However, the Panel notes that OPG's soil sampling indicates that total chromium, manganese, nickel and total phosphorus are present in concentrations above those listed in Table C-2: Unconfined Fill Guide Parameter List of the Guide.

#### **Recommendation # 2:**

*The Panel recommends that prior to site preparation, the Canadian Nuclear Safety Commission require OPG to conduct a comprehensive soils characterization program. In particular, the potentially impacted soils in the areas OPG identifies as the spoils disposal area, cement plant area and asphalt storage area must be sampled to identify the nature and extent of potential contamination.*

Given the potential for adverse environmental effects from lake infill, the Panel is of the view that OPG should minimize the amount of lake infill to less than the bounding scenario of 40 hectares, although it is recognized that this will increase the negative effects associated with truck traffic required to move excavated materials from the site. OPG should not be permitted to deposit fill in Lake Ontario beyond the two-metre depth contour, regardless of the cooling technology chosen. These issues will be addressed through Panel recommendations later in the report.

#### 4.5.3 Condenser Cooling Water Technology

The Panel's assessment of alternative means of carrying out the Project included alternative condenser cooling water technologies. Generation of up to 4,800 megawatts of electrical power requires the rejection of a considerable quantity of low-grade heat from the power plant condensers. Cooling water is circulated through the condensers to extract the reject heat, which must then be dissipated into the environment. A number of alternative conventional technology options exist for this heat dissipation function.

##### Proponent Assessment

OPG initially identified seven options in its assessment of alternative means for condenser cooling water technology. Assessment of these options resulted in four of them being taken forward to the environmental assessment. These were:

- once-through lakewater cooling;
- natural draft cooling towers;
- mechanical draft cooling towers; and
- fan-assisted natural draft cooling towers.

The study recommended that no further consideration be given to hybrid and dry cooling towers because of their high capital and operating costs and the absence of conditions that would necessitate constraint on water usage. The seventh option, which involved use of spray cooling ponds, was ruled out because of land space constraints.

OPG stated that none of the four retained options posed significant adverse effects and that a choice could be made based on a qualitative preference assessment. OPG concluded that the environmental effects that would arise with cooling towers would be greater than those from a once-through lakewater cooling system. OPG explained that losses of aquatic biota through impingement, entrainment, thermal effects and other disruptions would not be significant in terms of lake-wide populations. OPG noted that these adverse effects on the aquatic environment would be offset by lower costs, lower electrical power consumption, lower land area requirement, and the absence of visual effects of structures and condensation plumes associated with cooling towers.

OPG also emphasized that consultation with the local public indicated that the visibility of cooling towers and condensation plumes would contribute to a perceived negative image because it would emphasize the presence and emissions of a nuclear generating facility in the community.

##### Panel Assessment

The Panel notes that the OPG assessment of alternative condenser cooling technologies was based only on qualitative comparisons of cooling tower options with the once-through cooling water system. This provided a limited interpretation of the relative importance or magnitude of the potential environmental effects of each of the alternative technology options.

The Panel is of the view that the operation of a once-through cooling system would result in losses in the aquatic environment through impingement and entrainment of biota at the system intake, plus—to a lesser degree—through thermal effects in habitat areas in the vicinity of the system discharge ports. In contrast, the adverse effects for the cooling tower options were described as socio-economic effects related primarily to the visual landscape and community well-being. The qualitative assessment completed by OPG did not provide an adequate basis for its conclusion that the overall environmental effects associated with cooling towers would be greater than those that would result from a once-through cooling system.

The public reaction to potential visual effects may have been related to a perception of large cooling towers and concerns regarding the frequency of occurrence of condensation plumes. The Panel is of the view that mechanical cooling towers do not feature large structures, and that condensation plumes may not be a persistent phenomenon. The Panel notes that plume abatement technology may reduce the prevalence of these cooling tower condensation plumes.

Regardless of the condenser cooling water technology chosen, the Panel anticipates that any adverse effects that arise can be mitigated to ensure that there are no significant residual environmental effects.

CNSC staff felt that use of a closed-cycle cooling water system, such as any of the cooling tower options, would virtually eliminate aquatic effects associated with impingement, entrainment and thermal releases. CNSC staff noted further that

this technology has been defined as the best technology available to minimize adverse effects on fish for new large generating stations under the regulatory environment in the United States (*Clean Water Act*, 33 U.S.C. 1251 et seq. (1972), *Regulation 316b*). The regulatory approach in Canada is different in that it allows consideration of the various efficiencies and cost-benefits of a once-through cooling system relative to the closed cycle approach of cooling towers. If it is concluded that there are no significant adverse effects from any of the options, there may not be adequate justification for the higher expenditure required for cooling towers.

The Panel maintains that the assessment of condenser cooling water systems presented in the EIS did not provide a definitive comparison of alternative options with respect to environmental effects. The comparative assessment was based on qualitative comparisons of different aspects without appropriate weighting for factors that relate to loss of biota and effects on aquatic habitat, socio-economic considerations, capital costs and energy consumption.

In the case of the once-through condenser cooling water system, losses of aquatic biota and the effects on aquatic habitat could be mitigated so that there are no significant adverse effects in the aquatic environment. However, there would be a degree of residual adverse effects that should be considered in a relative assessment of alternative condenser cooling water systems. The Panel addresses this issue later in this report.

One of the factors of the cooling tower options is the negative image in the community of large cooling tower structures and condensation plumes. An independent review of the use of cooling towers in this application indicated that condensation plumes may not be as frequent as is anticipated in the OPG assessment. Further to this, there is an option of using plume abatement technology to reduce the occurrence of condensation plumes. On the question of tower structures, some of the cooling tower choices feature structures which are comparable in height to other reactor facility structures. The information available for cooling tower options indicates that the public perception issue can be addressed to a degree by choices made with cooling tower technology.

The Panel concludes that a further in-depth evaluation of the relative environmental effects

of alternative condenser cooling water systems is required.

**Recommendation # 3:**

*The Panel recommends that the Canadian Nuclear Safety Commission require that as part of the Application for a Licence to Construct a reactor, OPG must undertake a formal quantitative cost-benefit analysis for cooling tower and once-through condenser cooling water systems, applying the principle of best available technology economically achievable. This analysis must take into account the fact that lake infill should not go beyond the two-metre depth contour and should include cooling tower plume abatement technology.*

## 4.6 Parameters and Phases of the Project

This section presents the Panel's consideration of aspects of the components and phases of the Project. These include site layout scenarios, cost estimates, regulatory framework, the plant parameter envelope and decommissioning requirements.

### 4.6.1 Site Layout Scenarios

The site scenarios for the Project that create a bounding site development layout were summarized earlier in this report in the description of the Project.

OPG stated that for maximum land usage, all the bounding conditions, including reactors producing up to 4,800 megawatts of electricity and a condenser cooling system for this amount of power production, have been assessed and that the final Project layout will be confirmed to ensure it is within the bounding layout used in the environmental assessment.

The Panel considered a variety of site layouts presented by OPG to establish that the site could accommodate the required components of the Project. From the Panel's review presented in this report, new elements will have to be considered by the proponent such as reduced lake infill, on-site storage of radioactive waste and a potential option of building mechanical draft cooling towers with plume abatement.

As demonstrated in many areas of the Panel's analysis, the final Project layout must be optimized to fit within the bounding layout scenario for the Project with allowance for the

implementation of proposed mitigation measures. The Panel recognizes that the proposed electrical producing capacity of the Project may have to be reduced, or that the Project may have to be otherwise modified or built in a different location to allow implementation of the proposed mitigation measures on which the conclusions of the Panel are based.

#### 4.6.2 Estimated Costs of the Project

The Panel's review of the Project included consideration of the estimated costs of the Project. The cost estimates for the Project were summarized earlier in this report (see Table 4). OPG stated that for the purpose of establishing bounding Project cost and revenue, the construction cost was established as \$10 billion per unit and the annual operating revenue was established as \$500 million per unit. Since the procurement process is the responsibility of the Government of Ontario and a reactor technology had not been selected before the closing of the record for the environmental assessment, OPG stated that it could only provide a range of estimated costs based on publically available information.

The Panel notes that numerous participants expressed concerns regarding the cost of the Project and whether the Project would result in cost overruns similar to those encountered during the construction of the existing Darlington Nuclear Generating Station.

The Panel is of the view that the bounding Project cost and revenues may vary significantly based on the reactor technology chosen by the Government of Ontario.

The Panel requested that OPG provide information regarding the cause of the Darlington Nuclear Generating Station cost overruns. OPG responded that the cost overruns could be attributed to decisions made by the Government of Ontario at the time that affected the construction schedule as well as to the high interest rates at the time. OPG further responded that costs increased due to the need to implement design improvements to meet increased regulatory requirements as a result of lessons learned from the 1979 Three Mile Island nuclear accident and the 1986 Chernobyl nuclear accident.

The Panel is of the view that lessons learned from the 2011 Fukushima Daiichi nuclear accident will likely result in changes to regulatory requirements. According to OPG, any known regulatory requirements would be encompassed in the overall contract with the vendor for the chosen reactor technology. On the other hand, if new requirements are set after the contract is signed, the incurred costs would be the responsibility of OPG or the Government of Ontario. Therefore, the Panel believes that it would be prudent for the Government to ensure that lessons learned from the Fukushima Daiichi nuclear accident and any resulting increased regulatory requirements are incorporated into the Project as early as possible.

Furthermore, given that decommissioning costs depend on the amount of used fuel produced over the life of the Project and its long-term storage, Project cost estimates should be reviewed accordingly, due to the possibility of long-term on-site storage of waste.

#### 4.6.3 Jurisdictional Boundaries

The Panel's review of the Project included consideration of the jurisdictional boundaries associated with the Project.

Contrary to OPG's view that the Project should be subject only to the *Nuclear Safety and Control Act*, CNSC staff stated that OPG would be expected to comply with all federal, provincial and municipal requirements so long as they do not conflict with the requirements of the Act and its associated regulations. CNSC staff noted that in the event of such a conflict, OPG would be expected to notify the Canadian Nuclear Safety Commission. CNSC staff would address these issues on a case-by-case basis by working collaboratively with other regulatory agencies to minimize duplicative or conflicting requirements. The Panel agrees with these provisions.

The Panel notes that during the review, OPG acknowledged that although the Canadian Nuclear Safety Commission is the lead agency for regulating nuclear power plants in Canada, there would be many regulatory agencies involved in the Project. OPG provided a list of all of the approvals required for the Project and stated that it would be working with federal and provincial regulators to ensure that there is a cohesive understanding of the regulatory requirements of each jurisdiction.

**Recommendation # 4:**

*The Panel recommends that the Canadian Nuclear Safety Commission exercise regulatory oversight to ensure that OPG complies with all municipal and provincial requirements and standards over the life of the Project. This is of particular importance because the conclusions of the Panel are based on the assumption that OPG will follow applicable laws and regulations at all jurisdictional levels.*

**4.6.4 Site Preparation and Construction**

Regarding the site preparation and construction phase, CNSC staff stated that the bounding approach was acceptable for environmental assessment purposes. CNSC staff confirmed that the technology that is eventually selected for construction must fit within the defined bounding envelope for the Project. CNSC staff further stated that this evaluation would be performed once a reactor technology is selected and would be verified under the environmental assessment follow-up program. CNSC staff noted that this evaluation would also be required as part of the Application for a Licence to Construct the chosen reactor technology. The Panel agrees with this requirement and notes that the Application for a Licence to Construct would be covered by the Canadian Nuclear Safety Commission licence application process and, as such, would be subject to the Canadian Nuclear Safety Commission public hearing process.

As will be addressed later in the report, the Panel is of the view that some proposed site preparation activities, including lake infilling and removal of the bluff at Raby Head for shoreline stabilization, are irreversible and should therefore not be undertaken until there is certainty that the Project will proceed to the construction stage.

**Recommendation # 5:**

*To avoid any unnecessary environmental damage to the bluff at Raby Head and fish habitat, the Panel recommends that no bluff removal or lake infill occur during the site preparation stage, unless a reactor technology has been selected and there is certainty that the Project will proceed.*

**4.6.5 Operations and Maintenance**

On October 4, 2010, OPG provided revised plant parameter values and information to clarify where they were used in the environmental

assessment, including how they were applied. OPG also provided a revised plant parameter report that incorporated adjustments required to the data first submitted for a Licence to Prepare Site. Furthermore, on November 5, 2010, OPG provided its 2009 Dose Consequence Analysis report used in support of its environmental assessment.

CNSC staff noted that it initially encountered difficulties with the use of the bounding parameters in the application of the bounding values to the environmental assessment but were satisfied that the documents submitted by OPG in October and November 2010 addressed these issues. Regarding operations and maintenance, CNSC staff stated that the bounding approach is generally acceptable for environmental assessment purposes, noting that the technology that is eventually selected for construction at the Darlington Nuclear site must fit within the updated plant parameter envelope.

The Panel notes that there is a licensing phase for operation and maintenance during which the proponent would be required to submit specific details. Because of this and in light of the data submitted, the Panel determined that for environmental assessment purposes it has sufficient information to determine the likelihood of significant adverse environmental effects of the Project.

However, as stated in Recommendation # 1, the Panel maintains that if there is substantial change with the technology—in particular with respect to airborne and liquid effluent source terms, solid radioactive waste activity levels and safety systems compared with the technology covered in the review—a new environmental assessment must be conducted.

**4.6.6 Decommissioning and Abandonment**

The following are considerations of the regulatory requirements associated with the decommissioning and abandonment phase.

**Proponent Assessment**

OPG discussed the preliminary decommissioning plan and presented the potential hazards, protection strategies and environmental effects of decommissioning the Project facility at a conceptual level only, in accordance with the EIS Guidelines.

The OPG preliminary decommissioning plan provided a breakdown of each of the decommissioning works with a description of the main activities within each phase, and covered safety areas such as safeguards, quality assurance and decommissioning experience. The preliminary decommissioning plan also addressed the potential environmental effects of eventual decommissioning of the Project facility.

OPG noted that a number of successful decommissioning projects in the United States and other countries have demonstrated that technology and procedures are available to safely and effectively decommission nuclear facilities. OPG stated that successful approaches to safe storage and eventual dismantling of generating stations as well as the packaging, transportation and storage/disposal of radioactive waste have also been demonstrated.

Based on the protection strategies and the growing international decommissioning experience outlined in the preliminary decommissioning plan, the OPG assessment concluded that it was anticipated that effective and practical mitigation options would be available when required in the future so that decommissioning would not be likely to cause significant adverse effects on humans or their environment.

For the site preparation phase, OPG stated that in the event the Project is cancelled after the completion of site preparation activities, OPG would not decommission the site but would instead use it to support the existing licensed facilities, and would maintain the site in the condition to which it has been prepared up to that point. OPG noted that the site would be suitable for industrial use without specific risks or hazards.

In this regard, OPG held that its October 12, 2010 letter to the Canadian Nuclear Safety Commission would serve in lieu of the preliminary decommissioning plan originally submitted since no decommissioning work would be required for the site preparation activities. OPG noted that it would provide an updated preliminary decommissioning plan in accordance with Canadian Standards Association Standard N294-09, *Decommissioning of facilities containing nuclear substances* (2009) and *Canadian Nuclear Safety Commission Regulatory Guide G-219: Decommissioning*

*Planning for Licensed Activities* (June 2000) if it were to apply for an amendment to the Licence to Prepare Site to allow for more substantive site preparation work to proceed once a reactor technology is specified.

#### Panel Assessment

The Panel notes that CNSC staff stated that the OPG preliminary decommissioning plan was generally satisfactory for environmental assessment purposes. CNSC staff indicated that it reviewed the preliminary decommissioning plan against Regulatory Guide G-219 and found that it contained the majority of the elements required. CNSC staff noted areas for improvement that should be addressed in the next version of the preliminary decommissioning plan such as increased clarity on the rationale for the preferred decommissioning strategy and further details on alternative decommissioning strategies and their assessments.

CNSC staff noted that OPG would be required to commit to periodically reviewing and updating the preliminary decommissioning plan until a detailed decommissioning plan has been prepared, in accordance with changes in site conditions, changes to the proposed decommissioning objectives or strategy, or modifications to the Project facility. CNSC staff stated that OPG should revise its preliminary decommissioning plan every five years or as required by the Canadian Nuclear Safety Commission.

Regarding the site preparation phase, CNSC staff stated that it accepted the October 12, 2010 letter from OPG in lieu of its original preliminary decommissioning plan given that no decommissioning work would be required under the site preparation activities. CNSC staff concurred with OPG that an updated preliminary decommissioning plan would be required should OPG apply for a licence amendment to allow for more substantive site preparation work to be completed once a reactor technology has been specified. CNSC staff stated that it would review and assess the updated preliminary decommissioning plan for compliance with Canadian Standards Association Standard N294-09 and Regulatory Guide G-219.

The Panel has considered the potential hazards, protection strategies and environmental effects of decommissioning the Project. The Panel notes the OPG conclusion that decommissioning is not

likely to cause significant adverse effects on humans or their environment because it is anticipated that effective and practical mitigation options would be available when required in the future. The Panel accepts the CNSC staff conclusion that the preliminary decommissioning plan is generally satisfactory for environmental assessment purposes.

The Panel is of the view that the preliminary decommissioning plan shall reflect that no solution has yet been implemented for the long-term management of used fuel. The Panel acknowledges that the preliminary decommissioning plan would be updated as required by the *Nuclear Safety and Control Act* and Regulations.

Furthermore, the Panel is of the view that decommissioning is not likely to cause significant adverse effects if the mitigation measures are in place when anticipated.

**Recommendation # 6:**

*The Panel recommends that prior to site preparation, the Canadian Nuclear Safety Commission require OPG to update its preliminary decommissioning plan for site preparation in accordance with the requirements of Canadian Standards Association Standard N294-09. The OPG preliminary decommissioning plan for site preparation must incorporate the rehabilitation of the site to reflect the existing biodiversity in the event that the Project does not proceed beyond the site preparation phase.*

*OPG shall prepare a detailed preliminary decommissioning plan once a reactor technology is chosen, to be updated as required by the Canadian Nuclear Safety Commission.*

**4.6.7 Financial Guarantee**

The following is the Panel's consideration of the regulatory requirements associated with the financial guarantee for the Project.

Proponent Assessment

OPG stated that the preliminary decommissioning plan would be used to develop a cost estimate for the financial guarantee for the Project. OPG explained that the cost estimate and financial guarantee would be updated every five years in conjunction with the preliminary decommissioning plan to ensure that there would

be sufficient funding available to decommission the Project. OPG explained that each cost estimate is developed by a third-party consultant and validated by OPG and the Ontario Ministry of Finance before it is submitted to the Canadian Nuclear Safety Commission for approval.

OPG provided information regarding the decommissioning fund. OPG explained that it is party to the Ontario Nuclear Funds Agreement with the Government of Ontario. Under this agreement, OPG makes quarterly contributions to a segregated fund for decommissioning that covers all of the OPG nuclear generation stations. Further, the Government of Ontario is liable to make payments should the cost estimate for nuclear used fuel waste management rise above specified thresholds. OPG explained that the segregated fund can only be used for decommissioning activities, and OPG plans to have it fully funded by the projected end of life of the nuclear generation stations so as to not be a financial burden on future generations.

Regarding the site preparation phase of the Project, OPG proposed that the value of the financial guarantee should be \$0.00 if it is allowed to prepare the site before a reactor technology is chosen. OPG noted that the financial guarantee would be updated if more substantive site preparation activities were to be completed that would result in a decommissioning liability. OPG stated that no decommissioning liability would be incurred unless the Licence to Prepare Site was amended to allow excavation of the power plant base.

Panel Assessment

The Panel notes that many participants were of the opinion that waste management and decommissioning of the plant would be a financial burden for future generations. CNSC staff explained that, under the *Nuclear Safety and Control Act*, the Canadian Nuclear Safety Commission requires that financial guarantees be in place for decommissioning facilities. CNSC staff explained that licensees are required to update preliminary decommissioning plans in order to revisit the cost estimates for decommissioning and ensure that the decommissioning funds are maintained with realistic projected costs.

CNSC staff concurred that the OPG decommissioning fund is intended to cover the decommissioning of the entire fleet of OPG

nuclear reactors and is supported by the Government of Ontario.

Regarding the site preparation phase of the Project, CNSC staff concurred that the value of the financial guarantee should be \$0.00. CNSC staff stated that an updated financial guarantee would be required should OPG apply for a licence amendment to the Licence to Prepare Site that would allow for more substantive site preparation works that would result in a decommissioning liability.

The Panel has considered that a decommissioning financial guarantee would be required to be in place to fund the decommissioning of the Project and that the cost estimate would be revised at least every five years. Based on OPG current practice and the segregated decommissioning fund that is in place for existing OPG reactors, the Panel is confident that OPG—and, if necessary, the Government of Ontario—would continue to meet the requirements of the Canadian Nuclear Safety Commission to maintain an updated decommissioning fund. Furthermore, the Panel is satisfied that the funding for the financial

guarantee would be in place during the operation of the reactors so as to not be a financial burden on future generations.

Regarding the \$0.00 decommissioning financial guarantee for the site preparation phase, if substantive site preparation works are in place that would result in a decommissioning liability such as lake infill, removal of the bluff or construction of a wharf, then rehabilitation funds should be set aside in the event that the Project does not go ahead.

**Recommendation # 7:**

*The Panel recommends that prior to site preparation, the Canadian Nuclear Safety Commission require that OPG establish a decommissioning financial guarantee to be reviewed as required by the Canadian Nuclear Safety Commission. Regarding the decommissioning financial guarantee for the site preparation stage, the Panel recommends that this financial guarantee contain sufficient funds for the rehabilitation of the site in the event the Project does not proceed beyond the site preparation stage.*



## Chapter 5 – Effects Assessment of the Biophysical Environment

This chapter evaluates effects associated with the works and activities of the Project during all Project phases. The purpose is to establish if any significant residual effects will result from the Project on any of the biophysical environmental components after the application of mitigation measures. When applicable, proposed follow-up programs will be reviewed.

### 5.1 Atmospheric Environment

The following section presents the Panel's review of the effects of the Project on the atmospheric environment, including air quality and noise. As indicated by OPG, almost all works and activities associated with site preparation, construction and operation have the potential to interact with this component.

#### 5.1.1 Air Quality

Air quality modelling was used to predict changes in air quality. Different models were used to characterize vehicle emissions, the dispersion of contaminants in air and conditions associated with cooling towers. Predicted air concentrations were compared to existing conditions and federal and provincial regulatory criteria for air quality and existing air concentrations to determine how the Project could potentially impact air quality at different receptor locations (Figure 3: Receptor Locations). There are no federal or provincial criteria for assessing effects related to cooling tower operation. OPG used United States Nuclear Regulatory Commission *Standard Review Plans for Environmental Reviews for Nuclear Power Plants* (1999), providing guidelines only on effects on the terrestrial environment, such as salt drift, fog and ice.

#### Proponent Assessment

OPG presented information regarding non-radiological and radiological air emissions.

#### ***Non-radiological***

OPG stated that the air quality in the vicinity of the site does not differ substantially from the general air quality in southern Ontario within the Quebec-Windsor corridor and the Greater Toronto Area. OPG noted that the substances that combine to produce smog or acid rain,

including carbon monoxide (CO), oxides of nitrogen (NO<sub>x</sub>), volatile organic compounds (VOCs), sulphur dioxide (SO<sub>2</sub>) and suspended particulate matter (SPM), dominate air quality effects. OPG stated that concentrations of these conventional parameters in air in the local study area are largely attributable to traffic from Highway 401 and the use of local roads, with activities at the site and on-site traffic contributing only a small fraction to background air concentrations. OPG further stated that under existing conditions, air concentrations are well below applicable ambient air quality criteria, which are set to be protective of human health.

OPG indicated that the primary sources of emissions to air from the existing Darlington Nuclear Generating Station are related to internal combustion equipment, including NO<sub>x</sub>, SO<sub>2</sub> and CO, emissions from testing back-up power supplies or other emergency equipment, and emissions of treatment chemicals from the steam generators, including acetic acid, ammonia, formic acid, glycolic acid and hydrazine. OPG presented the estimated maximum half-hour average emission rate for each constituent, along with their respective Ontario Ministry of the Environment half-hour point of impingement limits, where available. OPG stated that the existing conditions were included in the model to create an effective baseline condition.

OPG noted that the existing Darlington Nuclear Generating Station emits various contaminants from ongoing maintenance and operational activities that have been assessed as part of the recent application for a Certificate of Approval (Air) submitted for the existing Darlington Nuclear site. OPG noted that current site activities comply with all applicable criteria, and with the exception of combustion sources associated with testing the back-up power supply and chemicals associated with steam generator water treatment, the emissions of most of the chemicals at the Darlington Nuclear site are considered negligible, as defined by the Ontario Ministry of the Environment.

OPG stated that a baseline meteorological study was completed to understand the climatology of the region surrounding the site. OPG explained

that analyses of wind speed and direction, air temperature, precipitation, snow pack, humidity, atmospheric pressure and temperature inversions were carried out from the available climatological records for the surrounding meteorological stations. OPG noted that most of the meteorological stations investigated in the study reported moderate precipitation amounts, mild winters, warm summers and moderate average wind speeds, and that the results were consistent with the expected results for the southern Ontario climate.

OPG presented the characterization of emissions using a bounding emissions scenario. For air quality modelling, OPG used volume source modelling at the centre of the Project facility with the intent of doses being conservative, reflective of the practice adopted in the Canadian Standards Association Standard N288.1-08, *Guidelines for calculating derived release limits for radioactive material in airborne and liquid effluents for normal operation of nuclear facilities* (2008). OPG noted that no stack parameters were required in the analysis.

OPG indicated that shoreline fumigation was not considered and explained that fumigation would have a small effect on air concentrations for the meteorological conditions and downwind distances of interest at Canadian nuclear facilities.

OPG provided information regarding its frequency analysis of certain elements and described how a measurable change would be identified. OPG explained that a negligible change was identified as a  $\leq 5\%$  increase above the baseline concentration, assuming the concentration is below the criteria. OPG further explained that a potentially meaningful change was identified as a  $\geq 10\%$  increase above baseline concentration, and if concentration is above criteria, then  $\geq 10\%$  increase in number of exceedances per year.

OPG stated that for most air quality constituents, effects due to the Project are not expected to exceed ambient air quality criteria. OPG noted some limited exceedances of 24-hour SPM, PM<sub>10</sub> and fine particles PM<sub>2.5</sub> are expected during the site preparation phase. OPG predicted no measurable changes during the construction phase and the operation phase. OPG stated that these exceedances were also predicted in a future scenario where the Project would not proceed,

meaning that the predicted concentrations exceeding the criteria are not associated with the Project. OPG further stated that exceedances of the nitrogen dioxide (NO<sub>2</sub>) ambient air quality criteria are also predicted at a limited number of receptors during site preparation due to site preparation activities and traffic on Highway 401, but these are expected to be infrequent.

OPG stated that a dust management program would be implemented during the site preparation and construction phases of the Project to control dust emissions at their source. OPG noted that examples of typical dust management strategies include application of dust suppressants, stabilization of completed soil surfaces and suspension of dust-generation activities during periods of inclement weather. OPG stated that no additional mitigation for Project-related air quality effects would be necessary.

#### ***Radiological***

OPG stated that the expected dose to the public from the Project would be approximately 0.005 millisieverts per year, which is well below the regulatory public dose limit of one millisievert per year and is a fraction of the annual dose from natural background radiation in Canada of 1.840 millisieverts per year. OPG noted that the dose would decrease as the distance from the Project facility increases and explained that this is because the dose would be primarily from air emissions, and air concentrations of radioactive emissions from the site would decrease over distances as a result of atmospheric dispersion.

#### **Panel Assessment**

The Panel's assessment of the effects of the Project on air quality included consideration of the characterization of radiological and non-radiological air emissions.

#### ***Radiological***

CNSC staff accepted OPG's characterization of the predicted emissions of nuclear substances from the Project.

CNSC staff concurred with OPG's use of Canadian Standards Association Standard N288.1-08, in which air emissions modelling is used to estimate the worst-case public dose. CNSC staff noted that the same Canadian Standards Association Standard also states that shoreline fumigation need not be considered in air emissions modelling.



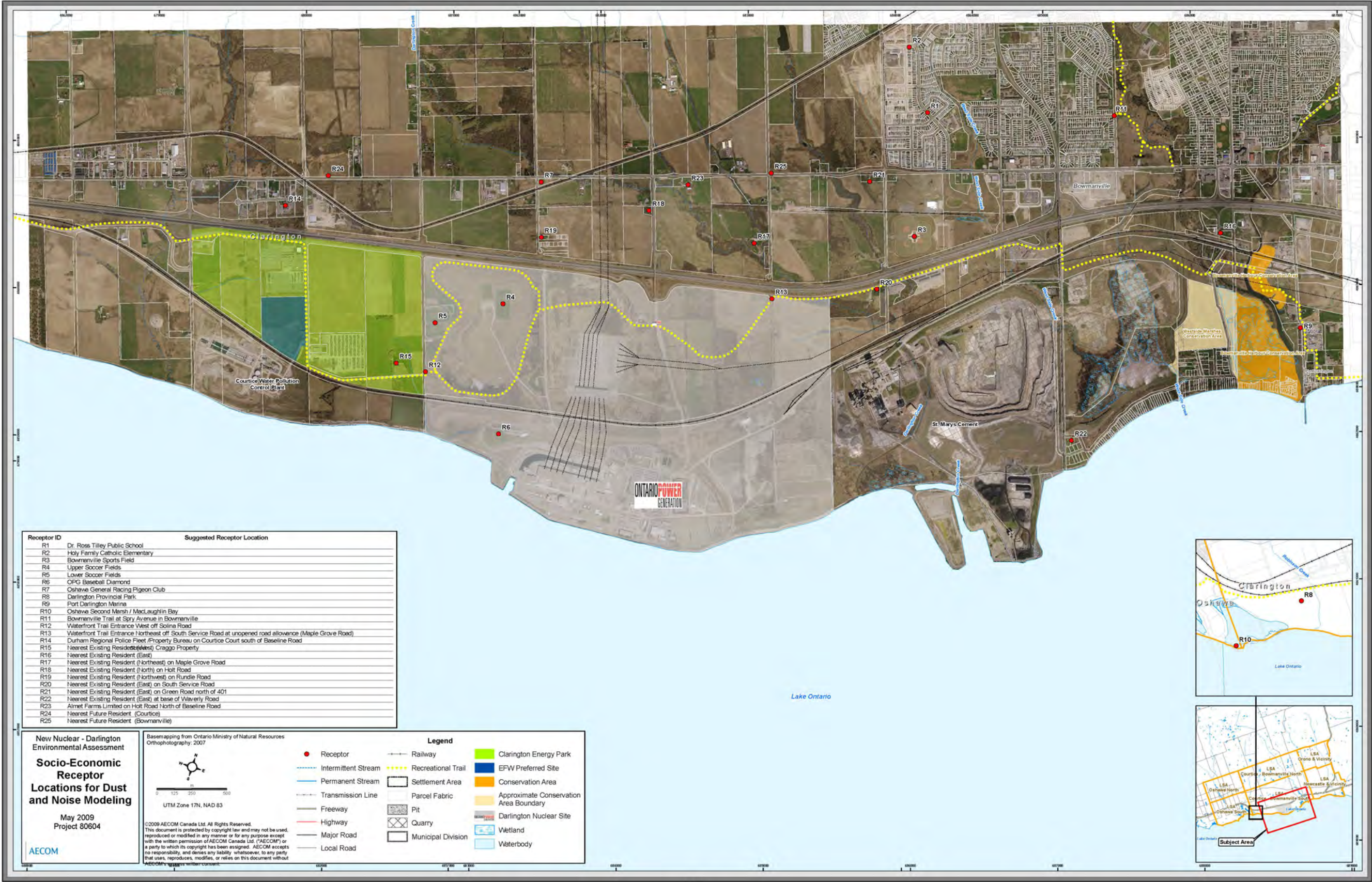


Figure 3: Receptor Locations





Environment Canada stated that atmospheric dispersion would have major influence on the distribution of any atmospheric radionuclide releases from the Project. Environment Canada explained that atmospheric dispersion would affect the geographic distribution of radionuclides, and detailed the environmental media that would be affected, such as air, water, soil, groundwater and sediment, as well as the concentrations and quantities of radionuclides being deposited. These would, in turn, ultimately affect radiological dose to humans and non-human biota. Environment Canada stated that the focus of its review was ensuring that the atmospheric dispersion modelling of radionuclides was appropriately conducted.

During the EIS review and comment period, Environment Canada requested additional information from OPG regarding atmospheric dispersion modelling. Environment Canada stated that the OPG responses were mainly satisfactory and that the results of the atmospheric dispersion modelling were credible for normal operations and for the major nuclear accident scenarios modelled.

#### ***Non-radiological***

The Panel considered the reviews completed by CNSC staff, Environment Canada and Health Canada, as well as the Ontario Ministry of the Environment regarding non-radiological releases to air.

CNSC staff noted that OPG conducted limited air monitoring in 2007. With respect to hazardous substances released during the operation phase of the Project, CNSC staff stated that the analysis of hazardous substance emissions was conservative, and with respect to operations releasing hazardous substances, that OPG's operations are not continuous and the sources of these contaminants are used in emergency situations only.

OPG stated that it would conduct an air monitoring program to confirm concentrations of total suspended particulate matter PM<sub>10</sub> and PM<sub>2.5</sub> in the Project area during the site preparation and construction phases. CNSC staff stated that this plan would be sufficient for environmental assessment purposes, noting that depending on the results, there may be future monitoring of the same parameters during other phases of the Project. CNSC staff further stated that monitoring would be covered under the

Canadian Nuclear Safety Commission licensing process and compliance monitoring.

CNSC staff concluded that the information provided by OPG is sufficient to determine that the Project is not likely to result in significant adverse environmental effects, taking into account the implementation of mitigation measures.

Environment Canada stated that it undertook a limited review of the atmospheric dispersion modelling for conventional substances. The review focused on the baseline meteorology and the general atmospheric dispersion modelling approach that was used by OPG. Environment Canada noted that it did not review the detailed atmospheric dispersion modelling for the individual conventional substances. Environment Canada stated that the OPG bounding approach was adequate.

Environment Canada stated that the largest effects to air quality as a result of emissions of Criteria Air Contaminants would occur during the site preparation and construction phases. Environment Canada noted that various measures could be implemented to reduce dust and particle emissions or formation from the site preparation and construction activities and to minimize air emissions, including those from construction vehicles. Environment Canada recommended that best practices be implemented as a component of the OPG mitigation strategy. Environment Canada stated that during the operating phase, overall emissions of Criteria Air Contaminants would be expected to drop to lower levels as construction activities cease. Environment Canada noted that this prediction would need to be verified based on the detailed design of the Project.

Health Canada noted that OPG predicted changes in local air quality as a result of the emission of several contaminants of potential concern, including Acrolein, NO<sub>2</sub>, SO<sub>2</sub> and PM<sub>2.5</sub> during site preparation and construction activities. Health Canada stated that OPG had provided general mitigation measures but noted that the specific details of some mitigation measures and monitoring of air contaminants during site preparation and construction activities were lacking. Health Canada recommended that OPG implement all technically and economically feasible mitigation measures to reduce potential public exposure to air contaminants.

Both Health Canada and Environment Canada recommended that OPG avoid operating heavy machinery during days when there are air quality or smog alerts, due to the cumulative effects on the air quality in the region. Health Canada recommended that OPG develop an action plan to address this issue.

The Ontario Ministry of the Environment provided information regarding the approvals process for Certificate of Approval for releases to air. The Ministry stated that Certificate of Approval applicants must demonstrate that projects can comply with environmental acts, regulations, policies, guidelines and standards before approval is granted. The Ministry stated that for the Project, air and noise approvals would be required for the standby/emergency generators, maintenance facilities (chemical cleaning, welding), the process venting (steam venting, storage tanks, workshops) and for building ventilation systems.

The Panel notes that some participants raised concerns regarding temperature-driven meteorological phenomena which can affect atmospheric dispersion near the sea or a large lake such as Lake Ontario, including shoreline fumigation, plume trapping and lake/land breeze effects.

Based on the information provided by Environment Canada, the Panel is satisfied that the OPG dispersion modelling for operational emissions is satisfactory. The Panel also recognizes that OPG would be required to operate within the regulatory requirements of the Certificate of Approval for air emissions.

The Panel notes OPG's intention to use a dust management program to mitigate the effects of the Project on air quality. The Panel also notes OPG's intent to monitor total suspended particulate matter,  $PM_{10}$  and  $PM_{2.5}$ , during site preparation and construction phases of the Project, and is of the view that the dust management program would reduce suspended particulate matter in the air. The Panel observes that OPG did not propose any further mitigation measures for other potential emissions from the Project.

The Panel accepts the recommendations made by Health Canada and Environment Canada that measures should be taken to reduce emissions

that impact air quality during smog alert periods, including not operating machinery, if necessary.

The Panel is of the view that the existing air quality in the local study has elevated concentrations of certain parameters such as suspended particulate matter and  $SO_2$  due to such contributing factors as traffic from Highway 401 and local roads. The Panel maintains that OPG should take all reasonable measures to ensure that the Project does not contribute to the further degradation of the atmospheric environment.

The Panel is of the view that some receptor locations will be subject to decreased air quality due to the additive effect of increased concentrations of Acrolein,  $NO_2$ ,  $SO_2$  and suspended particulate matter in the Project area as a result of the Project. However, the Panel concludes that the Project is not likely to result in significant adverse effects to air quality if the mitigation measures proposed by OPG, such as the dust management program and the air quality component of the nuisance effects management program, are implemented, along with the following recommendation.

**Recommendation # 8:**

*The Panel recommends that prior to site preparation, the Canadian Nuclear Safety Commission require OPG to develop a follow-up and adaptive management program for air contaminants such as Acrolein,  $NO_2$ ,  $SO_2$ , SPM,  $PM_{2.5}$  and  $PM_{10}$ , to the satisfaction of the Canadian Nuclear Safety Commission, Health Canada and Environment Canada. Additionally, the Canadian Nuclear Safety Commission must require OPG to develop an action plan acceptable to Health Canada for days when there are air quality or smog alerts.*

**5.1.2 Noise**

The following section presents the Panel's assessment of effects related to noise.

Proponent Assessment

OPG compared the effects of on-site stationary sources, such as cooling towers and standby generators, to the Ontario Ministry of the Environment noise criteria for land use planning. The combined noise levels from stationary sources and mobile sources, such as construction equipment and traffic, were also evaluated. OPG modelled four scenarios:

- site preparation;
- site preparation and construction;
- operation of two reactors and construction of two additional reactors and facilities; and
- operation of four reactors.

OPG noted that during operations, cooling towers would produce sound, with the mechanical and fan-assisted towers generating more sound than natural draft towers.

The qualitative criteria indicated in Table 6: Qualitative Criteria for Assessing Noise Effects were used by OPG to evaluate the magnitude of the incremental noise levels.

OPG stated that the noise environment in the vicinity of the Darlington Nuclear site is typical of an urban setting, dominated by traffic on Highway 401 and Baseline Road, as well as noise from the nearby St. Marys Cement plant and the existing Darlington Nuclear Generating Station. OPG stated that based on sound level measurements conducted in 2008, the noise environment at the nearest residential receptor would be typical of a major population centre, where the background sound level is dominated by the urban hum.

OPG indicated that a moderate increase in sound levels was predicted in the site preparation scenario at receptor location R15, the closest residence west of the Project site, where the average daytime background sound level increase was predicted to be 8.1 decibels. OPG explained that this increase would be of limited duration and would occur only during the day.

OPG stated that no other residential receptors would experience an increase in sound level greater than three decibels, the threshold for perception.

During the site preparation and construction scenario, the residential receptor locations R9, R16 and R20 would experience maximum one-hour daytime and nighttime sound levels increases of greater than three decibels as worker shifts are changing. OPG stated that the increase would be 4.3 decibels at receptor R20. Receptor R20 would also experience the largest noise increase during the operation of two reactors and the construction of the two additional reactors scenario. During that scenario, the predicted one-hour sound level increase was 5.2 decibels, which is also a moderate increase in sound level. During full operation of the four reactors, receptor R20 would experience a nighttime maximum one-hour increase of 3.3 decibels in sound level.

To mitigate these effects, OPG stated that it would determine estimates of the duration of specific noise-generating activities once a specific construction schedule has been prepared. OPG stated that it would undertake detailed planning to address the specific situation at each licensing step and manage noise emissions. OPG also stated that in accordance with Ontario Ministry of the Environment guidance, construction equipment would be maintained in good working order and would meet specified performance limits, and noted that it would measure noise levels during site preparation and construction activities to periodically confirm

Table 6: Qualitative Criteria for Assessing Noise Effects

Increase Over Background Sound Level, in decibels (dBA)	Change in Subjective Loudness	Impact Rating
Up to 3 dBA	Hardly Perceptible	Marginal to none (not measurable)
4 to 5 dBA	Noticeable	Low
6 to 10 dBA	Almost twice as loud	Moderate
11 + dBA	More than twice as loud	High

the effectiveness of the Noise Management Plan and verify the predictions of the environmental assessment

OPG concluded that the predicted noise increases for the balance of the residential receptors is expected to be negligible during all phases of the Project and that no additional mitigation would be required.

#### Panel Assessment

Health Canada stated that OPG provided limited information on noise monitoring, noise complaint response mechanisms and a Noise Management Plan. As such, Health Canada recommended that for the licensing stages of the Project, OPG should include noise monitoring and best management practices in its Noise Management Plan, discuss any construction activity occurring outside of municipal noise curfew hours with local residents in advance, establish a complaint response mechanism to address any concerns of the public, outline the methodology and frequency of noise monitoring, and provide details on the course of action OPG would take should noise levels exceed applicable limits. The Panel agrees with the Health Canada assessment that for some receptors near the Project, there would be a noticeable increase in noise.

Furthermore, during the Project review, the proponent confirmed that site preparation activities would involve a 16-hour working day and construction activities would be performed over a 10-hour day. A Municipality of Clarington noise by-law specifies curfew times for construction and excavation activities. OPG intends to request authorization to operate outside these times if necessary. The Panel predicts however, that evening activities would contribute to the noise nuisance.

In addition, OPG confirmed that there would be low and moderate noise increases at some receptor locations. The Panel maintains that the noise nuisance from the Project would not only be from an increase in noise over the background sound level but also in the fact that site preparation and construction activities would occur over prolonged periods of many years, without respite. These activities would also produce disturbing tonal and impulsive noises from blasting and coffer dam installation, for example, and from equipment such as generators and crushers. OPG included tonal and impulsive

noises in its assessment and stated that no complaints have been received regarding steam venting from the existing Darlington Nuclear Generating Station. However, the Panel notes that tonal and impulsive noise can be a source of noise nuisance.

Based on this assessment, the Panel is of the view that OPG should incorporate additional mitigation measures proposed by Health Canada to reduce annoyance that residents may experience.

Furthermore, the Panel notes that the plant parameter envelope contemplates maximum lake infill of 40 hectares. However, in the event that the final site layout reduces the actual amount of lake infill, OPG may need to transport more excavated material off site for disposal. The Panel is of the opinion that this could increase the amount of noise generated by the Project, and as such, OPG would have to re-evaluate the assumption that 10% of the total vehicles on Highway 401 are heavy trucks since this figure was used to access background sound levels at noise sensitive receptors.

The Panel also recognizes that OPG would be required to operate within the regulatory requirements of the Certificate of Approval for noise emissions. The Panel concludes that if the proposed mitigation measures—such as the Noise Management Plan, the Nuisance Effects Management Program and the following recommendation—are applied, the Project is not likely to result in significant adverse effects due to noise.

#### **Recommendation # 9:**

*The Panel recommends that the Canadian Nuclear Safety Commission, in collaboration with Health Canada, require OPG to develop and implement a detailed acoustic assessment for all scenarios evaluated. The predictions must be shared with potentially affected members of the public. The OPG Nuisance Effects Management Plan must include noise monitoring, a noise complaint response mechanism and best practices for activities that may occur outside of municipal noise curfew hours to reduce annoyance that the public may experience.*



## 5.2 Geological Environment

This section presents the Panel's assessment of effects on the geological environment. The principal elements of the geological environment under review are the coastal geomorphology and geological and geotechnical information for the site and the regional study area.

### 5.2.1 Proponent Assessment

OPG stated that the baseline coastal environment at the site includes armour stone fascia along the Darlington Nuclear Generation Station section of the site. To the east and west of this armour stone protection, the shoreline comprises a frontage of high glacial bluffs. According to OPG, the main erosion mechanisms are wave-induced toe erosion of the bluffs along with further erosion by rainfall run-off and slope instability due to groundwater flow and freeze-thaw cycles in sand lenses.

The proponent obtained geological information on the site from field studies and from published background data for the region. Soil geochemical and physical properties were obtained from a soil sampling program. Based on this work, OPG concluded that the soil across the site was generally of good quality and for the most part does not exceed criteria listed in the Ontario *Environmental Protection Act* standards with respect to industrial/commercial land use in a non-potable groundwater setting.

OPG reported that the regional and site geology consists of overburden and bedrock formations. The overburden is predominantly sand and till deposits, while shaly limestone is present in the upper layers of the bedrock, below which the substance is mainly limestone. OPG stated that there is no evidence of karstic features in the local bedrock.

### 5.2.2 Panel Assessment

CNSC staff noted that the information provided by OPG on site geological structures was obtained from just two deep boreholes. CNSC staff stated that this limited sampling may not be adequate to confirm aspects of the site geological structure, such as the lack of karstic features in the local bedrock. CNSC staff also noted that OPG did not provide information on the mechanical properties of the overburden materials such as the shear strength and dynamic properties including shear wave velocity, damping ratio and shear modulus.

CNSC staff stated that OPG did not provide baseline soil quality information for the area of the proposed northeast waste soil stockpile area. CNSC staff was of the view that this soil quality data would be required to validate predicted effects from the proposed northeast waste stockpile area on the local soil quality.

It is the Panel's view that OPG's characterization of the geological environment is based on an investigation that appears to have been limited in scope. Conclusions about subsurface geological structures and conditions were drawn from data obtained from just two deep boreholes, and the baseline characterization of soil quality was derived from a single soil sampling program. The Panel notes that the proponent has committed to undertaking a detailed geotechnical investigation that will enable a more complete characterization of the baseline geologic environment at the site.

Given this commitment, the Panel accepts that the information presented by the proponent is adequate to support the conclusion that the Project is not likely to result in significant adverse environmental effects. However, the Panel recommends that the geotechnical investigation being considered by the proponent be conducted prior to site preparation activities to confirm the site characterization reported in the review.

#### **Recommendation # 10:**

*The Panel recommends that the Canadian Nuclear Safety Commission require OPG to undertake a detailed site geotechnical investigation prior to commencing site preparation activities. The geologic elements of this investigation should include, but not be limited to:*

- *collecting site-wide information on soil physical properties;*
- *determining the mechanical and dynamic properties of overburden material across the site;*
- *mapping of geological structures to improve the understanding of the site geological structure model;*
- *confirming the lack of karstic features in the local bedrock at the site; and*
- *confirming the conclusions reached concerning the liquefaction potential in underlying granular materials.*

**Recommendation # 11:**

*The Panel recommends that the Canadian Nuclear Safety Commission require OPG to develop and implement a follow-up program for soil quality during all stages of the Project.*

### 5.3 Surface Water Environment

The following section presents the Panel's review of the effects of the Project on the surface water environment. The surface water environment predicted to experience the greatest effects from the Project is the area of Lake Ontario that is adjacent to the site. Surface water elements that interact with the lake are liquid effluents from the Project, site drainage and shoreline processes.

#### 5.3.1 Proponent Assessment

OPG stated that the surface water quality of Lake Ontario within the regional, local and site study areas generally meets federal and provincial water quality guidelines and objectives that are considered to be protective of the aquatic environment. However, there have been occasional occurrences of inflows to Lake Ontario that have resulted in exceedances of provincial water quality objectives set out in *Water Management, Policies, Guidelines: Provincial Water Quality Objectives of the Ministry of the Environment* (July 1994).

OPG stated that on-site surface water bodies have been found to have elevated levels of phosphorus, nitrates, conductivity, sodium, aluminum, boron, cobalt, iron and zirconium. The proponent believes that this is a result of local use of road salt, run-off from the existing landfill, and applications of fertilizers by local farmers. OPG noted that based on sampling over a period from 1996 to 2001, total suspended solid levels and other stormwater parameters were within typical urban stormwater concentration ranges at the Darlington Nuclear site.

OPG identified cadmium, copper, lead and selenium as contaminants of potential concern in the sediment of Lake Ontario, based on baseline sediment quality data indicating that concentrations exceed regulatory criteria and background.

OPG stated that a number of contaminants would enter the aquatic environment due to operation of the reactors. Releases of radiological

contaminants would arise from the operation of the radioactive liquid waste management system. Thermal discharge and conventional contaminants would be released through the operation of the condenser circulating water, service water and cooling systems. OPG also stated that discharges of stormwater would also be expected to release chemical constituents particularly during the site preparation and construction phases. The proponent stated that the contaminants from these various systems would be managed with appropriate treatments to comply with regulatory requirements.

OPG stated that over different phases of the Project, marine and shoreline construction work would affect water quality, alter currents and local surface water conditions, and affect the transport of sediments. Again, OPG proposed measures such as good industry management practices and sediment control to manage and limit adverse effects.

OPG stated that degradation of the embayment formed at the mouth of Darlington Creek could be mitigated through design of the adjacent lake infill to optimize flushing potential with local current and creek flows. An adaptive management strategy could be developed to reduce the potential for unwanted algal growth in the embayment.

OPG concluded that with the proposed mitigation measures, the Project would not result in significant adverse effects on the surface water environment.

#### 5.3.2 Panel Assessment

As a consequence of the bounding approach in the environmental assessment, specific site layout and points of release into Lake Ontario were not defined. CNSC staff noted that more baseline water quality data for shoreline and offshore locations—and especially for the embayment area that may be created at the outlet of Darlington Creek—would be required for licensing and permitting activities.

Environment Canada identified a need for sediment quality baseline data for the area near the outlet of Darlington Creek, given the likelihood of changes in sediment transport in this area associated with excavated material being placed along the adjacent shoreline as lake infill. Environment Canada recommended that data should be collected prior to the

commencement of any in-water work that could affect the surface water environment in this area.

The proponent did not complete an assessment of bounding scenarios for conventional liquid effluents with implementation of mitigation measures. The Panel notes that such an assessment would have enabled confirmation of the conclusions reached concerning possible environmental effects from liquid effluents.

OPG provided little information on the pollutants and contaminant loadings that would enter the surface water environment with stormwater runoff. However, the proponent committed to designing stormwater management facilities in accordance with requirements in the *Ontario Stormwater Management Planning and Design Manual* (March 2003). This was supported by a commitment to develop a follow-up program where parameters to be measured and the frequency of sampling would be specified. Based on these commitments and additional information provided by the proponent, the Panel is of the view that adequate controls and mitigation measures would be in place to prevent significant adverse environmental effects in the surface water environment.

In the absence of a choice of reactor technology for the Project, OPG did not undertake a detailed assessment of the effects of liquid effluent and stormwater runoff to the surface water environment. Instead, the proponent committed to managing liquid effluent releases in compliance with applicable regulatory requirements and to applying best management practices for stormwater. This strategy does not comply with the expectations given in the EIS Guidelines. Nevertheless, CNSC staff indicated that there is experience of similar regulatory release limits and management practices being applied at other nuclear facilities to control and minimize effects in the surface water environment.

As discussed later in the report, the proponent should evaluate the possible effects of climate change on the required capacity of storm water management facilities.

The Panel is of the view that the Project is not likely to result in significant adverse environmental effects, given the proposed mitigation measures and commitments made by

the proponent, along with the following recommendations.

**Recommendation # 12:**

*The Panel recommends that before in-water works are initiated, the Canadian Nuclear Safety Commission require OPG to collect water and sediment quality data for any future embayment area that may be formed as a consequence of shoreline modifications in the vicinity of the outlet of Darlington Creek. This data should serve as the reference information for the proponent's post-construction commitment to conduct water and sediment quality monitoring of the embayment area.*

**Recommendation # 13:**

*The Panel recommends that the Canadian Nuclear Safety Commission require OPG to collect and assess water quality data for a comprehensive number of shoreline and off-shore locations in the site study area prior to commencing in-water works. This data should be used to establish a reference for follow-up monitoring.*

**Recommendation # 14:**

*The Panel recommends that following the selection of a reactor technology for the Project, the Canadian Nuclear Safety Commission require OPG to conduct a detailed assessment of predicted effluent releases from the Project. The assessment should include but not be limited to effluent quantity, concentration, points of release and a description of effluent treatment, including demonstration that the chosen option has been designed to achieve best available treatment technology and techniques economically achievable. The Canadian Nuclear Safety Commission shall also require OPG to conduct a risk assessment on the proposed residual releases to determine whether additional mitigation measures may be necessary.*

**Recommendation # 15:**

*The Panel recommends that following the start of operation of the reactors, the Canadian Nuclear Safety Commission require OPG to conduct monitoring of ambient water and sediment quality in the receiving waters to ensure that effects from effluent discharges are consistent with predictions made in the environmental impact statement and with those made during the detailed design phase.*

**Recommendation # 16:**

*The Panel recommends that prior to the start of construction, the Canadian Nuclear Safety Commission require the proponent to establish toxicity testing criteria and provide the test methodology and test frequency that will be used to confirm that stormwater discharges from the new nuclear site comply with requirements in the Fisheries Act.*

## 5.4 Groundwater Environment

This section presents the Panel's review of the effects of the Project on the groundwater environment. In general, groundwater in the local study area flows in a southerly direction and discharges either into local creeks and streams or into Lake Ontario. Within the site study area, the till units have low hydraulic conductivity and restrict groundwater movement whereas the interglacial deposits between the till units have moderate conductivity and transmit groundwater across the site.

### 5.4.1 Proponent Assessment

OPG stated that it assessed groundwater quality on site with data obtained from existing and newly constructed networks of monitoring wells. It stated that the groundwater quality was compared to assessment criteria found in the Ontario *Environmental Protection Act* standards for industrial/commercial land use in a non-potable groundwater setting. OPG stated that tritium was found in a number of shallow groundwater samples. OPG reported that in 2008, the maximum level reached 501 Becquerels per litre close to the site of the existing operating reactors. The highest reported concentrations of tritium measured in groundwater flows near the site boundaries were 112 Becquerels per litre at the fence line in the north and 360 Becquerels per litre at the south near the shoreline.

OPG detected nitrate, associated with the use of fertilizers, in a number of samples as well as trace levels of organic compounds.

OPG stated that the major effect associated with excavation and grading during site preparation would be the dewatering component. OPG predicted that dewatering would lower the water table by approximately 14 metres and permanently change the groundwater flow on the site. It would reduce the flow in Darlington

Creek and eliminate a tributary that flows through the site and on to the St. Marys property. However, OPG stated that the effect on Darlington Creek would be mitigated by increased recharge resulting from stormwater management and additional recharge from the northeast landfill. As a result, OPG determined that the effect on Darlington Creek, as predicted by groundwater flow modelling, would be in the region of two to five percent of base flow.

OPG stated that groundwater flux to the lake would likely remain the same but the points of discharge would change. The geological and hydrogeological environment would be affected but would not be likely to experience a significant adverse effect.

OPG stated that during the construction stage, stormwater management facilities would be developed in accordance with industry standard best management practices. Changes in groundwater flow resulting from stormwater management would likely be minor compared to the effects from dewatering during site preparation. OPG indicated that industry standard practices would be adopted to mitigate any potential adverse effects on groundwater quality.

OPG noted that existing groundwater quality has been affected by the active ventilation systems at the existing operating reactors. OPG stated that the potential effects of emissions from the new reactors would depend on the choice of reactor technology. An assessment of likely effects on the groundwater environment was completed using operating records of the existing operating reactors. Based on that data, OPG predicted that the operation of the active ventilation systems in the new reactors may increase tritium concentrations to a maximum of 500 Becquerels per litre in groundwater found in the protected area around the reactors located inside the interior security fence. Based on this observation, the proponent concluded that the operation of reactor active ventilation systems is unlikely to have significant adverse effect on groundwater quality or the hydrogeological environment.

### 5.4.2 Panel Assessment

CNSC staff stated that the baseline hydrogeology and groundwater studies presented in the review primarily cover the site study area. Information beyond the site boundary is limited to data from the Darlington Nuclear Generating Station

## Radiological Environmental Monitoring Program.

Natural Resources Canada recommended that the scope of the groundwater flow monitoring program should be expanded to cover changes during site preparation and construction. Aspects of the recommended groundwater flow monitoring program should include required monitoring locations, frequency of monitoring and the required duration of the program for the period of transition to stable conditions following the completion of construction and the initial period of operation.

CNSC staff also recommended that OPG be required to commit to completing an assessment of potential effects to groundwater once a reactor technology is selected for the Project. CNSC staff specified that this assessment should be supported by enhanced modelling of groundwater flow and contaminant transport.

CNSC staff and some participants at the hearing raised questions regarding the possible effects on groundwater flow during future phases of quarrying on the St. Marys Cement site. This concern relates to the possible draw-down of groundwater on the Project site when quarrying operations approach the boundary with the Project site.

The Panel accepts the proposal advanced by CNSC staff for assessment of the ingress and transport of contaminants in groundwater on site, assessment of the effect of expansion on the St. Marys Cement site on groundwater flow, and consideration of a need for OPG to expand the site Radiological Environmental Monitoring Program. It also accepts the recommendation made by Natural Resources Canada for expansion of the scope of the groundwater monitoring program to cover changes in groundwater flow from site preparation through construction to operation and until the stable flow conditions are reached.

The Panel agrees with the conclusion reached by CNSC staff and Natural Resources Canada that the Project is unlikely to affect the groundwater environment. The Panel concludes that the Project is not likely to cause significant adverse environmental effects on groundwater quality and the hydrogeological environment if the mitigation measures proposed by OPG as well as the following recommendations are observed.

### **Recommendation # 17:**

*The Panel recommends that the Canadian Nuclear Safety Commission require OPG to provide an assessment of the ingress and transport of contaminants in groundwater on site during successive phases of the Project as part of the Application for a Licence to Construct. This assessment shall include consideration of the impact of wet and dry deposition of all contaminants of potential concern and radiological constituents, especially tritium, in gaseous emissions on groundwater quality. OPG shall conduct enhanced groundwater and contaminant transport modelling for the assessment and expand the modelling to cover the effects of future dewatering and expansion activities at the St. Marys Cement quarry on the Project.*

### **Recommendation # 18:**

*The Panel recommends that based on the groundwater and contaminant transport modelling results, the Canadian Nuclear Safety Commission require OPG to expand the Radiological Environmental Monitoring Program. This program shall include relevant residential and private groundwater well quality data in the local study area that are not captured by the current program, especially where the modelling results identify potential critical groups based on current or future potential use of groundwater.*

### **Recommendation # 19:**

*The Panel recommends that the Canadian Nuclear Safety Commission require OPG to expand the scope of the groundwater monitoring program to monitor transitions in groundwater flows that may arise as a consequence of grade changes during the site preparation and construction phases of the Project. The design of the grade changes should guide the determination of the required monitoring locations, frequency of monitoring and the required duration of the program for the period of transition to stable conditions following the completion of construction and the initial period of operation.*

## 5.5 Terrestrial Environment

This section presents the Panel's review of the terrestrial environment. The Panel's assessment includes the existing conditions and effects of the Project at the site, local and regional study areas

with respect to vegetation communities and species, wetlands, insects, bird communities and species, amphibians and reptiles, mammal communities and species, and landscape connectivity. The Panel's review also includes soil quality changes with respect to possible effects on soil fauna.

#### 5.5.1 Proponent Assessment

The proponent's assessment focused on establishing interactions between the Project and the environment or changes to the current conditions for each Project activity.

Large amounts of data on the terrestrial environment have been collected for the existing Darlington Nuclear Generating Station through works associated with the Darlington Nuclear biodiversity program from 1997 to 2007. However, OPG identified several gaps which were addressed by supplemental baseline data collection.

OPG provided information regarding the existing soil quality at the Darlington Nuclear site, including baseline concentrations of conventional and radiological constituents in the terrestrial environment, including soil. Baseline characterization of non-radioactive substances within the terrestrial environment included the collection of data on existing concentrations of metals, arsenic and other parameters in soil, vegetation, insects, earthworm and small mammals. OPG used these data in conjunction with results of the previous ecological risk assessments conducted at the existing Darlington Nuclear site to select the contaminants of potential concern for the ecological risk assessment. The Ontario Ministry of the Environment *Ontario Typical Range of Chemical Parameters in Soil, Vegetation, Moss Bogs and Snow* (1993) was used to represent background levels of non-radioactive soil contaminants of potential concern at the Darlington Nuclear site. All measured concentrations were below the Ontario typical range values. The only identified contaminants of potential concern were strontium and zirconium, which have available toxicity data for mammalian species but are not included in the Ontario typical range values for soil.

The OPG assessment of effects focused on physical change to the terrestrial conditions, such as habitat removal, and its effect on the valued ecosystem components within the various

environmental subcomponents discussed below. Figure 4: Bounding Extent of Direct Losses of Terrestrial Features illustrates the bounding extent of direct losses of terrestrial features.

#### Vegetation Communities and Species

OPG determined that the likely effects on the vegetation communities and species subcomponent would result from direct loss of approximately 113 hectares of cultural meadow and thicket ecosystem, the loss of approximately 17 hectares of wetland and thicket ecosystem and the conversion of an additional five hectares of the wetland ecosystem into upland vegetation due to changes in groundwater flow. OPG stated that site clearing and grubbing may result in the loss of rare plant species such as the shag-bark hickory, butternut, common water flaxseed, cup plant and loesel's twayblade.

OPG proposed mitigation measures, including replanting, maintaining of biodiversity of Coot's Pond, creation of wetland features in the site study area, and the salvage and relocation/replanting of rare plant species. OPG stated that the residual effect after implementation of the proposed mitigation measures would be a loss of approximately 40 to 50 hectares of cultural meadow ecosystem in the site study area.

#### Wetlands

OPG stated that there are no provincially or regionally significant wetlands on the Project site, and that there is the potential for icing and salt deposition from the operation of cooling towers to affect natural vegetation associated with the wetland area located immediately east of the Project site on the St. Marys Cement property. OPG concluded that these effects would likely not be measurable and would therefore not cause significant adverse effects. OPG stated that dewatering likely to occur in conjunction with on-land earthmoving and grading activities has the potential to change some wetland areas to upland vegetation communities.

#### Insects

OPG determined that the likely effects on the insect subcomponent will be bounded by the direct loss of habitat as a result of Project activities. OPG stated that the Project would result in adverse effects on dragonflies and damselflies, particularly the loss on the site of a rare species of dragonfly, the Amber-winged



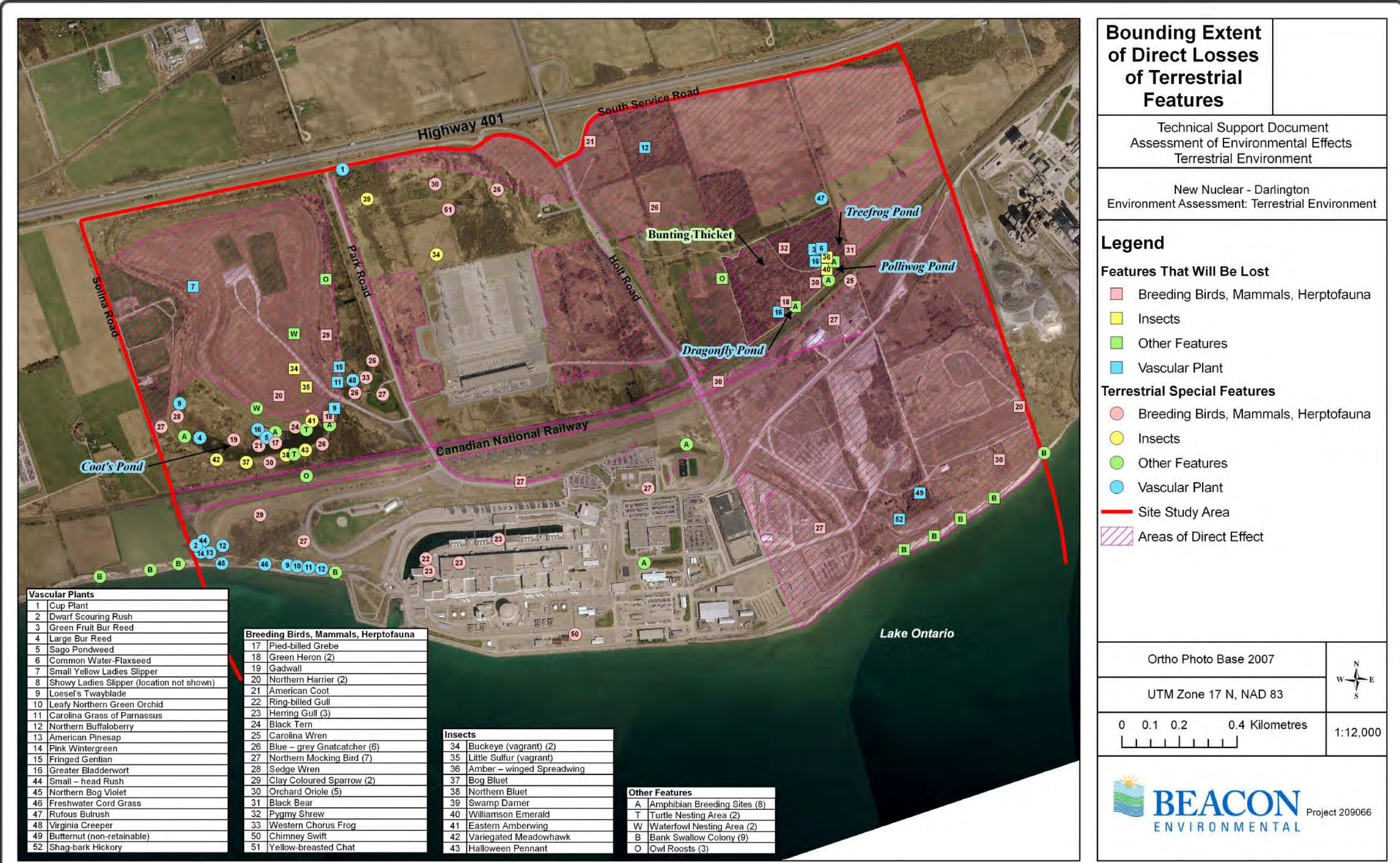


Figure 4: Bounding Extent of Direct Losses of Terrestrial Features







Spreadwing, whose only known habitat on the site (Treefrog Pond) would be lost as a result of the Project. OPG stated that the clearing of the site would also result in the loss of approximately 74 hectares of habitat for the monarch butterfly and other migrant insects. Through the implementation of non-insect specific proposed mitigation measures such as replanting and the creation of ponds, the Project would result in a net loss of approximately 24 to 34 hectares of the on-site habitat used by the monarch butterfly.

#### Amphibians and Reptiles

OPG determined that the likely effects on the amphibian and reptile subcomponent would be the removal of three amphibian breeding areas: Treefrog Pond, Polliwog Pond and Dragonfly Pond. OPG proposed no specific mitigation measures for amphibians but stated that the ameliorating effects of mitigation measures for the vegetation community and species subcomponent, including creation of fish-free wetland ponds, would have direct beneficial effects on amphibians and reptiles in the site study area.

#### Mammal Communities

OPG's assessment of effects on mammal communities and species concluded that the Project would cause the loss of approximately 113 hectares of cultural meadow and thicket ecosystem, which is an important meadow vole habitat. OPG stated that effects on mammal communities and species may also occur as a result of collisions with Project-related traffic.

#### Bird Communities

OPG determined that the likely effects on bird communities and species subcomponents would include a decrease in the population of breeding birds as a result of the removal of existing breeding bird habitat in the site study area (effects on Bank Swallow colonies and habitat are discussed later in the report.) OPG stated that site-clearing activities would also result in the loss of an estimated 74 hectares of migrant bird habitat and would result in the loss of approximately 113 hectares of cultural meadow and thicket ecosystem, which is a feeding and winter foraging area for raptors. OPG also stated that the presence of large/tall structures and buildings, potentially including natural draft cooling towers, would result in bird strikes causing injury to and death of birds and that the

security fencing on the site would result in bird entrapment and cause injuries and death of birds.

OPG proposed the following measures:

- the implementation of good industry management practice in the design and development of lighting systems and structures and security fencing systems;
- replanting efforts;
- the provision of on-site artificial nesting habitat for Chimney Swift and Purple Martin;
- partnering in research into declining populations of aerial foragers in Ontario; and
- the integration of interpretive opportunities such as signage and observation decks.

OPG concluded that the residual effects on bird communities and species, after implementation of the proposed mitigation measures would include a decrease in populations of breeding birds in the site study area through habitat loss and bird strikes associated with natural draft cooling towers.

#### Landscape Connectivity

In its assessment of effects on landscape connectivity, OPG identified an interruption along the east-west corridor and limited access for wildlife travel at points in time during the site preparation and construction phase of the Project. The mitigation measures proposed by OPG included measures to maintain wildlife travel on the east-west corridor during construction activities and to enhance corridor function for the long term.

#### Soil Quality

OPG stated that the likely effects on soil quality would occur mostly as a result of changes associated with the management of stormwater during the site preparation and construction, and the operation and maintenance phases of the Project. OPG stated that runoff from work sites and from parking areas and roadways containing road salt, oils and other petroleum hydrocarbons would discharge into ditches, swales and retention ponds and infiltrate the surface. OPG concluded that the changes in soil quality as a result of the Project from non-radiological components would not cause adverse effects to soil fauna.

#### Conventional Hazardous Substances

OPG calculated the existing and potential exposures to identified non-radioactive

contaminants of potential concern and then compared those values to published toxicity reference values. The existing atmospheric concentrations of the steam-generated chemicals, such as hydrazine and ammonia, and combustion products, such as NO<sub>2</sub> and SO<sub>2</sub>, were calculated for several locations across the Darlington Nuclear site where terrestrial biota may be exposed. OPG stated that the predicted air concentrations for all of the contaminants of potential concern were below either ambient air quality criteria or phytotoxic benchmarks, and therefore current exposure to the identified contaminants of potential concern would not result in any adverse effects to non-human biota. OPG found that exposure to soil concentrations of strontium and zirconium would be below the levels that could represent a risk to terrestrial ecological receptors.

#### 5.5.2 Panel Assessment

The Panel's assessment of the effect from the Project on the terrestrial environment includes a review of vegetation communities and species, wetlands, insects, amphibians and reptiles, mammal communities, bird communities, species at risk, landscape connectivity and soil quality.

CNSC staff stated that the information provided by OPG for subcomponents such as insects and bird communities and species consisted of species inventories with estimated or observed numbers of individuals and some limited discussion of habitat. OPG also provided existing conditions for the regional and local study areas, although with less detail than was provided for the site study area. However, CNSC staff stated that it considered the information provided by OPG to be appropriate given the potential for effects on the terrestrial environment at these spatial scales.

CNSC staff stated that the presence and status of species at risk have been adequately described by OPG, with the exception of the Least Bittern. CNSC staff noted that this species has been observed repeatedly on the Darlington Nuclear site at Coot's Pond, and efforts to confirm its breeding status have been unsuccessful. Although an individual was identified on the St. Marys Cement property in 2008, it is not clear if breeding surveys (i.e., with call playback) were attempted at Coot's Pond subsequent to the 2007 attempts. CNSC staff stated that it expected that the breeding status of Least Bitterns would be

confirmed prior to commencing activities which would disturb the site.

CNSC staff stated that the major consideration for the variety of valued ecosystem components within each subcomponent was achieving adequate representation of habitat types, and that in some cases (such as for breeding mammals), this has been oversimplified by OPG. CNSC staff indicated that in the information provided by OPG, breeding mammals were represented only by the muskrat and the meadow vole, as indicators for aquatic and terrestrial habitats respectively. OPG explained that the selection of meadow voles was driven also by the fact that they can be easily sampled for monitoring. However, CNSC staff stated that there has been no sampling thus far that would constitute a baseline that could be used for comparing against future monitoring results for these or most other indicator species.

In response to a request from the Panel that OPG provide clarification on existing and predicted risks to wildlife using the Canadian National Railway right-of-way as an east-west corridor, OPG indicated that no surveys have taken place on the CN-owned right-of-way. OPG stated that it is not proposing that the right-of-way be used as a future wildlife corridor. This response was considered adequate by CNSC staff.

The assessment performed by OPG was based on a bounding site layout representing the greatest overall physical disturbance in the Project area. CNSC staff agreed with the list of environmental subcomponents selected by OPG for the assessment, the evaluation of their interaction with the Project, and the assessment criteria/parameters chosen.

#### Vegetation Communities and Species

OPG determined that the residual effect to vegetation communities and species would be a loss of approximately 40 to 50 hectares of cultural meadow ecosystem in the site study area. Based on the information provided by the proponent, CNSC staff agreed with this assessment and stated that this loss of habitat may adversely affect biodiversity and landscape connectivity in the area. Given that the effects would be restricted to the site, the overall effects on a local or regional scale is likely to be limited. CNSC staff supported OPG's commitment to develop a follow-up program to confirm the effectiveness of the proposed mitigation

measures for vegetation communities and species.

The Panel concludes that the estimated residual effect would be a loss of approximately 40 to 50 hectares of cultural meadow ecosystem in the site study area in spite of the restoration of the two areas situated in the north-east and north-west quadrants of the site (see Figure 5: Mock-up of Future Darlington Nuclear Site).

The Panel notes, however, that if a combination of smaller lake infill area and a cooling tower condenser cooling option is selected, these restorable areas may not be available. Environment Canada stated that OPG did not provide a thorough examination of potential site layout options, and that a thorough evaluation of site layout opportunities should be conducted to minimize the overall effects on terrestrial and aquatic environments and maximize the space available for subsequent terrestrial habitat rehabilitation. The Panel agrees with this assessment.

**Recommendation # 20:**

*The Panel recommends that the Canadian Nuclear Safety Commission require OPG to perform a thorough evaluation of site layout opportunities before site preparation activities begin, in order to minimize the overall effects on the terrestrial and aquatic environments and maximize the opportunity for quality terrestrial habitat rehabilitation.*

Wetlands

Because there are no provincially or regionally significant wetlands on the Project site, the Panel concludes that the Project is not likely to have a significant adverse effect on wetlands. However, there is likely to be some effect on the wetland area located immediately east of the Project site on the St. Marys Cement property due to dewatering and on-land earthmoving and grading activities.

The Panel notes that site preparation activities would result in the destruction of the three artificial ponds constructed by OPG in the north-east portion of the Project site. Environment Canada stated that similar wetlands could be established as part of the restoration plan for the site, and the Panel concurs with this assessment.

Environment Canada recommended that OPG apply appropriate best management practices to

prevent or minimize the potential runoff of sediment and other contaminants into wildlife habitat associated with Coot's Pond during site preparation and construction phases. The Panel supports this recommendation.

**Recommendation # 21:**

*The Panel recommends that the Canadian Nuclear Safety Commission require OPG to compensate for the loss of ponds, like-for-like, preferably in the site study area. The Panel also recommends that the Canadian Nuclear Safety Commission require OPG to use best management practices to prevent or minimize the potential runoff of sediment and other contaminants into wildlife habitat associated with Coot's Pond during site preparation and construction phases.*

Insects

CNSC staff stated that OPG's planned site clearing activities would result in the loss of habitat for the monarch butterfly and other migrant insects. The Project would adversely impact the Amber-winged Spreadwing, a rare species of dragonfly, because of the loss of Treefrog Pond, which is the species' only known habitat on the site. Based on information provided by the proponent, CNSC staff determined that the ameliorating effects of the mitigation measures proposed for vegetation communities and species, specifically replanting and creation of new fish-free wetland ponds, would have some beneficial effects for insects in the site study area. OPG indicated that it would complete the proposed replanting and creation of new wetland ponds in the northeast quadrant of the site as early as possible, and would not have to wait until the completion of the proposed lake infill. CNSC staff supported OPG's commitment to develop a follow-up program to confirm the effectiveness of the proposed mitigation measures for insects.

The Panel concludes that the clearing of the site would result in the loss of approximately 74 hectares of habitat for the monarch butterfly and other migrant insects, including the only known on-site habitat of the Amber-winged Spreadwing. The Panel notes OPG's commitment to develop a follow-up program to confirm the effectiveness of the proposed mitigation measures for insects.

Amphibians and Reptiles

With respect to amphibians and reptiles, it was the opinion of CNSC staff that the loss of the

Figure 5: Mock-up of Future Darlington Nuclear Site



artificial ponds on the site, which are amphibian breeding areas, should have been considered a residual effect of the Project. The Panel agrees that the loss of three amphibian breeding ponds on site, even if they were man-made, should be considered a residual effect of the Project. CNSC staff, however, agreed with the assessment and supported the commitment of OPG to develop a follow-up program to confirm the effectiveness of the proposed mitigation measures for amphibians and reptiles.

#### Mammal Communities

CNSC staff agreed with the opinion of the proponent that mitigation measures to be undertaken for the vegetation community and species subcomponent, such as replanting, would minimize effects on mammal communities and species in the site study area. CNSC staff noted a deficiency in the follow-up program planned by OPG because it addresses road mortality only and does not appear to be as inclusive as for other faunal groups.

#### **Recommendation # 22:**

*The Panel recommends that the Canadian Nuclear Safety Commission require OPG to develop a follow-up program for insects, amphibians and reptiles, and mammal species and communities to ensure that proposed mitigation measures are effective.*

#### Bird Communities

OPG predicted that the effects to bird communities from the Project would be a decrease in populations of breeding birds in the site study area and losses due to bird strikes associated with natural-draft cooling towers, should this option be chosen for the condenser cooling system. CNSC staff agreed with this assessment, provided that OPG meets its commitment to develop a follow-up program to measure the effectiveness of its proposed mitigation measures. The Panel agrees with the conclusions reached by OPG and CNSC staff.

Environment Canada stated that OPG provided extensive information on the species of wildlife found at the site—including migratory birds—based on considerable monitoring of the existing terrestrial environment at the existing Darlington Nuclear Generating Station since at least 1997. OPG documented a total of 86 species of birds as confirmed or probably breeding at the site to date, primarily utilizing upland successional, meadow and wetland habitats that have been

preserved or created since the construction of the existing Darlington Nuclear Generating Station. Most of these habitats are found to the north of the rail line on the site. Environment Canada stated that the majority of these species are common breeders in the region and Ontario, with a few exceptions.

Environment Canada concluded that if land-clearing activities for site development of the Project are conducted during the migratory bird breeding season it could result in the destruction of migratory birds and their eggs and nests.

Environment Canada explained that birds that have fledged from nests often rely upon parental help for food and protection from predators for a period that extends beyond nesting. Clearing on a large scale can displace birds from territories, food and shelter from predation. OPG committed to planning its land-clearing activities when migratory bird nests are not active, and to conducting a pre-clearing survey for bird nests when there is a potential for active nests to be present. Environment Canada supported OPG's commitment and noted that it typically recommends a time period to proponents for avoidance of such construction activities to protect most species' nesting activities.

#### **Recommendation # 23:**

*The Panel recommends that Environment Canada collaborate with OPG to develop and implement a follow-up program to confirm the effectiveness of OPG's proposed mitigation measures for bird communities should natural draft cooling towers be chosen for the condenser cooling system.*

#### **Recommendation # 24:**

*The Panel recommends that during the site preparation stage, Environment Canada shall ensure that OPG not undertake habitat destruction or disruption between the period of May 1 and July 31 of any year to minimize effects to breeding migratory birds.*

#### Species at Risk

The *Species at Risk Act* (S.C. 2002, c. 29) provides for the protection and recovery of listed species at risk in Canada. Species at risk that are protected under the *Migratory Bird Convention Act* (S.C. 1994, c. 22) are part of Environment Canada's responsibilities. The *Species at Risk Act* requires the identification of any adverse

effects on a listed species or its critical habitat to identify measures to avoid or lessen those effects, and to undertake monitoring to determine the effectiveness of mitigation or identify where further mitigation is required. The prohibitions of the Act protecting individuals and residences apply to species that are listed as extirpated, endangered or threatened but do not apply to species listed as special concern.

Environment Canada stated that at least seven wildlife species currently listed under the *Species at Risk Act* are known to have existed recently within the Darlington Nuclear site. An additional two species have been designated as species at risk by the Committee on the Status of Endangered Wildlife in Canada (COSEWIC) and are under assessment for future designation under the Act (Table 7: Species at Risk in the Regional Study Area). COSEWIC is a committee of experts that assesses and designates which wildlife species are in danger of disappearing from Canada.

The Ontario Ministry of Natural Resources stated that three species protected under the Ontario *Endangered Species Act, 2007* (S.O. 2007, c.6)

exist on the Project site: Least Bittern, Chimney Swift and Bobolink. The Ministry noted that the *Endangered Species Act* provides protection for these species.

Environment Canada also noted that a few other bird species listed under The *Species at Risk Act* have been observed infrequently on the Darlington Nuclear site as migrants, including Short-eared Owl, Common Nighthawk, Olivesided Flycatcher and Canada Warbler. However, Environment Canada concluded that as the Darlington Nuclear site is not considered to be an important migratory stopover habitat, no effects on any of these species are expected.

Environment Canada recommended that OPG submit restoration plans to it for review. Environment Canada noted that native grassland consisting of tall vegetation species is particularly good habitat for Eastern Meadowlark and Bobolink, and recommended that the proponent refer to the ecological restoration manual *Planting the Seed – A Guide to Establishing Prairie and Meadow Communities in Southern Ontario* (2000) when developing these plans. Environment Canada stated that

Table 7: Species at Risk in the Regional Study Area

Species	SARA Status <sup>1</sup>	COSEWIC Status <sup>2</sup>	Occurrence
Least Bittern*	Threatened	Threatened	Observed in 2006 and 2007
Peregrine Falcon	Threatened	(Not active)	Nests at adjacent St. Marys Cement Site
Chimney Swift* <sup>†</sup>	Threatened	Threatened	Probable breeding, pair observed in 2009
Yellow-breasted Chat	Special Concern	Special Concern	Observed in 2009
Bobolink*	Not Listed	Threatened	Breeding; 5 nests in 2007
Snapping Turtle	Not listed	Special Concern	Observed regularly
Western Chorus Frog	Threatened	Threatened	Single calling individual in 1997
Butternut	Endangered	Endangered	1 diseased specimen in 2009
Monarch	Special Concern	Special Concern	Observed regularly

\* Denotes species also protected under the Ontario *Endangered Species Act* (2007)

<sup>†</sup> Denotes species that are listed as near threatened on the International Union for Conservation of Nature Red List of Threatened Species (2011)

<sup>1</sup> SARA: *Species at Risk Act*

<sup>2</sup> COSEWIC: Committee on the Status of Endangered Wildlife in Canada

while OPG estimates there will be a residual loss of approximately 40 percent of cultural meadow and cultural ticket habitat, this loss could be offset by developing restoration plans tailored to the needs of the Eastern Meadowlark, Bobolink and the monarch.

Environment Canada noted that a COSEWIC Status Report for Eastern Meadowlark is currently in preparation. Environment Canada explained that if Eastern Meadowlark is assessed as a species at risk it will be considered for addition to the List of Wildlife Species at Risk under the *Species at Risk Act*. If Eastern Meadowlark were to be listed as a species at risk, the listing would trigger the development of either a recovery strategy or management plan for the species which would set out broad approaches for the recovery or management of this species in Canada. Environment Canada stated that it is not currently possible to predict specific recommendations or actions that might be proposed (if any) with regard to the current Project site should the species be listed under the Act.

OPG estimated that up to 16 pairs of Eastern Meadowlark nest at the Darlington Nuclear site, and the nesting habitat of half of these pairs could be impacted by the Project due to the loss of the cultural meadow habitat. OPG proposed to mitigate this loss by restoring 40–50 hectares of cultural meadow habitat on the site following construction. Environment Canada's assessment was that this area of restored meadow habitat should be large enough to accommodate the current number of breeding pairs of Eastern Meadowlark if an ecological restoration approach tailored to the needs of this species were adopted.

The Ontario Ministry of Natural Resources stated that Bobolink exhibit high breeding site fidelity, meaning they tend to return to the same meadow area year after year. The Ministry noted that no studies were found indicating the effect of noise or large machinery on Bobolink occurrence, with the exception of one study suggesting that Bobolink might occur in smaller numbers within one kilometre of a busy highway. However, the Ministry stated that even if the birds do abandon areas close to the development, it would be expected that they would return to those areas when the disturbance stops.

In response to questions by the Panel, the Ontario Ministry of Natural Resources stated that Least Bittern appear to be tolerant of human presence and have been known to persist in urbanized areas, and that the apparent breeding of the species at Raby Head Marsh on the adjacent St. Marys Cement site, which is 100 metres from a noisy conveyor belt, suggests that the species is somewhat tolerant of noise. The Ministry also stated that siltation resulting from agricultural run-off containing insecticides may degrade nesting habitats and reduce food supplies in agricultural areas. Because Least Bittern fly low to the ground, collisions with motor vehicles, barbed-wire fences and transmission lines could be a significant mortality factor.

The Ontario Ministry of Natural Resources stated that Chimney Swift now mostly nest in chimneys, primarily in the downtown sections of towns and cities, so are generally not greatly disturbed by busy and noisy areas. The Ministry concluded that if the Chimney Swift is nesting on the Project site it would almost certainly be in one of the existing buildings, so would not likely be directly affected by development on the site. The Ministry stated that a successful design for artificial nest structures for Chimney Swift, such as the one proposed by OPG, has yet to be developed in Ontario. The Ministry noted that it is currently researching the topic and results of that work would be available to OPG by the end of 2012. The Panel notes that the Chimney Swift is the only species in Table 7 that has the status of near threatened on the *International Union for Conservation of Nature Red List of Threatened Species* (2011), and suggests that the Ministry should take this under consideration when advising OPG.

**Recommendation # 25:**

*The Panel recommends that the Canadian Nuclear Safety Commission require OPG to conduct more sampling to confirm the presence of Least Bittern before site preparation activities begin. The Panel recommends that the Canadian Nuclear Safety Commission require OPG to develop and implement a management plan for the species at risk that are known to occur on site. The plan should consider the resilience of some of the species and the possibility of off-site compensation.*



### Landscape Connectivity

With respect to landscape connectivity, CNSC staff stated that OPG should have considered the loss of three ponds—Treefrog Pond, Polliwog Pond and Dragonfly Pond—in the site study area. CNSC staff stated that these water bodies were vital to the maintenance of landscape connectivity and should be considered in this capacity in any site restoration plans.

CNSC staff expressed the opinion that the potential for wildlife to cross the Canadian National Railway property exists in the site study area. The Panel agrees with this assessment.

The Panel notes the OPG commitment to develop a follow-up program to confirm the effectiveness of the proposed mitigation measures for landscape connectivity.

### Soil Quality

CNSC staff reviewed OPG's assessment of potential effects of the Project on soil quality and supported the conclusion that changes in soil quality as a result of the Project would not cause an adverse effect on soil fauna. The Panel concurs with this conclusion.

### Conventional Hazardous Substances

In response to a Panel request for information on stored inventories of hazardous materials and sources, types and quantities of non-radioactive wastes predicted to be generated by the Project, OPG indicated that specific details regarding the chemicals to be stored and used on the site could not be provided before a reactor technology is selected for the Project. CNSC staff stated that the OPG response was conditionally acceptable based on its review of previous ecological risk assessments conducted at the site, an assessment of current practices for hazardous chemical management at the Darlington Nuclear Generating Station, and the need for a comprehensive assessment of hazardous releases.

Environment Canada summarized the requirements associated with the presence of hazardous substances within any facility in Canada. Under the *Canadian Environmental Protection Act* (S.C. 1999, c. 33), Environment Canada would evaluate if there are substances meeting certain quantity thresholds that would require a proponent to inform the public and prepare emergency plans. Depending on the situation, Environment Canada would evaluate substance dispersion, response strategy

development, cleanup priorities, sampling and monitoring requirements. Environment Canada advised the Panel that ammonia and hydrazine would have to be evaluated after the reactor technology has been chosen.

The Panel agrees with the positions of Environment Canada and CNSC staff.

#### **Recommendation # 26:**

*The Panel recommends that the Canadian Nuclear Safety Commission require OPG to develop a comprehensive assessment of hazardous substance releases and the required management practices for hazardous chemicals on site, in accordance with the Canadian Environmental Protection Act, once a reactor technology has been chosen.*

The Panel concludes that the Project is not likely to result in significant adverse environmental effects to the terrestrial environment, provided the proposed mitigation measures and the Panel's recommendations are implemented.

## **5.6 Bank Swallow Colonies and Habitat**

Bank Swallows currently burrow in the bluff at Raby Head along the shore of the Project site. This section presents the Panel's assessment of the impact of the Project on this species.

### **5.6.1 Proponent Assessment**

OPG provided information regarding the baseline conditions of the Bank Swallow habitat and the effects of the Project. OPG indicated that a loss of Bank Swallow nesting habitat is expected to occur during the site preparation and construction phase.

OPG provided information regarding the Bank Swallow colonies inhabiting the bluffs on the Lake Ontario shoreline at the Project site and on neighbouring sites. In 2007, an estimated 1,300 active burrows were located on the Project Site. This represents approximately 15 percent of the active burrows located in Durham Region. OPG concluded that it is unknown whether the colonies at the Darlington Nuclear site could be considered important in a regional context.

OPG determined that the likely effects on Bank Swallows would be caused by the removal of the shoreline bluffs in the Project site which would



result in a decrease in the Bank Swallow nesting habitat and the overall colony size.

The bounding layout included 100 percent removal of the Lake Ontario shoreline bluffs on the Project site due to associated lakefront development. OPG considered this removal to have the potential to cause a significant adverse effect and proposed a number of mitigation measures that would be explored if the bounding scenario of 100 percent bluff removal was realized. The proposed mitigation measures included provision of artificial Bank Swallow habitat and acquisition of Bank Swallow habitat off site for protection.

In response to a Panel request, OPG indicated that if the bounding scenario were not realized, meaning that less than 100 percent of the bluff is removed, the acquisition of off-site nesting habitat for protection purposes would no longer be considered.

#### 5.6.2 Panel Assessment

Environment Canada stated that Bank Swallow populations are in decline.

In response to a Panel request, OPG assessed the effectiveness of the proposed mitigation measures and assigned a risk of failure (low, medium or high) to each. OPG assigned a low risk of failure to the implementation of artificial nesting habitat for Bank Swallows. This mitigation measure is most critical for the protection of the colonies of Bank Swallows currently occupying the bluff at Raby Head. Although OPG provided four examples of artificial nesting habitat which have had successful Bank Swallow breeding in the United Kingdom, it acknowledged that the success of artificial nest habitats cannot be guaranteed.

CNSC staff stated that it would expect the artificial nest habitat to be constructed to have the capacity to maintain a population which is at least equal to the number of breeding pairs currently supported by the amount of bluff that is removed. CNSC staff also noted that, depending on the amount of bluff removed, it is likely that an artificial nest habitat of the required scale may not have been attempted before. The location of the artificial habitat would also likely have an effect on the probability of success and that, ideally, habitat should be constructed as close to the original bluff site as possible.

CNSC staff recommended to the Panel that the development and approval of the Bank Swallow mitigation plan should be done in cooperation and consultation with CNSC staff and other stakeholders, including Environment Canada. CNSC staff stated that this plan should outline an adaptive management approach to the mitigation of effects on Bank Swallows to ensure that appropriate actions are implemented should the proposed mitigation measures be less effective than predicted.

The Panel accepts the recommendation from CNSC staff, but is of the view that OPG must implement all of its proposed mitigation measures for Bank Swallow habitat in the event that any of the bluff at Raby Head is removed.

The Panel concludes that the Project is not likely to result in significant adverse environmental effects on Bank Swallows, provided that the following recommendation is implemented.

#### **Recommendation # 27:**

*The Panel recommends that prior to any destruction of the Bank Swallow habitat, the Canadian Nuclear Safety Commission require OPG to implement all of its proposed Bank Swallow mitigation options, including:*

- *the acquisition of off-site nesting habitat;*
- *the construction of artificial Bank Swallow nest habitat with the capacity to maintain a population which is at least equal to the number of breeding pairs currently supported by the bluff and as close to the original bluff site as possible; and*
- *the implementation of an adaptive management approach in the Bank Swallow mitigation plan, with the inclusion of a threshold of loss to be established in consultation with all stakeholders before any habitat destruction takes place.*

## 5.7 Aquatic Environment

This section presents the Panel's review of the effects of the Project on the aquatic environment. The aquatic environment at the Project site comprises wetland ponds, Darlington Creek and its on-site intermittent tributaries, a Lake Ontario intermittent tributary, and the nearshore area of Lake Ontario adjacent to the site.

#### 5.7.1 Proponent Assessment

The proponent stated that the principal effects of the Project on aquatic biota and habitat would result from the removal and alteration of on-site ponds, flow alteration in Darlington Creek and the tributaries, in-filling of the lake, degradation near the Darlington Creek outlet, in-water construction of a once-through condenser circulating water system, effects caused by the once-through cooling water intake and thermal effects from the cooling water discharge.

OPG stated that the on-site ponds would be re-established at new locations on the site, and effects in the impacted tributaries are to be managed in compliance with authorizations from the Fisheries and Oceans Canada. OPG noted that flow in Darlington Creek is predicted to remain almost unchanged overall because reduced input from tributaries would largely be offset by new recharge flows.

OPG stated that in-water construction and lake infill would result in losses of biota. However, these are expected to be minor effects that could be offset by fish capture and release. OPG also stated that these activities would require authorizations and habitat compensation under the *Fisheries Act*.

OPG stated that the intake of cooling water in the new once-through cooling system would result in impingement and entrainment of biota. This effect was considered by the proponent to be relatively minor even when combined with similar effects from the existing Darlington Nuclear Generating Station. No lake-wide population level effects or cumulative effects are expected.

OPG stated that possible thermal effects on round whitefish egg and larval development were considered to be negligible or minor beyond the mixing zone of the proposed once-through cooling system diffuser. OPG noted that monitoring programs supported by adaptive management measures would be implemented to address any other adverse effects.

#### 5.7.2 Panel Assessment

OPG proposed measures for management of the effects of the Project in the on-site components of the aquatic environment. The loss of on-site ponds would be compensated so as to establish a

biodiversity corridor within the site, as previously discussed.

OPG committed to undertake mitigation and fish habitat restoration and compensation for changes in Darlington Creek, the Darlington Creek intermittent tributaries and the Lake Ontario intermittent tributary. These measures would be implemented as agreed with federal and provincial agencies to satisfy requirements of Fisheries and Oceans Canada, the *Fisheries Act* and the Ontario Ministry of the Environment *Certificate of Approval for Industrial Sewage Works*.

The Panel notes that the larval and adult fish surveys in 2009 and 2010 form the primary basis of the proponent's characterization of baseline conditions in the nearshore area of the lake. These data and data from previous surveys (1998) indicate a degree of inter-year and inter-seasonal variability. Moreover, based on information that was available at the hearing, there appears to the Panel to be only a limited amount of historical data on fish population that could form the basis of an understanding of likely population trends over the projected life of the Project.

The Panel notes that OPG has developed a Round Whitefish Action Plan in consultation with responsible and federal authorities to seek a better understanding of adaptive management measures that may be required to minimize effects on this species. The proponent conducted further sampling in the fall of 2010 and in the spring of 2011 as part of this plan. The Panel is of the view that more survey data are required to fully characterize the fish population and habitat in the vicinity of the Project site and to contribute to understanding the nature of variability of the fish population over successive years. The Panel also notes that several hearing participants stated that the nearshore area at the Project site is frequented by a number of species at risk, including deepwater sculpin, lake sturgeon, Atlantic salmon and American eel, although the area does not contain habitat for these species.

Fisheries and Oceans Canada and the Ontario Ministry of Natural Resources stated that round whitefish spawn in the nearshore area at or adjacent to the Darlington Nuclear site. They further stated that round whitefish is one of the species likely to suffer negative effects on its

distribution and abundance because the lake-wide population is under stress.

The Panel is of the view that there is a need for further studies to develop a better understanding of the effects of shoreline alteration on the local habitat. Fisheries and Oceans Canada, CNSC staff and the Ontario Ministry of Natural Resources stated that there is a risk of effects to fish habitat from OPG's bounding lake infilling scenario. Proposed mitigation measures include limiting lake infill to water less than two metres in depth to reduce the effects of the Project on fish habitat.

OPG predicted loss of aquatic biota during in-water construction activities. The Panel notes that this work would be subject to permitting controls that limit the extent of adverse consequences. In addition, an adaptive management strategy may be required to mitigate possible residual effects that could arise from changes due to an embayment formed as a result of lake infill activities near the mouth of Darlington Creek.

OPG concluded that fish loss through predicted impingement and entrainment associated with cooling water intake is not expected to have a significant effect on lake-wide populations. OPG based this conclusion on extrapolation of data from impingement and entrainment sampling at the existing Darlington Generating Station in 2007. The Panel is of the view that while the proponent deemed the 2007 data to represent current conditions, the adequacy of this single year snapshot for assurance in long-term operation may be questioned given changes in fish populations that have been observed near the Project site over the past few decades. The Panel is of the view that additional impingement sampling data should be obtained to supplement the 2007 data. There should be a commitment to long-term monitoring of impingement because of evidence of continuing changes in the lake's fish community.

The Panel notes OPG's conclusion that there is a residual effect from the once-through cooling system on fish. However, OPG does not consider this effect to be significant. The Panel is of the view that measures should be taken to reduce the effect to the extent that it is reasonably practicable to do so.

Fisheries and Oceans Canada stated that the native fish population in Lake Ontario is under stress. In a submission to the Panel, Lake Ontario Waterkeeper stressed the importance of the nearshore environment as a fish habitat. In the case of the north shore of Lake Ontario, both Fisheries and Oceans Canada and Lake Ontario Waterkeeper drew attention to the importance of this habitat to a number of native species.

Given the projected level of intake losses and the uncertain future state of the fish community, OPG and federal and provincial department specialists discussed a range of measures to mitigate the potential effects of the once-through cooling system intake. These measures included fine mesh travelling screens and live fish return systems, acoustic deterrents, and locating the intake in deeper water.

Environment Canada stated that adverse effects in early life stages of round whitefish could arise from temperature exceedances up to the edge of the once-through cooling system diffuser mixing zones, and noted that this effect could become more pronounced if warmer temperatures become more prevalent with climate change. In addition, CNSC staff recommended that the effect of the surface water thermal plume resulting from the diffuser discharge should be assessed and mitigation of this effect should be considered. One option discussed by CNSC staff, Fisheries and Oceans Canada and Environment Canada was the placement of the diffuser further offshore and away from sensitive habitat areas. Environment Canada recommended enhanced resolution modelling for prediction of mixing and temperature profiles in the vicinity of the coolant diffuser ports for the purpose of detailed design and assessment of a preferred location for the coolant diffuser.

CNSC staff referred to historical studies reported by OPG which indicated evidence of round whitefish spawning in the vicinity of the inshore end of the existing Darlington Nuclear Generating Station once-through cooling system diffuser. CNSC staff also made reference to data from sampling completed in 2009 in which round whitefish larvae were captured near the proposed location of the new nuclear Project diffuser. The Panel is of the opinion that this suggests there is a need to place the Project diffuser in deeper water to reduce the risk of thermal effects in a potential round whitefish habitat area.

CNSC staff observed that cooling water discharges would likely disrupt local currents and could displace fish, particularly fish eggs and larvae, which drift passively through habitat areas. The Panel notes that contaminant and thermal plumes could pose a hazard which should be assessed and addressed as appropriate in follow-up monitoring activities.

CNSC staff recommended that fish population monitoring in the vicinity of the Project site should be continued over the life of the Project to test the effectiveness of mitigation measures and to monitor for adverse effects.

CNSC staff also recommended that the total area of fish habitat affected by the various aquatic environment stressors should be estimated. These effects could include thermal and contaminant plume effects, construction loss, modification of habitat in the embayment, losses due to infilling in the lake, and physical displacement by diffuser-induced current.

The Panel accepts the conclusions reached and recommendations made by CNSC staff, Environment Canada, Fisheries and Oceans Canada and the Ontario Ministry of Natural Resources. It notes from these assessments that there will likely be effects on fish and fish habitat in the nearshore area at the Project site from the operation of a condenser once-through cooling system. These effects include entrainment and impingement at the cooling water intake and thermal effects from diffuser discharge flows in an area that appears to be a habitat for round whitefish.

It appears to the Panel that there is limited knowledge on the nature of changes observed over time in fish populations along the north shore of Lake Ontario, and in particular, in the critical nearshore habitat in the site study area. The Panel believes that a precautionary approach should be adopted to address the uncertainties in this situation. Appropriate design and mitigation measures should be taken to avoid harm to fish and fish habitat over the projected life of the Project. One of these mitigation measures is the location of the once-through cooling system intake and diffuser beyond the nearshore environment. Closing comments, provided by Fisheries and Oceans Canada, confirmed that placement of the intake and the diffuser in deeper water would reduce the adverse residual effects on aquatic biota.

The Panel concludes that the Project is not likely to result in significant adverse environmental effects on the aquatic environment, provided that OPG implements its proposed mitigation measures, as well as the following recommendations.

**Recommendation # 28:**

*The Panel recommends that Fisheries and Oceans Canada require OPG to continue conducting adult fish community surveys in the site study area and reference locations on an ongoing basis. These surveys shall be used to confirm that the results of 2009 gillnetting and 1998 shoreline electrofishing reported by OPG, and the additional data collected in 2010 and 2011, are representative of existing conditions, taking into account natural year-to-year variability.*

*Specific attention should be paid to baseline gillnetting monitoring in spring to verify the findings on fish spatial distribution and relatively high native fish species abundance in the embayment area, such as white sucker and round whitefish. The shoreline electrofishing habitat use study is needed to establish the contemporary baseline for later use to test for effects of lake infill armouring, if employed, and the effectiveness of mitigation.*

**Recommendation # 29:**

*The Panel recommends that Fisheries and Oceans Canada require OPG to continue the research element of the proposed Round Whitefish Action Plan for the specific purpose of better defining the baseline condition, including the population structure, genome and geographic distribution of the round whitefish population as a basis from which to develop testable predictions of effects, including cumulative effects.*

**Recommendation # 30:**

*In the event that a once-through condenser cooling system is chosen for the Project, the Panel recommends that prior to the construction of in-water structures, Fisheries and Oceans Canada require OPG to conduct:*

- *additional impingement sampling at the existing Darlington Nuclear Generating Station to verify the 2007 results and deal*

- with inter-year fish abundance variability and sample design inadequacies; and
- additional entrainment sampling at the existing Darlington Nuclear Generating Station to better establish the current conditions. The program should be designed to guard against a detection limit bias by including in the analysis of entrainment losses those fish species whose larvae and eggs are captured in larval tow surveys for the seasonal period of the year in which they occur. A statistical optimization analysis will be needed to determine if there is a cost-effective entrainment survey design for round whitefish larvae.

**Recommendation # 31:**

Irrespective of the condenser cooling system chosen for the Project, the Panel recommends that Fisheries and Oceans Canada not permit OPG to infill beyond the two-metre depth contour in Lake Ontario.

**Recommendation # 32:**

In the event that a once-through condenser cooling system is chosen for the Project, the Panel recommends that Fisheries and Oceans Canada require OPG to mitigate the risk of adverse effects from operation, including impingement, entrainment and thermal excursions and plumes, by locating the system intake and diffuser structures in water beyond the nearshore habitat zone. Furthermore, OPG must evaluate other mitigative technologies for the system intake, such as live fish return systems and acoustic deterrents.

**Recommendation # 33:**

The Panel recommends that Fisheries and Oceans Canada require OPG to conduct an impingement and entrainment follow-up program at the existing Darlington Nuclear Generating Station and the Project site to confirm the prediction of adverse effects, including cumulative effects, and the effectiveness of mitigation. For future entrainment sampling for round whitefish, a statistical probability analysis will be needed to determine if unbiased and precise sample results can be produced.

**Recommendation # 34:**

In the event that a once-through condenser cooling system is chosen for the Project, the Panel recommends that prior to construction, Environment Canada ensure that enhanced resolution thermal plume modelling is conducted by OPG, taking into account possible future climate change effects. Fisheries and Oceans Canada shall ensure that the results of the modelling are incorporated into the design of the outfall diffuser and the evaluation of alternative locations for the placement of the intake and the diffuser of the proposed condenser cooling water system.

**Recommendation # 35:**

In the event that a once-through condenser cooling system is chosen for the Project, the Panel recommends that prior to operation, the Canadian Nuclear Safety Commission require OPG to include the following in the surface water risk assessment:

- the surface combined thermal and contaminant plume; and
- the physical displacement effect of altered lake currents as a hazardous pulse exposure to fish species whose larvae passively drift through the area, such as lake herring, lake whitefish, emerald shiner and yellow perch.

If the risk assessment result predicts a potential hazard then the Canadian Nuclear Safety Commission shall convene a follow-up monitoring scoping workshop with Environment Canada, Fisheries and Oceans Canada and any other relevant authorities to develop an action plan.

**Recommendation # 36:**

In the event that a once-through condenser cooling system is chosen for the Project the Panel recommends that during operation, the Canadian Nuclear Safety Commission require OPG to undertake adult fish monitoring of large-bodied and small-bodied fish to confirm the effectiveness of mitigation measures and verify the predictions of no adverse thermal and physical diffuser jet effects.

**Recommendation # 37:**

*In the event that a once-through condenser cooling system is chosen for the Project, the Panel recommends that prior to construction, the Canadian Nuclear Safety Commission require OPG to determine the total area of permanent aquatic effects from the following, to properly scale mitigation and scope follow-up monitoring:*

- *the thermal plume + 2° C above ambient temperature;*
- *the mixing zone and surface plume contaminants;*
- *physical displacements from altered lake currents; and*
- *infill and construction losses and modifications.*

## 5.8 Radiological Effects in Non-human Biota

This section presents the Panel's review of the possible radiological effects of the Project on non-human biota. Radiological emissions and effluents from the Project are eventually dispersed in the environment. However, the dispersion pathways can lead to transient or permanent accumulation in susceptible receptors.

### 5.8.1 Proponent Assessment

OPG's assessment was based on data obtained from the Darlington Radiological Environmental Monitoring Program, supplemented by results from recent measurements of levels of radionuclides in organisms. OPG stated that the use of recent measured values provided a realistic and current assessment of radiation risks, which were all found to be 1,000 times lower than the International Atomic Energy Agency and Canadian Nuclear Safety Commission reference dose rate recommendations for various organisms.

OPG concluded that there would likely be no ecological risks associated with radiation exposure of biota in the site study area.

### 5.8.2 Panel Assessment

CNSC staff stated that the approach used by the proponent to assess radiological risk to biota was conventional and suitably conservative. CNSC staff further stated that the conclusion of very minimal future risks was acceptable and would be unlikely to change in the event of minor variations in releases to the environment. Even in the case of variations in tritium releases from

different technology choices, the levels that could accumulate in biota over time would be far below levels of ecological significance.

In response to a Panel request to assess the dose consequence, including levels of organically-bound tritium in calculations of dose to non-human biota, OPG stated that organically-bound tritium was not included in the calculations but that equivalent conservatism was incorporated in the risk estimates by weighting the activity level of tritiated water by a factor of three.

The Panel is of the view that the approach and process used by OPG for calculating and interpreting radiation doses to non-human biota is acceptable for quantifying this aspect of the environmental assessment for aquatic and terrestrial biota. The Panel accepts the conclusion that the Project is not likely to have significant adverse effects on non-human biota in the site study area.

## 5.9 Effects of the Environment on the Project

This section presents the Panel's review of the effects of the environment on the Project. The effects of the environment comprise geotechnical and seismic hazards, and hazards that could arise due to severe weather and climate conditions.

Potential environmental conditions identified by OPG that could interfere with the Project are listed in Table 8: Potential Environmental Conditions and Interference with the Project.

### 5.9.1 Geotechnical and Seismic Hazards and Effects

This section presents the Panel's assessment of the geological stability of the Project site and the effects of earthquakes on the Project.

#### Proponent Assessment

OPG identified and assessed the stability of a number of natural and human-made slopes on the site. These slopes included dykes and cut-slopes whose failure could affect the safety of the Project facility. OPG concluded that all slopes would be stable under static loading, with a factor of safety meeting the requirements of the Canadian Dam Association *Dam Safety Guidelines* (2007).

OPG stated that assessment of data available from two deep boreholes indicated no evidence

Table 8: Potential Environmental Conditions and Interference with the Project.

Potential Environmental Condition	Principal Affected Component(s) of the Project
Flooding	<ul style="list-style-type: none"> <li>• Shoreline works</li> <li>• Integrity and function of external structures and systems: <ul style="list-style-type: none"> <li>○ Electrical power systems</li> <li>○ Power block</li> <li>○ Ancillary facilities</li> </ul> </li> <li>• Stormwater management system</li> </ul>
Severe Weather	<ul style="list-style-type: none"> <li>• Integrity and function of external structures and systems <ul style="list-style-type: none"> <li>○ Electrical power systems</li> <li>○ Power block</li> <li>○ Ancillary facilities</li> </ul> </li> </ul>
Biophysical Environment <ul style="list-style-type: none"> <li>• Zebra and quagga mussels</li> <li>• Attached algae</li> <li>• Fish</li> <li>• Ice</li> <li>• Sediment</li> </ul>	<ul style="list-style-type: none"> <li>• Water systems: <ul style="list-style-type: none"> <li>○ Condenser circulating water system (including intake structure)</li> <li>○ Service water system</li> </ul> </li> </ul>
Seismicity	<ul style="list-style-type: none"> <li>• Systems critical to safe plant shutdown <ul style="list-style-type: none"> <li>○ Safety and related systems</li> <li>○ Electrical power systems</li> </ul> </li> </ul>
Climate Change	<ul style="list-style-type: none"> <li>• Integrity and function of external structures and systems <ul style="list-style-type: none"> <li>○ Electric power systems</li> <li>○ Power block</li> <li>○ Ancillary facilities</li> </ul> </li> <li>• Water systems <ul style="list-style-type: none"> <li>○ Condenser circulating water system</li> <li>○ Service water system</li> </ul> </li> <li>• Stormwater management system</li> </ul>

of karstic features in the bedrock. OPG also concluded that liquefaction is not expected to be an issue at the site.

OPG stated that blasting operations at the St. Marys Cement quarry are not likely to cause adverse effects at the site, and noted that in the current Phase 1 quarry operation, blasting is being carried out one kilometre away from the Project site boundary. Data from two monitoring stations indicated that the current peak ground velocity, at the site boundary, is below the threshold for potential damage to the Project.

OPG assessed proposed foundations and buried structures based on the plant parameter envelope and other available data. OPG concluded that there is little risk of foundation instability and structural failure under static and dynamic loading, provided the foundations are designed according to allowable bearing capacity and design groundwater conditions.

OPG characterized seismicity at the site based on hazard levels obtained from a 2009 probabilistic seismic hazard assessment. OPG stated that a preliminary assessment of the site and the

surrounding area indicated no evidence of near-surface faulting in the bedrock. OPG identified no seismicity-related issues that would render the site unsuitable for construction of a nuclear facility.

OPG has evaluated the risks of a number of seismicity-related phenomena such as volcanism, tsunami, seiches and seismically induced landslides. OPG noted that there is a seiche potential in Lake Ontario, and shoreline protection would be installed at the site to protect against this risk. In the cases of the other phenomena, the risks have been assessed from improbable to minimal effects.

#### Panel Assessment

CNSC staff accepted the approaches adopted by the proponent to characterize baseline geotechnical conditions and to assess the effects of geotechnical and seismic hazards. CNSC staff, however, stated that the assessment of these hazards is based on limited baseline information, and recommended that a geotechnical investigation be completed to confirm OPG's conclusions. CNSC staff further recommended that the scope of the investigation should include a determination of the shear strength and dynamic properties of the site overburden material and the underlying sedimentary rocks, a liquefaction assessment for liquefiable soil units, the liquefaction potential of the proposed northeast waste stockpile/landfill, and the stability of dyke slopes and cut slopes under dynamic loads.

Another issue of concern identified by participants was a possible effect of activities at St. Marys Cement quarry on groundwater flow at the Project site and the potential for settlement in the quaternary deposits due to groundwater drawdown. CNSC staff recommended that an assessment should be completed for the projected life of the Project and the full scope of quarry excavations at the St. Marys Cement site.

CNSC staff recommended that monitoring should be required for blasting on the St. Marys Cement site during the Phase 4 St. Marys Cement blasting operations, as this phase of blasting would occur close to the Project site boundary.

With respect to seismic hazards, CNSC staff recommended that there should be a review of the uniform hazard response spectrum of the

sedimentary rock with siturock and dynamic data from the detailed site geotechnical investigation. This should be augmented by the development of a uniform hazard spectrum of the overburden material.

OPG did not identify paleoseismologic features at the site. The Panel notes, however, that studies on deep seismic structures have not been completed. Natural Resources Canada stated that while there were no known faults at the site, it was not unusual to find ancient inactive faults in deep structures. Natural Resources Canada described the seismic characterization of the region of the site as one in which there was a low level of seismic risk, which is typical of intra-plate regions well removed from activity along faults zones. Nevertheless, the Panel is of the view that the proponent should conduct field work to examine paleoseismologic features as part of an effort to reduce uncertainty related to seismic hazards at the site.

In the light of the major seismic event and tsunami experienced in Japan in March 2011, Natural Resources Canada reviewed the nature of seismic hazards in different seismic zones. Natural Resources Canada contrasted the active plate boundary conditions in Japan with the stable intra-plate environment along the north shore of Lake Ontario, concluding that there was very low risk of a major seismic event in the vicinity of the site study area.

The Panel agrees with the CNSC staff assessment of geotechnical hazards and effects and with the CNSC staff and Natural Resources Canada assessments of seismic hazards and effects. However, the Panel maintains that the proponent has conducted an assessment of effects of geotechnical and seismic hazards based on limited baseline information and that there are areas where more information on site-specific conditions, soils and structures is required for confirmation of the suitability of the site.

The Panel notes that the proponent has committed to undertaking a detailed geotechnical investigation to obtain more site-specific information.

The Panel agrees with the conclusions from CNSC staff and Natural Resources Canada that, presently, there are no geotechnical and seismic hazards identified that would render the site unsuitable for the construction of new nuclear



facilities. However, some aspects requiring follow-up action are outlined in the following recommendation.

**Recommendation # 38:**

*The Panel recommends that the Canadian Nuclear Safety Commission require that the geotechnical and seismic hazard elements of the detailed site geotechnical investigation to be performed by OPG include, but not be limited to:*

*Prior to site preparation:*

- *demonstration that there are no undesirable subsurface conditions at the Project site. The overall site liquefaction potential shall be assessed with the site investigation data; and*
- *confirmation of the absence of paleoseismologic features at the site and, if present, further assessment to reduce the overall uncertainty in the seismic hazard assessment during the design of the Project must be conducted.*

*During site preparation and/or prior to construction:*

- *verification and confirmation of the absence of surface faulting in the overburden and bedrock at the site.*

*Prior to construction:*

- *verification of the stability of the cut slopes and dyke slopes under both static and dynamic loads with site/Project-specific data during the design of the cut slopes and dykes or before their construction;*
- *assessment of potential liquefaction of the northeast waste stockpile by using the data obtained from the pile itself upon completion of site preparation;*
- *measurement of the shear strength of the overburden materials and the dynamic properties of both overburden and sedimentary rocks to confirm the site conditions and to perform soil-structure interaction analysis if necessary;*
- *assessment of the potential settlement in the quaternary deposits due to the groundwater drawdown caused by future St. Marys Cement quarry activities; and*
- *assessment of the effect of the potential settlement on buried infrastructures in the deposits during the design of these infrastructures.*

*Prior to operation:*

- *development and implementation of a monitoring program for the Phase 4 St. Marys Cement blasting operations to confirm that the maximum peak ground velocity at the boundary between the Darlington and St. Marys Cement properties is below the proposed limit of three millimetres per second (mm/s).*

## 5.9.2 Severe Weather and Climate

OPG conducted an assessment of extreme weather conditions and climate extreme values and trends for the region in which the Project is located. Among the aspects addressed are risks linked with flooding and effects that could arise due to climate change.

### Proponent Assessment

OPG stated that coastal flooding hazards include potential high water level, storm surge, seiche, wind wave, tsunamis and other lake-related physical causes and factors that could affect the safety of the Project. In the case of on-site floods, OPG considered the probable maximum flood within the Darlington Creek watershed along with maximum flows associated with the probable maximum precipitation that could fall directly on the site. OPG concluded that the identified potential flood hazards could be mitigated through conventional engineering means and methods.

The OPG assessment of the effect of climate change on local hydrology indicated that the likely effect would be of low consequence. Stormwater management facilities could be built to function with the climate change projections in accordance with Canadian National Building Code requirements that are applicable at the time of construction of the reactor facility.

OPG stated that an adaptive management strategy could be adopted to address nuisance algal growth at the eastern end of the proposed lake infill caused by climate change and a rise in lake water temperature.

### Panel Assessment

CNSC staff recommended that OPG modify its assessment of flooding hazards to consider grading and construction work on the site, changes in conditions in the lake, and projections for climate change. It recommended that this

additional assessment should include contingency plans to account for uncertainties associated with flooding and other extreme weather hazards that may arise during the construction, operation and decommissioning phases of the Project.

CNSC staff observed that the climate change assessment provided by OPG is based on very general projections that are not specific to the Project. CNSC staff recommended further assessment of available literature to enable projection of possible bounds of parameters, such as the intensity of extreme precipitation events. CNSC staff stated that conservative projection of such events would enable provision of adequate capacity in hydrological designs at the construction stage. The Panel concurs with this assessment and notes that if cooling towers are selected for the Project, effects of extreme weather events, such as tornadoes must be assessed.

OPG did not assess the potential effects of drought and a decrease in the level of Lake Ontario as a result of climate change. CNSC staff noted that environmental consequences could arise due to reduced capacity for lakewater-based cooling functions.

CNSC staff observed that the OPG assessment of possible effects of attached algae did not include specific data to support the conclusion reached on the significance of present and possible long-term hazards from algae. CNSC staff stated that no information was provided on possible trends or the frequency of problems caused by algal build up in the intake system at the current operating facility. The CNSC staff review of available information on algal build up indicated that there are uncertainties and possible limitations regarding the long-term effectiveness of the cooling water intake proposed for the Project.

The proposed location of the intake for the Project is the nearshore zone of the lake at a depth that is above the thermocline. CNSC staff suggested that a possible strategy to reduce the susceptibility to algal fouling would be to move the intake into deeper water, to a depth beyond the thermocline.

CNSC staff stated that the information on hydrology and floods provided by OPG was sufficient to determine the potential for effects of the environment on the Project. CNSC staff stated that the Project was not likely to be affected by flooding, but that a contingency plan may be required to address uncertainties associated with flooding and other extreme weather hazards.

CNSC staff stated that, in general, the information provided by OPG regarding climate change was sufficient to determine the potential for effects of the environment on the Project, and that the Project was not likely to be affected by climate change. However, CNSC staff recommended that OPG conduct localized climate change modelling for the detailed design of the Project. The Panel suggests that it would be helpful in this respect for OPG to collaborate with the Ontario Regional Adaptation Collaborative.

CNSC staff noted that OPG provided limited discussion of the consequences of a period of drought and the potential effects of drought on the Project. Nevertheless, CNSC staff concluded that OPG provided enough information to determine the potential for effects of the environment on the Project and recommended that OPG ensure its mitigation measures take dry weather conditions into account.

Based on the information presented by the proponent, the Panel concludes that it is unlikely that there will be any residual adverse effects of the environment on the Project for algal disruption of cooling water flows in the short to medium term. The Panel notes that while the long-term adverse effects of algae on the Project are difficult to predict with reliability, based on the information provided, the Panel concludes that the Project is not likely to be affected provided that the design and contingency measures proposed by OPG to reduce the effects from an increased growth of algae are implemented.

The Panel concludes that the environment is not likely to significantly affect the Project, provided that the proposed design and mitigation features—such as flood protection and shoreline protection—along with the following recommendations, are implemented.

**Recommendation # 39:**

*The Panel recommends that prior to construction, the Canadian Nuclear Safety Commission require OPG to prepare a contingency plan for the construction, operation and decommissioning Project stages to account for uncertainties associated with flooding and other extreme weather hazards.*

*OPG shall conduct localized climate change modelling to confirm its conclusion of a low impact of climate change. A margin/bound of changes to key parameters, such as intensity of extreme weather events, needs to be established to the satisfaction of the Canadian Nuclear Safety Commission. These parameters can be incorporated into hydrological designs leading up to an application to construct a reactor, as well as measures for flood protection.*

*OPG must also conduct a drought analysis and incorporate any additional required mitigation/design modifications, to the satisfaction of the Canadian Nuclear Safety Commission, as part of a Licence to Construct a reactor.*

**Recommendation # 40:**

*The Panel recommends that prior to construction, the Canadian Nuclear Safety Commission require OPG to:*

- establish an adaptive management program for algal hazard to the Project cooling water system intake that includes the setup of thresholds for further actions; and*
- factor the algal hazard assessment into a more detailed biological evaluation of moving the intake and diffuser deeper offshore as part of the detailed siting studies and the cost-benefit analysis of the cooling system.*



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## Chapter 6 – Analysis of the Human Environment

This chapter evaluates effects of the Project associated with the human environment. The human environment includes socio-economic conditions, land use, the visual impact of the Project, Aboriginal interests, physical and cultural heritage, transportation and waste management.

The purpose of this chapter is to establish if the Project will result in significant residual effects on the human environment after the application of mitigation measures.

### 6.1 Socio-Economic Conditions

Socio-economic conditions include the human, financial, physical, social and natural assets in the local and regional study areas. This section of the review presents the outcome of an assessment of the effects of the Project on these assets.

#### 6.1.1 Proponent Assessment

OPG outlined the baseline socio-economic conditions within the local and regional study areas using the concept of community well-being and an organizational framework of community asset considerations in its assessment, including human, financial, physical, social and natural assets. OPG stated that it established baseline conditions through the collection and analysis of information from various sources, including the Statistics Canada Census, Municipal Property Assessment Corporation data, regional and municipal plans and records, as well as mapping and interviews with stakeholders. OPG concluded that the current state of the regional and local study area communities can be characterized as having a reasonably healthy balance of community assets with respect to skills and labour supply, existing municipal infrastructure, health and safety services, financial wealth and a healthy environment.

OPG provided information regarding human assets, which relate to elements such as population and demographics, skills and labour supply, education, health and safety facilities and services, social services, and economic development services. OPG stated that between 1996 and 2006, virtually all municipalities in the regional study area experienced growth in their

populations, including an influx of new immigrants; however, the population is aging and household sizes are decreasing. OPG noted that the labour force is strong and diverse, although there is a shortage of skilled labour, particularly in the construction sector.

OPG also provided information regarding financial assets, which relate to elements such as employment, business activity, tourism, income, residential property values, and municipal finance and administration. OPG stated that the economic base is diverse and rapid employment growth has occurred since 1996, which has resulted in increased property values. OPG stated that in 2006 it was the second largest employer in Durham Region. OPG noted that the tourism industry and agriculture are also important components of the economy of Durham Region.

OPG described the physical assets of Durham Region, including housing, municipal infrastructure and services, community character, land use, traffic and transportation. OPG stated that the local and regional study areas comprise a mix of urban, suburban and rural land uses and natural areas, including Darlington Provincial Park, the McLaughlin Bay Wildlife Reserve and the Oshawa Second Marsh. Overall, residents are served by a broad range of municipal infrastructure and services.

OPG further described social assets related to elements, such as community and recreational facilities and programs, residents' use and enjoyment of private property, community cohesion, and physical and cultural heritage resources. OPG stated that there are several hundred community and recreational facilities throughout the regional and local study areas, with 29 community and recreational features located within approximately three to four kilometres of the Darlington Nuclear site. OPG noted that the site offers publicly-accessible sports fields and a fitness loop. OPG stated that while there are a broad range of factors that influence people's use and enjoyment of property, few consider their use and enjoyment of property to be affected by operations at the existing Darlington Nuclear site. OPG noted that public attitude research has shown that there is a strong sense of belonging and most people feel

that there is a common vision among residents in the local study area.

OPG explained that natural assets relevant for the socio-economic assessment include the atmospheric, surface water, aquatic, terrestrial, geological and hydrogeological environments, as well as the radiation and radioactivity environment. OPG stated that the Darlington Nuclear site is an important local environmental resource due to its biodiversity. OPG noted that the air quality in the vicinity of the site does not differ substantially from the general air quality in southern Ontario and that the noise environment in the vicinity of the Darlington Nuclear site is typical of an urban setting. OPG stated that, in general, local study area residents reported high ratings of feelings of personal health, sense of safety and overall community satisfaction, and high levels of confidence in ongoing operations at the Darlington Nuclear site.

Based on its analysis, OPG concluded that the Project would not result in any significant adverse effects to the socio-economic environment and that the Project is expected to result in a number of beneficial socio-economic effects.

OPG stated that the effects of the Project on human assets would be positive and extend across the regional and local study areas, and that the Project would create direct jobs and indirect business opportunities, particularly during the construction stage. OPG noted that the Project would place a sustained demand on the labour force and increase demands on health and safety facilities and services.

OPG maintained that the Project would likely improve the financial assets of communities in the local and regional study areas. OPG expected that as a result of the increased number of jobs, the total household income in the local and regional study areas would increase, along with property tax revenue. OPG noted, however, that the increased traffic and visual impacts from the Project would likely adversely affect individual business operations, tourism and residential property values.

Regarding physical assets, OPG stated that the Project would increase the physical presence of industry along the Lake Ontario waterfront and Highway 401, which could result in adverse effects on some businesses and property values.

OPG stated that although direct effects on municipal infrastructure and services such as fire-fighting, water, sewage and conventional waste management would be likely, there would also likely be service capacity available to meet the demands of the Project. OPG stated that the Project would likely generate demand for new housing developments, resulting in increased diversification of the housing stock, as well as increased demand for municipal infrastructure and servicing. OPG noted that the Project could adversely affect community character if large cooling towers were required.

OPG indicated that the Project would have both positive and negative influences on social assets in the local study area, though a measureable adverse effect on community cohesion was considered likely. OPG noted that public access to the Darlington Nuclear site during the site preparation and construction phase would likely be limited and that some community and recreational facilities would be displaced. OPG further noted that the majority of adverse effects on social assets would likely be localized in the immediate vicinity of the Darlington Nuclear site and would not be extreme or widespread. OPG concluded that there is a low likelihood that the Project could cause nuisance effects of sufficient magnitude to adversely affect community and recreational facilities or people's use and enjoyment of private property.

OPG stated that the noise, dust, traffic and visual effects of the Project would adversely affect a variety of natural and community assets, but the most adverse effects would be limited to the Darlington Nuclear site or areas in close proximity. OPG acknowledged that a nuclear accident could cause a decrease in property values in the local and regional study areas.

OPG indicated that most of the adverse effects could be appropriately mitigated. OPG stated that mitigation measures would include a Traffic Management Plan, Nuisance Effects Management Plan, continual sharing of information and partnerships with stakeholders to address issues which may have an effect on community assets, and a Host Municipality Agreement to provide compensation to the Municipality to mitigate effects resulting from the Project.

#### 6.1.2 Panel Assessment

The Panel notes that CNSC staff retained the services of IBI Group to conduct its review of socio-economic effects. CNSC staff concluded that given the sources of the baseline data and analysis, OPG's existing socio-economic conditions assessment was credible. The Panel concurs with this conclusion.

CNSC staff indicated that OPG described a broad and relatively exhaustive assessment of the potential effects the Project may have on the economy and community assets. CNSC staff noted that while the evaluation of the effects of the Project on the local and regional economy is largely quantitative in nature, the assessment of the potential effects on community assets is more qualitative. Nevertheless, CNSC staff indicated that the OPG conclusions regarding the effects of the Project on these socio-economic elements appeared to be based on the most dependable data available.

CNSC staff stated that the OPG conclusion that there would be no adverse effects on housing as a result of the Project was not well-substantiated. CNSC staff explained that an increased demand for housing is expected during 2018–2024, when the number of workers for the operation and maintenance phase of the first set of reactor units would overlap with the number of workers for the construction phase of the second set of reactor units, resulting in an increased strain on available housing. CNSC staff noted that OPG indicated that there is less diversity in housing stock in Clarington and a very small rental market, and as such, it was unclear if OPG assumed that additional housing would be built to accommodate the workers. The Panel notes that the fluctuating temporary and transient worker population during the construction stage may also compete with tourists for temporary accommodation in the vicinity of the site.

The Panel notes the OPG conclusion that funding for the provision of the required services to meet the direct and indirect demands of the Project would be made available through increased household property taxes and property taxes to be paid by OPG. However, OPG provided details regarding the fiscal effects of increased demand for community and social services as a result of the Project. CNSC staff noted that workers commuting to the Darlington Nuclear site from outside of the regional study area, who do not pay local property taxes, would use services and

facilities such as roads, transit, recreation facilities, hospitals and health care, schools, and daycare. The fluctuating and shorter-term demand the Project might place on facilities was not considered in detail in the review. The Panel notes the Municipality of Clarington commented that the effect of the Project on socio-economic considerations is addressed in the Clarington Host Municipality Agreement.

Local governments and agencies responsible for regulating land use within the local and regional study areas, including the Municipality of Clarington, the City of Oshawa and the Region of Durham, noted concerns with the Municipal Finance and Administration section of the EIS as it pertains to community assets. They suggested that further discussions with OPG and close monitoring of the Project should occur. The Panel notes that the Region of Durham is actively engaged with the proponent to develop a host community agreement to mitigate the effects of the Project on the Region and compensate for costs associated with the Project for soft services and infrastructure.

The Panel notes that the OPG primary mitigation measure on socio-economic assets is the continued sharing of information with key stakeholders. The Panel is of the view that OPG and key stakeholders should consider targeting future discussions on the effects of the Project on the housing supply and demand, community recreational facilities and programs, services and infrastructure as well as additional measures to help deal with the pressures on these community assets.

The Panel notes that OPG indicated that the number of jobs created by the Project in the regional study area is expected to be approximately 35 percent of the 3,500 total jobs created by the Project. The Panel further notes that there are no means to favour a higher percentage of jobs in the region. The Panel acknowledges that the Clarington Board of Trade indicated that the OPG estimate of business activity for the construction phase was considerably lower than other comparable estimates, such as that made by the Conference Board of Canada.

The Panel reiterates, as indicated by CNSC staff, that OPG did not provide details regarding the potential fiscal effects of increased demand on community and social services resulting from the

Project. As such, the Panel is of the view that the demand for such services should be monitored.

The Panel is of the view that the Project is not likely to result in significant adverse socio-economic environmental effects, taking into account the implementation of mitigation measures, such as the Clarington Host Municipality Agreement and the nuisance effects management plan, along with the following recommendation.

**Recommendation # 41:**

*The Panel recommends that prior to site preparation, the Canadian Nuclear Safety Commission coordinate discussions with OPG and key stakeholders on the effects of the Project on housing supply and demand, community recreational facilities and programs, services and infrastructure as well as additional measures to help deal with the pressures on these community assets.*

**6.1.3 Training and Employment of Aboriginal Persons**

This section presents the Panel's review of training and employment opportunities for Aboriginal persons in relation to the Project.

Proponent Assessment

OPG stated that it has programs to support and promote Aboriginal employment. OPG stated that it is committed to building long-term, mutually-beneficial working relationships with Aboriginal communities, in accordance with its Aboriginal relations policy. OPG further stated that it would continue to explore employment and business opportunities with the Aboriginal communities.

OPG provided information regarding various Ontario universities and colleges with Aboriginal programs, as well as the Ontario *Aboriginal Post Secondary Education and Training Policy Framework* (2011). OPG noted that it provides five scholarship programs, three specifically for people of Native ancestry in post-secondary education.

OPG also provided information regarding recruitment and discussed job opportunities in the areas of skilled trades, engineering and applied sciences and corporate and security functions. OPG further noted that it has several

initiatives for student positions, including co-op, summer, internship and articling positions.

Panel Assessment

Some Aboriginal groups held that the Project might provide opportunities for employment. They also voiced concerns that their student population may not be able to benefit from the permanent employment opportunities presented by the Project. They noted that although there may be employment opportunities for tradespersons during the construction phase of the Project, skilled, longer-term jobs during the operation and maintenance phases of the Project may not be available to Aboriginal persons. The Aboriginal groups noted that they have held discussions with OPG regarding careers for students in areas such as engineering.

The Panel is of the view that OPG should pursue its strategy to ensure that Aboriginal students are trained so as to be able to benefit from the permanent employment opportunities that would be available during the lifetime of the Project. In this regard, OPG should collaborate with various secondary and post-secondary education institutions, as well as Aboriginal groups, to ensure that such programs would be successful.

As for employment during the site preparation and construction phase, the Panel suggests that every effort should be made to advertise opportunities available to Aboriginal groups.

**Recommendation # 42:**

*The Panel recommends that on an ongoing basis, OPG pursue its strategy to ensure that Aboriginal students can benefit from the permanent job opportunities that will be available during the lifetime of the Project. In this regard, OPG should collaborate with various secondary and post-secondary education institutions as well as Aboriginal groups to ensure that such programs would be successful.*

**6.2 Land Use and Development**

This section presents the Panel's assessment of the effects of the Project on the land use in the local and regional study areas. This section contains discussion on land use around the Project site, including existing land uses, land use policies and plans, ongoing development applications and policy changes.



### 6.2.1 Proponent Assessment

OPG presented a baseline characterization of the land use around the site, consisting of field surveys to identify and confirm existing land uses, a review of federal, provincial, regional and local land use policies and plans, and monitoring of ongoing development applications and policy changes. OPG also provided a detailed overview of the existing Official Plan land use designations, policies and planning objectives and zoning by-law provisions regulating the Darlington Nuclear site and lands within the local and regional study areas.

OPG explained that the site is directly surrounded by rural and industrial land uses, with Highway 401 running east-west directly north of the Darlington Nuclear site. OPG noted that beyond Highway 401 to the north, the land use is rural residential and agricultural. It noted that the St. Marys Cement facility is located east of the site with a residential neighbourhood bordering St. Marys further east. OPG stated that west of the site are agricultural uses, automotive uses, the Courtice water pollution control plant and Darlington Provincial Park. It noted that the urban areas within the local study area include residential, commercial and employment areas and are generally located in the Municipality of Clarington and in the City of Oshawa. OPG further noted that rural areas within the local study area include agricultural areas, rural hamlets and conservation uses.

OPG also provided descriptions of existing land uses elsewhere within the local study area, including anticipated future development such as 15,592 proposed residential units to be built in Clarington and 13,869 proposed residential units to be built in Oshawa, and planned employment areas.

OPG stated that no commercial fishery was identified in Lake Ontario within the Region of Durham.

OPG presented the following four land use scenarios to assess the land use effects of the Project:

1. Existing Land Uses;
2. Growth Scenario (2006–2031);
3. Growth Scenario (2032–2056); and
4. Long-term Growth Scenario (beyond 2056).

Figure 6: Region of Durham, Long-term Growth Scenario, presents the growth scenario of the Region of Durham from 2006 to 2056 and beyond.

Regarding changes in the use and development of land that may be brought about by the Project, OPG concluded that as the intensity of the use increases on the Darlington Nuclear site, the existing sensitive land uses surrounding the site would likely transition to employment and industrial uses. OPG noted that this was a reflection of land use change over time and was not deemed an effect of the Project.

OPG further concluded that the existing, planned future and long-term land use within the 10 kilometre land use assessment zone and beyond were not anticipated to conflict with the Darlington Nuclear site. OPG explained that the site includes an established nuclear facility and the proposed on-site activities are in keeping with the intended land use for the site as a nuclear generating facility. OPG noted that these activities include ancillary and auxiliary uses in relation to the generation of nuclear power. OPG further noted that limited planned and future growth to 2031 is proposed within proximity to the Darlington Nuclear site.

OPG described mitigation measures to reduce the potential temporary and long-term effects that the Project may have on land use, such as increased noise, dust and traffic. OPG stated that mitigation measures would include site screening and buffering, planned transport routes away from sensitive land uses and consideration of Canadian Nuclear Safety Commission Regulatory Document RD-346, *Site Evaluation for New Nuclear Power Plants* (September 2008) and Ontario Ministry of the Environment Guidance Document D-6, *Compatibility Between Industrial Facilities and Sensitive Land Uses* (July 1995). OPG also identified additional mitigation measures, including host community agreements and ongoing monitoring and discussion with the Region of Durham and the Municipality of Clarington on proposed land use changes and effects on implementation of emergency plans.

### 6.2.2 Panel Assessment

The Panel notes that CNSC staff retained the services of IBI Group to conduct the review of the land use information.

CNSC staff concurred with the OPG conclusion that existing and future land uses within proximity to the Darlington Nuclear site are not expected to conflict with the Project, particularly given that the proposed on-site activities are in keeping with the intended land use for the site as a nuclear generating facility.

According to CNSC staff, the evaluation of effects on land use and value was largely qualitative in nature, and as noted by the proponent, relied heavily on professional judgement and anticipated changes reasonably expected to result from the Project. Overall, the conclusions and claims made by the proponent related to land use and value appeared to be based on the most dependable data available and represented a reasonable assessment of the potential severity of negative effects to land use and value, particularly given the anticipated benefits of the Project. CNSC staff indicated that their review of comments received from governments and agencies responsible for regulating land use within the local and regional study areas, including the Municipality of Clarington, the City of Oshawa and the Region of Durham, suggested general satisfaction and agreement with the proponent's assessment of the potential effects of the Project on land use and values and proposed mitigation measures.

The Panel notes that CNSC staff concluded that the information submitted by OPG was sufficient to determine the potential adverse effects the Project could have on land use and values and their significance. The data and analysis provided by OPG illustrated that the Project is not likely to result in significant adverse environmental effects, taking into account the implementation of mitigation measures.

The Panel further assessed specific aspects of the mitigation measures proposed by the proponent. OPG presented the growth scenario for the Region of Durham up to 2056. The Panel notes that this scenario includes residential areas less than one kilometre from the fence of the site, in an area bordering Holt Road, planned between 2031 and 2056. The Panel further notes that a residential development is currently being built (see Table 9: Proposed Sensitive Land Uses within Close Proximity to the Darlington Nuclear Site, ID 18).

In Figure 7: Proposed Sensitive Land Uses within the Contiguous Zone of the Darlington

Nuclear Site, this residential area appears to be included within the contiguous zone or primary evacuation zone of the Darlington Nuclear site.

Other residential developments in this zone have already been approved by the Municipality of Clarington Council, or are under review, as listed in Table 9.

The Panel considered the information presented by Emergency Management Ontario regarding the emergency response zones surrounding the Darlington Nuclear site. Figure 8: Primary Zone and Response Sectors, illustrates Emergency Management Ontario emergency primary zone and response sectors. Emergency Management Ontario explained that the Exclusion Zone is the one-kilometre on-site area inside the site boundary; the Primary Zone extends from the Exclusion Zone up to a 10-kilometre radius around the site. The Primary Zone includes a Contiguous Zone covering the area from the site boundary up to four kilometres immediately surrounding the Darlington nuclear site.

Emergency Management Ontario further stated that the Secondary Zone extends up to 50-80 kilometres around the site.

For the purpose of the environmental assessment, OPG described the Exclusion Zone for the Project as being 500 metres from the venting or release stacks of the new reactor facility, the Contiguous Zone as a three-kilometre radius and the Primary Zone as a 10-kilometre radius. The Municipality of Clarington measures these zones from the geographical centre of the entire Darlington Nuclear site.

The Panel recognizes that OPG has committed to continuing to engage in discussions with the Region of Durham and the Municipality of Clarington regarding future land use structure in the Primary and Contiguous zones. OPG has also indicated that it would continue to monitor land use activity in proximity to the Project and consult with the Municipality of Clarington and the Region of Durham on proposed land use changes and their effects to ensure maintenance of effective emergency response. The Panel notes, however, that residential development in the D3 area of Figure 8 is expected to take place after 2031 (see also Figure 6).

The Panel believes that OPG and the Municipality of Clarington may be on a

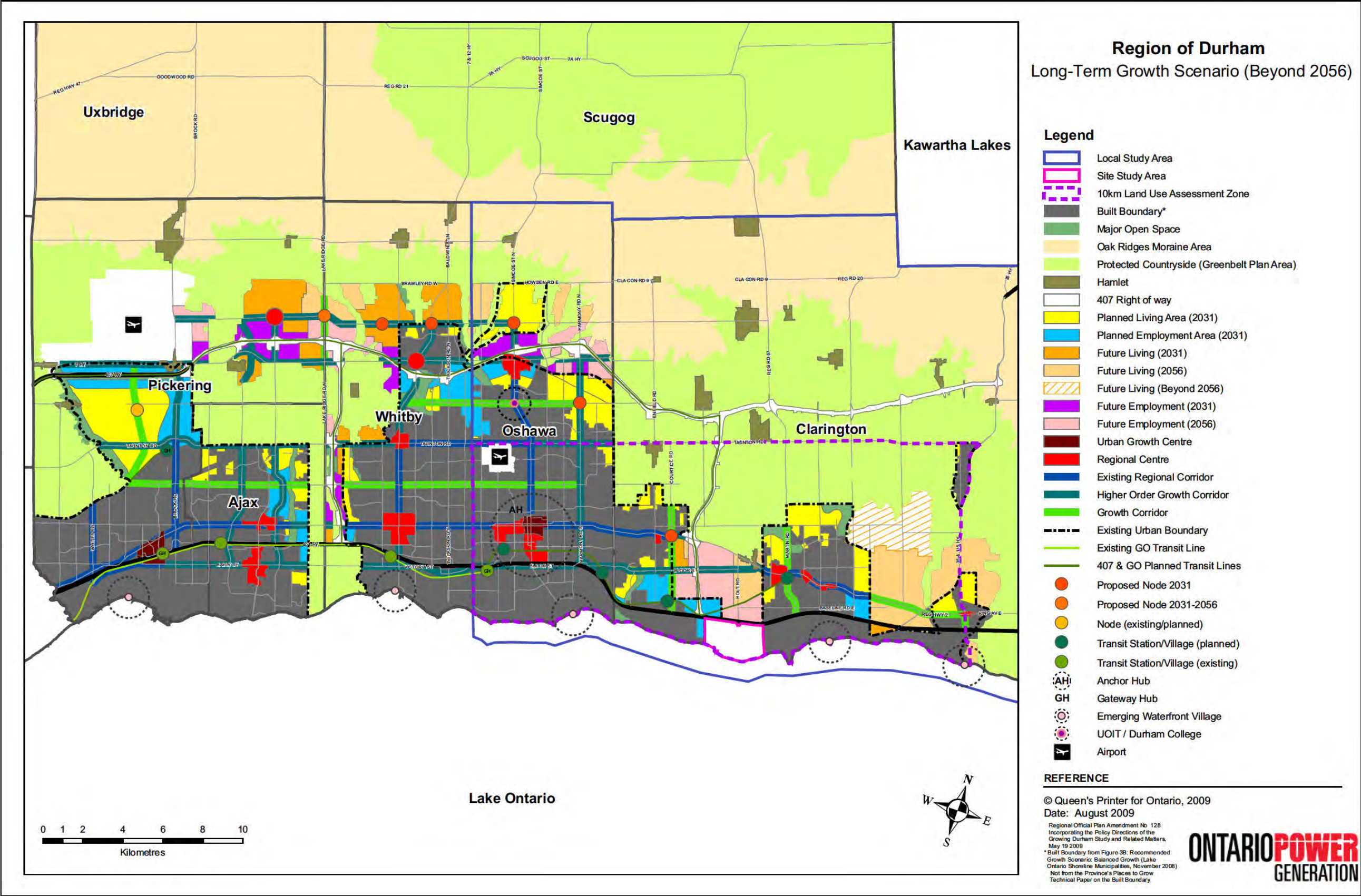


Figure 6: Region of Durham Long-term Growth Scenario





Table 9 - Proposed Sensitive Land Uses within Close Proximity to the Darlington Nuclear Site

Project Location	Application Type	Applicant	Land Use	Area (ha)	Total Units	Singles	Semis	Town-homes	Apts	Description of Application	Approval Date	Status
S. of railway tracks, W. of Green Rd. & N. of Baseline Rd. (PART LOT 17, CON 1)	Combined OPA / ZBLA / Subdivision	WED Investments Ltd. (The Kaitlin Group)	Residential	19.03	389	144	0	44	201	To permit 389 dwelling units, including 144 single detached, 44 townhouses and 201 medium density units, a park block and a public elementary school.	12/12/2005	Under Construction
Clarington Blvd., North of the CPR Rail Corridor	Combined ZBLA / Subdivision	829426 Ontario Ltd. (The Kaitlin Group)	Residential	0	250	0	0	0	0	To permit two blocks with 250 units in total.		With Staff
120, 124, 128, 132, 136 Aspen Springs Dr.	Condominium	Aspen Heights Ltd.	Residential	2.732	162	0	0	0	162	To permit 162 apartment units.	2/12/2007	Council Approved
N. of Baseline Rd. West (LOT 16, CON 1)	Combined ZBLA / Subdivision	970973 Ontario Ltd.	Residential	33.98	106	106	0	0	0	To permit 106 single detached dwelling units.	4/17/1996	Council Approved
Green Rd. & Bagnell Cres.	Part-Lot Control Exemption	Darlington Springs Ltd. (The Kaitlin Group)	Residential	0	98	66	0	32	0	To permit 66 single detached units and 32 townhouse dwelling units, a 1.99ha separate school block, a 1.78 ha neighbourhood park and a neighbourhood commercial block.		With Staff
John Scott Ave. (LOT 13, CON 1)	Combined ZBLA / Subdivision	Municipality of Clarington (Applicant)	Residential	1.34	19	19	0	0	0	To permit 19 single detached dwelling units.		With Staff
73 Remmington St. (N. of Bottrell St, & E. of Green Rd.)	Part-Lot Control Exemption	Aspen Springs West Ltd.	Residential	0.32	8	8	0	0	0	To permit construction of 8 single detached dwelling units.		With Staff
922 Green Rd. (Green Rd., S. of Baseline Rd.)	Combined OPA / ZBLA	896433 Ontario Ltd.	Residential	0	0	0	0	0	0	To convert lands that are currently designated as prestige employment lands to medium and low density residential uses. No residential breakdown has been given.		Application Received



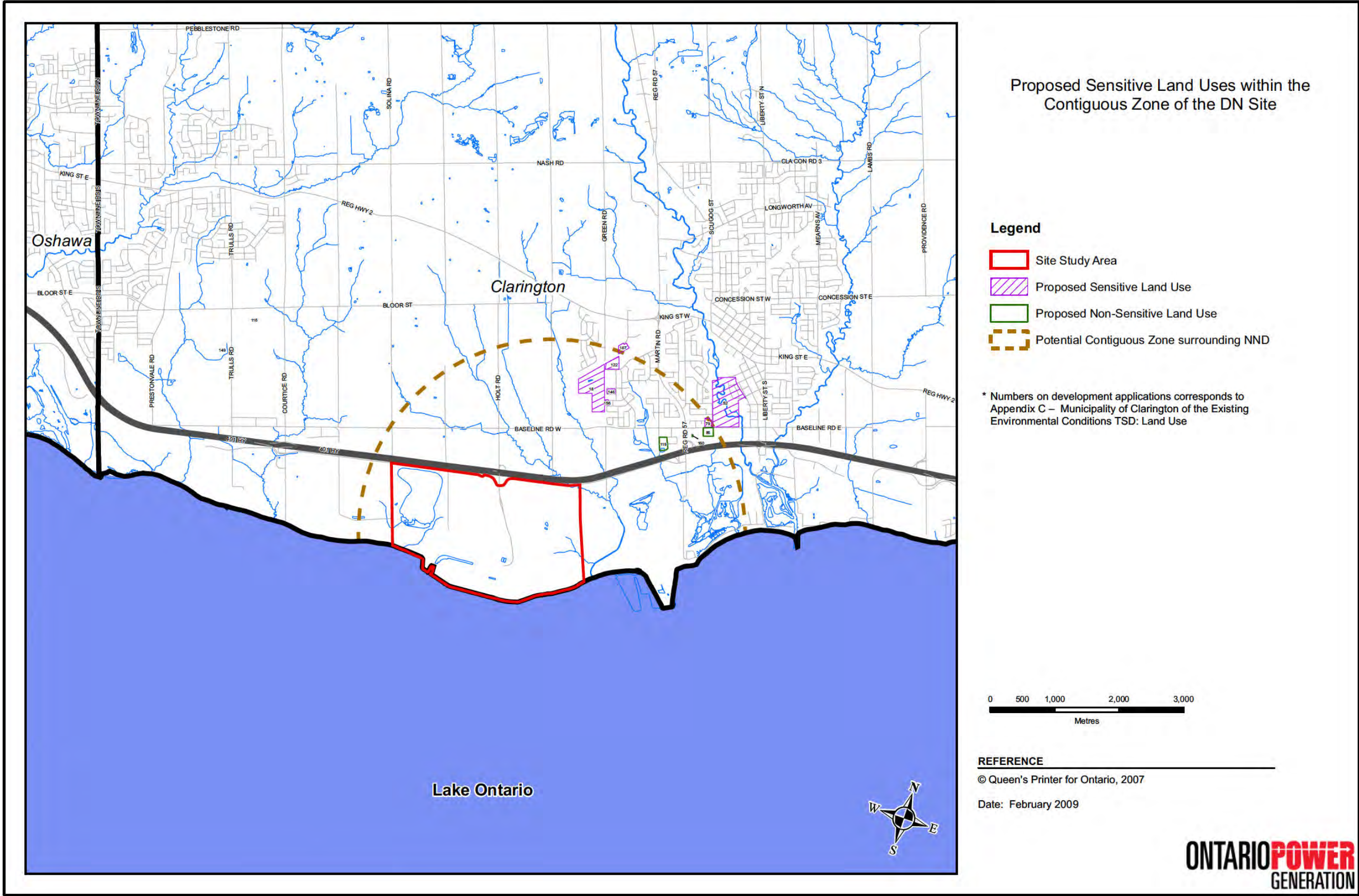


Figure 7: Proposed Sensitive Land Uses within the Contiguous Zone of the Darlington Nuclear Site







Figure 8: Primary Zone and Response Sectors



‘collision course’ regarding the development of land neighbouring the Darlington site. Should the Municipality go ahead with the proposed residential developments between 2031 and 2056, a residential living area would be located less than one kilometre from the site boundary.

The Panel recognizes that OPG would be required to meet the dose acceptance criteria stipulated in Canadian Nuclear Safety Commission Regulatory Document RD-337, *Design of New Nuclear Power Plants* (November 2008). The Panel also recognizes that OPG has demonstrated that the dose consequences for anticipated occupational occurrences and design basis accidents meet the dose acceptance criteria in RD-337 as close as 500 metres from the containment for the reactors in the plant parameter envelope. Therefore, land development after 2031 could be permitted as planned and OPG would have no recourse to stop it.

During the hearing, the Panel heard that two schools, Dr. Ross Tilley Public School and Holy Family Separate School, are located 3.39 kilometres and 3.6 kilometres from the centre of the Darlington site, respectively. OPG confirmed that they were 2.8 kilometres and 3.1 kilometres respectively from the closest bounding location of the new reactors. The Panel notes that one of these schools is currently located within the Contiguous Zone for the Project.

Based on its discussion with Emergency Management Ontario at the hearing, the Panel is of the view that although there are appropriate measures in place to ensure that vulnerable populations, including hospitals, schools and retirement homes, can be safely evacuated in the event of an accident, it would be prudent to avoid such developments, within a three-kilometre zone around the Project site.

The Panel is aware that as a result of incidents such as the 1984 accident in Bhopal, India, buffer zones between industrial developments and residential areas are often imposed. These are put in place not only for accident risk-abatement purposes but also for nuisance-avoidance and aesthetic purposes. The Panel is of the opinion that a situation similar to that in Pickering, where residential areas are found within three kilometres of a nuclear site, must be avoided. The Panel notes that the Municipality of

Clarington was open to being given any development criteria in this respect.

Furthermore, given the apparent challenge encountered during the evacuation following the Fukushima Daiichi nuclear accident, the Panel is of the view that it would be prudent to avoid any further residential development north of Highway 401 in the D1, D2, D3 and D5 emergency response sectors. All of these areas are located less than three kilometres from the site boundary.

The Panel believes that appropriate steps must be taken to evaluate and define buffer zones around nuclear facilities in Canada, taking into consideration the lessons learned from the Fukushima Daiichi nuclear accident. The Panel believes that the Government of Ontario should take appropriate measures to ensure that no residential development takes place in the Contiguous Zone.

**Recommendation # 43:**

*The Panel recommends that the Canadian Nuclear Safety Commission engage appropriate stakeholders, including OPG, Emergency Management Ontario, municipal governments and the Government of Ontario to develop a policy for land use around nuclear generating stations.*

**Recommendation # 44:**

*The Panel recommends that the Government of Ontario take appropriate measures to prevent sensitive and residential development within three kilometres of the site boundary.*

**Recommendation # 45:**

*The Panel recommends that the Municipality of Clarington prevent, for the lifetime of the nuclear facility, the establishment of sensitive public facilities such as school, hospitals and residences for vulnerable clientele within the three kilometre zone around the site boundary.*

## 6.3 Site Selection Considerations

This section includes the Panel’s assessment of site selection for the Project.

### 6.3.1 Proponent Assessment

OPG stated that it carried out an evaluation of the Darlington Nuclear site to confirm its suitability for the Project in compliance with the

Canadian Nuclear Safety Commission Regulatory Document RD-346, *Site Evaluation for New Nuclear Power Plants*. Based on this evaluation, OPG concluded that the Darlington Nuclear site is suitable for the Project.

OPG noted that the Darlington Nuclear site has been home to the existing Darlington Nuclear Generating Station since 1990 and expressed the view that the performance and operational history of that facility has demonstrated the suitability of the site for that purpose. OPG further stated that the Darlington Nuclear site was originally planned for—and the current station designed with the intention of—eventually becoming a multi-station facility. OPG further stated that nothing has transpired in the subsequent years to render the site unsuitable for this purpose.

OPG noted that it did not evaluate any other sites for the proposed Project because the direction it received from the Government of Ontario was to proceed solely with an evaluation of the Darlington Nuclear site.

#### 6.3.2 Panel Assessment

CNSC staff concluded that OPG provided sufficient information to satisfy the expectations set forth in RD-346. The Panel accepts the CNSC staff conclusion in this regard.

The Panel recognizes that some participants supported the location of the Project because an existing nuclear generating station is currently located at the site. The Panel also recognizes the views of participants who disagreed with the Government of Ontario's selection of the site for the Project. Participants were of the view that the site footprint cannot accommodate cooling towers without lake infill; the site is located near large populations and along the shore of Lake Ontario which is a source of drinking water for millions of inhabitants; and large releases from the Project could also have repercussions in Quebec and the United States. They also felt that proper emergency response measures were not in place to evacuate or relocate populations, for instance in the Greater Toronto Area, in the case of a severe accident. It was felt that alternative sites should have been evaluated by OPG.

The Panel acknowledges that all nuclear generating stations in Ontario are located in the Great Lakes St. Lawrence basin. The Panel recognizes that existing regulations require

measures to ensure that severe nuclear accidents do not have significant consequences beyond the site boundary. However, the fact that such accidents have occurred in the last 25 years further emphasizes the need for a prudent approach.

#### **Recommendation # 46:**

*Given that a severe accident may have consequences beyond the three and 10-kilometre zones evaluated by OPG, the Panel recommends that the Government of Ontario, on an ongoing basis, review the emergency planning zones and the emergency preparedness and response measures, as defined in the Provincial Nuclear Emergency Response Plan (PNERP), to protect human health and safety.*

### 6.4 Current Use of Land and Resources by Aboriginal Persons

This section presents the Panel's assessment of the effects of the Project on traditional land use activities.

#### 6.4.1 Proponent Assessment

OPG indicated that there was no current use of land and/or resources at the Project site, nor would the Project affect traditional land use activities.

OPG described the consultation activities it had undertaken. OPG stated that it engaged Aboriginal, First Nations and Métis communities to determine the lands or resources used by Aboriginal peoples for traditional purposes.

OPG also sought to incorporate traditional knowledge both in the development of the EIS and in the conduct of the environmental assessment.

OPG noted that it created a new knowledge fund to facilitate the contribution of new information and/or research findings that were of relevance to the environmental assessment. OPG further noted that the Métis Nation of Ontario received funding to support a Traditional Ecological Knowledge study.

OPG committed to continuing to engage Aboriginal groups throughout the environmental assessment and licensing processes. OPG concluded that there were no current issues of

lands or resources in the site vicinity and that it was unlikely that the Project will result in adverse effects on traditional lands or resource use.

#### 6.4.2 Panel Assessment

CNSC staff stated that OPG provided detailed information and outcomes of engagement of a wide range of Aboriginal groups that could possibly have a legitimate interest in the Project. CNSC staff concluded that the Project is not likely to result in significant adverse effects on current use of land and resources for traditional purposes by Aboriginal persons.

At the hearing, some Aboriginal groups expressed views regarding the effects of the Project on the aquatic environment, boating and cultural heritage and resources. These issues are addressed in the relevant sections of this report.

The Panel notes that the Métis Nation of Ontario commented on land use, urban development as a barrier to traditional species for hunting and harvesting purposes, visual impacts, and potential effects to traditional species and fish habitat. The Panel further notes that the submissions made by the Métis Nation of Ontario and Alderville First Nation did not identify any current traditional land use of the site and surrounding area.

The Panel notes that the Métis Nation of Ontario requested that OPG commit to developing a mutually agreeable work plan that would incorporate the following:

- the inclusion of Métis species of interest in the planting of the Darlington Waterfront Trail to assist OPG meet its no net loss targets;
- the inclusion of Métis traditional knowledge in the Darlington Information Centre and on plaques along the Darlington Waterfront Trail; and
- the inclusion of Métis Nation of Ontario in the development of an Aboriginal Procurement Policy specific to the Darlington New Nuclear Plant Project and that encourages economic development and employment opportunities for Métis people and businesses in the area.

The information presented did not lead the Panel to conclude that Aboriginal persons currently use

land and resources at the Project site for traditional purposes.

## 6.5 Physical and Cultural Heritage

According to the proponent, the Project activities that will potentially interact with valued archaeology, built heritage and cultural landscape ecosystem components are associated with mobilization and preparatory works, excavation and grading, marine shoreline works and stormwater management.

### 6.5.1 Proponent Assessment

OPG presented information regarding the effects of the Project on physical and cultural heritage, including archaeology and built heritage and cultural resources.

OPG described the site study area as mainly agricultural with no evidence of churches, schools or mills during the 19th century, although one blacksmith shop was located in the far west of the site. OPG noted that the site was extensively altered from original southern Ontario agricultural landscape due to the construction and operation of the existing Darlington nuclear generating station. OPG identified two areas of potential heritage interest: the Burk Family Cemetery and plaque, and a historic cairn.

OPG described its evaluation of the archaeology of the site and concluded that there were no anticipated residual adverse environmental effects on archaeology resources.

OPG explained that its archaeological assessment comprised multiple stages. In the Stage 1 archaeological assessment of the site, areas with archaeological potential within the site study area were delineated based on land features and prior land use, and the areas with archaeological potential were recommended for further assessment in a Stage 2 assessment. The Stage 2 archaeological assessment identified 12 pre-contact Aboriginal sites and 12 Euro-Canadian sites (early 19th to 20th century). OPG stated that of those sites, five pre-contact Aboriginal and three Euro-Canadian sites were advanced for a Stage 3 assessment based on having sufficient artifactual, contextual and/or historical mapped evidence to justify additional archaeological investigations.

OPG stated that the results of the Stage 3 assessment resulted in the identification of two Euro-Canadian sites, known as the Brady and Crumb sites, which retained sufficient heritage significance and value to warrant further archaeological consideration because artifacts from the mid-19th century were found. OPG indicated that no Aboriginal archaeological resources were carried forward due to a lack of heritage value. OPG stated that total displacement of the Brady and Crumb sites were carried forward for further consideration of mitigation measures through a Stage 4 archaeological assessment, which is an excavation of the resources.

OPG stated that a Stage 4 mitigative excavation of the Brady site was completed in November 2010 and four cultural features were excavated along with 64,000 historical and Aboriginal pre-contact artifacts. The Brady site was completely excavated and all features and artifacts were documented. OPG noted that Aboriginal communities with an interest in the site were informed of the Aboriginal pre-contact artifacts and attended an on-site briefing and visit.

OPG committed to developing a detailed environmental protection plan that would be followed in the event of new discoveries of physical and cultural heritage resources during site preparation and construction activities, in alignment with the Ontario Ministry of Tourism and Culture *Standards and Guidelines for Consultant Archaeologists* (2011).

OPG also provided information regarding the built heritage and cultural landscape component of the assessment. OPG stated that the assessment of built heritage and cultural landscapes was conducted in accordance with the *Ontario Heritage Act* (R.S.O. 1990, c. O.18) and that no properties in the site study area were designated under *Part IV: Conservation of Property of Cultural Heritage Value or Interest* of the Act.

OPG noted that due to lack of heritage value, no Euro-Canadian cultural landscapes were carried forward. Regarding built heritage, OPG indicated that in the event that surplus soils need to be placed at the existing northwest landfill area, the Burk Cemetery would be displaced. OPG stated that in this event, the Burk Cemetery would be documented and re-located. The cemetery would be closed under the requirements of the Ontario

*Cemeteries Act (Revised)* (R.S.O. 1990, c. C.4), which includes provisions for notification of interested persons and the ability for interested persons to submit comments to the Registrar designated under the Act.

In addition, OPG stated that the historic cairn was erected in 1989 to commemorate the opening of the existing Darlington Nuclear Generating Station. OPG stated that it is located just outside the site fence and contains a plaque and a time capsule to be opened in 2129.

With respect to underwater archaeology, OPG stated that there are no known marine archaeological sites in the lake in the vicinity of the site study area. OPG noted that two videos of the bottom substrate in the area of proposed lake infilling were reviewed for potential underwater archaeological sites and none were observed.

OPG concluded that no residual adverse environmental effects on archaeology resources or built heritage and cultural resources were anticipated as a result of the Project.

#### 6.5.2 Panel Assessment

The Panel considered the CNSC staff review of OPG's assessment. The Panel notes that OPG followed the standards and guidelines for archaeological field work as required by the Government of Ontario.

During the hearing, the Mississaugas of the New Credit First Nation expressed concerns regarding the archaeological work being done on the site. It indicated that it had not been informed of findings on the site, and noted that it had been invited to the site when the dig was completed. OPG explained that the Aboriginal artifacts were found during the Stage 4 assessment of the Brady site, which was thought to be only a Euro-Canadian site. OPG noted that it halted the excavation to make further arrangements once these artifacts were identified. The Panel confirmed with OPG that Aboriginal groups would be involved in the Stage 4 assessment of the Crumb site, which was also identified as a Euro-Canadian site. The Panel notes that this assessment was expected to be performed in the summer and fall of 2011.

The Ontario Ministry of Tourism and Culture indicated that the interest of the Government of Ontario in the Brady archaeological site had been addressed and that it was satisfied that OPG had



committed to implementing mitigation measures through the conduct of Stage 4 excavations of the areas with heritage value. The Panel notes that CNSC staff concurred that a Stage 4 excavation is an appropriate mitigation measure for those resources impacted in this manner.

The Panel expects that the OPG Environmental Protection Plan will be applicable to all archaeological and heritage resources that are found in both the terrestrial and aquatic environments and that OPG would follow the Environmental Protection Plan and the requirements of the *Cemeteries Act* to close the Burk Cemetery. The Panel cautions that in the event that OPG is unable to close the Burk Cemetery, OPG would have to find alternative means of disposing of surplus excavated material.

The Panel is of the view that the Project is not likely to result in significant adverse environmental effects on physical and cultural heritage if all proposed mitigation measures, such as Stage 4 excavation and consultation, are implemented.

## 6.6 Visual Effect of Cooling Towers

This section presents the Panel's review of the visual effect of the Project in the local and regional study areas. The primary visual effect from the Project would be from cooling towers and their associated vapour plume, should they be used.

### 6.6.1 Proponent Assessment

Regarding views and vistas, OPG stated that the existing visual character of the Darlington Nuclear site and the local and regional study areas included the existing Darlington Nuclear Generating Station and accompanying infrastructure. OPG further stated that the proposed Project—potentially with cooling towers and their associated vapour plume—would likely be visible in the landscape.

OPG noted that should the Project require the use of natural or mechanical draft cooling towers, the visual effects of the Project could not be fully mitigated. OPG noted that such a change could also have an effect on the use and enjoyment of surrounding properties, and that the visual intrusion by a utility structure in a sensitive

viewshed could have the potential to reduce property values.

OPG presented its conclusions from its viewshed and photographic modelling. OPG stated that natural draft cooling tower structures would create a continuous visual effect throughout the life of the towers because there would be no variability in their appearance. OPG also stated that natural draft cooling towers would be visible from more locations than the existing St. Marys Cement facility and that they would likely be visible at distances greater than 20 kilometres from the Darlington Nuclear site. OPG further stated that for a worst-case plume, the natural draft scenario would only have a significant effect on the views of three surveyed points in the Bowmanville area.

Regarding mechanical draft cooling tower structures, OPG stated that they would rarely be visible from the receptor locations, but the associated vapour plume would be.

### 6.6.2 Panel Assessment

The Panel is of the view that OPG presented only a worst-case scenario and concluded that the visual effect from natural draft cooling tower structures and the associated vapour plume released from natural and mechanical draft cooling towers could not be mitigated. The Panel agrees that natural draft cooling tower structures would have a significant visual effect on the landscape, and for this reason, they should not be considered for use at the site.

The assessment by Pacific Northwest National Laboratories underlined that plume abatement could be used as a mitigation measure with cooling towers. During the hearing, the Panel asked OPG to perform a visual assessment using plume abatement on mechanical or hybrid cooling towers. OPG's study on the visual effects of mechanical draft cooling towers found that with plume abatement, a plume would still exist, although it would be reduced in frequency by 70 % and in dimension by 66%. The visual effect that had been determined to be high in the EIS assessment would then be qualified as moderate for the three surveyed points in the Bowmanville area.

The Panel notes that the Municipality of Clarington expressed concerns about the perceived stigma of cooling towers and the resulting socio-economic effect they could have

on the local and regional study areas. The Municipality stated that it is most concerned with the visual effect that the plume would have on visitors passing through the region on Highway 401 because it may deter people and businesses from moving to the area.

The Panel notes that the Municipality of Clarington is of the view that the total compensation amount to be paid for effects from the Project, pursuant to the Clarington Host Municipality Agreement, would not be sufficient in the event that the Project includes cooling towers. OPG acknowledges this position and accepts that the Municipality may not support the use of cooling towers.

The Panel agrees with the OPG opinion that the existing visual effect of the Project site is already industrial due to the presence of the St. Marys Cement facility. The Panel partially agrees with the concerns of the Municipality but believes that people and businesses in the area should be aware of the presence of the nuclear facility regardless of its visual effect.

The Panel notes that OPG has expressed the view that it would be unacceptable to use plume abatement. OPG has also stated that if cooling towers are to be used for the Project, lake infill would be required up to the four metre depth contour, which is the maximum lake infill bounding scenario for the Project. As was discussed earlier in the report, the Panel is of the view that OPG should not be permitted to build the lake infill beyond the two metre depth contour, and as such, OPG should amend its site planning accordingly if cooling towers are used.

The Panel notes that OPG acknowledged that the visual effect from cooling towers may have an adverse effect on the use and enjoyment of other surrounding properties and could potentially reduce property values. CNSC staff noted concerns regarding the proponent's comparison of effects from cooling towers with those of once-through cooling. CNSC staff noted that trade-offs between aquatic species mortality from once-through cooling were compared to perceived socio-economic effects, capital costs and losses in plant efficiency for cooling towers. The CNSC staff position was that OPG should perform a formal quantitative cost-benefit analysis for the full range of condenser cooling alternatives, applying the principle of best available technology economically achievable

The Panel agrees with this position and is of the view that this analysis should incorporate a two metre depth contour for lake infill and plume abatement, as recommended earlier in this report.

## 6.7 Transportation

This section presents the Panel's review of the interactions of the Project with transportation in the regional, local and site study areas. The aspects of transportation include traffic, rail and boating. The assessment also considers the transportation of dangerous goods.

### 6.7.1 Traffic

The Panel reviewed the information presented regarding the effects of the Project on traffic, particularly on local roads and Highway 401.

#### Proponent Assessment

Based on intersection traffic analysis at the site study area and link analysis at the local and regional study areas, OPG concluded that the overall traffic operations of the area surrounding the Darlington Nuclear site are satisfactory. OPG noted that specific deficiencies exist at two locations: the Holt Road and South Service Road intersection and the Highway 401 and Waverly Road highway ramps.

Based on collision data analysis and site audits, OPG stated that road safety concerns at the site and local study areas were generally minor and only warranted further evaluation as part of the effects assessment.

OPG analyzed future baseline conditions and the Project effects for each of the following four scenarios: Site Preparation in 2012, Construction Commencement in 2016, Peak Construction and Operations in 2021, and Full Operation in 2031. OPG assumed that a series of improvements would be made to the regional, local and site road networks, including the widening of regional roads, upgrades at the Highway 401 and Holt Road interchange, the Highway 407 East extension, and the East Durham Link. Based on these assumptions, OPG concluded that the traffic effects due to the Project construction would be mitigated with no expected residual effects.

OPG stated that no major effects to road safety would be expected, and that many of the existing issues would be mitigated through road network improvements.



Due to the uncertainty regarding the amount of excavated material to be disposed of off site, OPG acknowledged that the volume and routing of heavy trucks associated with off-site disposal of excavated material was an uncertainty in the Project that could have safety and operational effects.

OPG proposed that an ongoing process with the Ontario Ministry of Transportation, Durham Region and local municipalities to establish a coordinated program for road transportation and road network improvements within the local study area would be a mitigation measure to ensure the Project assumptions would be carried out.

OPG also proposed a traffic management plan to mitigate the potential traffic issues associated with the proposed Project. OPG stated that effects on traffic operations and safety beyond the site study area would be addressed in this plan.

#### Panel Assessment

Based on the assessment by CNSC staff, the Panel notes that the OPG baseline assessment was generally credible. One issue noted by CNSC staff was that the detailed traffic analysis was roughly confined to the site study area, which limited the area of assessment for environmental effects. The effects of site-generated traffic were expected to be greatest at this level and a detailed assessment would be necessary to develop appropriate measures for mitigation. CNSC staff noted that OPG committed to conducting a more detailed traffic analysis on an expanded study area by shifting the northern boundary of its analysis to Regional Highway 2.

The Panel notes that the Project is expected to have an adverse effect on local traffic operations for a considerable length of time, although OPG concluded that there would be no adverse residual effects as a result of the Project, assuming that the extensive list of road network improvements would be implemented at the required times. The Panel is of the view that since the assumed road network improvements are beyond the control of the proponent and subject to outside funding and approvals, the OPG assessment did not reflect a potential worst-case scenario. The Panel notes that if the assumed freeway improvements are not realized or are delayed, the magnitude and geographic

extent of the effects of the Project on the regional road network could be much worse than what OPG has predicted, and additional mitigation would be required.

In the Panel's view, as suggested by CNSC staff, OPG's proposed mitigation measures of a coordinated program and the Traffic Management Plan may not be sufficient to account for the worst-case scenario.

The Panel notes that until a decision is made regarding the disposal of excavated materials, the off-site disposal and associated effects on traffic operations and safety remain uncertain. Although OPG expects the effects on traffic operations to be limited, a more detailed review would be required once OPG has made this decision.

The Panel is concerned that queuing at the Highway 401 Eastbound off-ramp at Waverley Road, which was noted by CNSC staff in its review, could spill back onto Highway 401. OPG has expressed that these theoretical queue reaches would not be realized; however, further considerations and associated mitigation strategies may be required.

In addition, the Panel notes that less critical concerns were identified by CNSC staff that may require additional mitigation measures. These concerns included a possible need for improvements at the Canadian Pacific Belleville at-grade crossings at Holt Road, the need to quantify the expected increase in collisions that could result from the increase in traffic volumes, the need for additional mitigation measures at the intersection of the highway ramp at South Service Road and the potential for establishing transit route connections to service the Project site. The Panel notes that several additional mitigation measures were proposed by CNSC staff to reduce the effects of the Project.

The Panel is of the view that these deficiencies and OPG's assumption of road network improvements by municipal governments and the Province of Ontario warrant further consideration in OPG's proposed Traffic Management Plan.

Despite these shortcomings, the Panel notes that the CNSC staff review concluded that the Project is not likely to result in significant adverse environmental effects, taking into account the implementation of mitigation measures. The

Panel concurs with this view but recommends that additional analysis be completed to ensure that appropriate mitigation measures are in place in the event that OPG's assumptions do not remain valid.

The Panel notes that OPG provided a summary of recommended road improvements. The Panel is of the view that these improvements must go ahead as proposed or there may be a risk to traffic operations, including an increased collision rate in the local study area. The Panel believes that these improvements are necessary to safely evacuate the local population in the event of a beyond design basis accident at the site, and notes that OPG's evacuation time estimates were based on the assumption that these road improvements would be completed.

The Panel concludes that the Project is not likely to result in significant adverse environmental effects with respect to traffic, provided that OPG's proposed mitigation measures, such as the Traffic Management Plan, along with the following recommendations, are implemented.

**Recommendation # 47:**

*The Panel recommends that prior to site preparation, the Canadian Nuclear Safety Commission ensure the OPG Traffic Management Plan addresses the following:*

- *contingency plans to address the possibility that the assumed road improvements do not occur;*
- *consideration of the effect of truck traffic associated with excavated material disposal on traffic operations and safety;*
- *further analysis of queuing potential onto Highway 401; and*
- *consideration of a wider range of mitigation measures, such as transportation-demand management, transit service provisions and geometric improvements at the Highway 401/Waverley Road interchange.*

**Recommendation # 48:**

*In consideration of public safety, the Panel recommends that prior to site preparation, the Canadian Nuclear Safety Commission coordinate a committee of federal, provincial and municipal transport authorities to review the need for road development and modifications.*

## 6.7.2 Rail Safety and Capacity

The Panel's assessment of rail safety and capacity included a review of the rail activity in the local and site study areas. The Panel also assessed the effect of the rail crossings through the Project site.

### Proponent Assessment

OPG provided a description of rail activity and historical incidents in the area. In its analysis of rail safety and capacity, OPG covered the issues of grade crossings and stated that the Project is expected to have very few effects on rail capacity. OPG noted that the at-grade crossing of Holt Road at the Canadian Pacific Rail corridor may be a safety issue if Holt Road were used as a transport route for large volumes of excavated material, although the effect on capacity would be expected to be marginal. OPG stated that if Holt Road were chosen as a haul route, appropriate mitigation measures, such as gate control and grade separation, would be investigated and implemented as part of the Traffic Management Plan.

OPG also covered the issue of the proximity of the rail line that runs east-west through the Darlington Nuclear site. OPG addressed the issue of whether a derailment, either accidental or through a malevolent act, could pose a risk to the reactor blocks or storage facilities for radioactive material. In order to protect the Project facilities from a possible derailment, OPG proposed using a berm or retaining walls. OPG noted that there would be an additional element of security because portions of the rail line are recessed between 5 and 10 metres.

### Panel Assessment

Regarding the grade crossing, the Panel notes the CNSC staff conclusion that some improvement may be warranted at the at-grade crossings at Holt Road as train and vehicle volumes are expected to rise over the life of the Project. The Panel also notes that Transport Canada did not express any immediate concerns for the rail crossing at Holt Road because standard procedures are in place to ensure the safe design of crossings. The Panel agrees that the suggestion proposed by CNSC staff is a prudent approach, especially if there is a need to modify or reconstruct the grade crossing or to modify the road, even if OPG made a commitment to adhere to specific standards.

The Panel notes the views of Transport Canada regarding the proximity of the rail line to the Project site. Transport Canada explained that there are no regulatory requirements with respect to the construction or alteration of buildings and other structures, not being railway works, on properties adjoining the land on which a rail line is situated and that any proposal must be designed to prevent those buildings or structures from constituting a threat to safe railway operations.

The Panel also agrees with the Transport Canada comment that the construction of a permanent structure or berm to minimize the risks associated with a derailment or other adverse incident would be a prudent measure, as well as the Transport Canada recommendation that OPG should conduct an assessment in this regard, jointly with the railway company.

The Panel is of the view that the Project is not likely to result in significant residual adverse environmental effects on rail safety and capacity, taking into account the implementation of OPG's proposed mitigation measures. However, the Panel makes the following recommendations.

**Recommendation # 49:**

*The Panel recommends that prior to construction, Transport Canada ensure that OPG undertake additional quantitative analysis, including collision frequencies and rail crossing exposure indices, and monitor the potential effects and need for mitigation associated with the Project.*

**Recommendation # 50:**

*The Panel recommends that prior to construction, Transport Canada require OPG to conduct a risk assessment, jointly with Canadian National Railway, that includes:*

- *an assessment of the risks associated with a derailment or other rail incident that could affect the Project;*
- *an analysis of the risks associated with a security threat, such as a bomb being placed on a train running on the tracks that bisect the Project;*
- *a comparative evaluation of the effectiveness of various mitigation measures or combination of measures (e.g., blast wall, retaining wall, recessed tracks, berm and railway speed restrictions within the vicinity of the site);*

- *a determination of the design criteria necessary to ensure the effectiveness of these measures (e.g., the appropriate height, strength, material and design of a blast wall); and*
- *a critical analysis to confirm that these measures, when properly designed and implemented, would be sufficient to provide protection to the Project site in the event of a derailment at full speed or other adverse event.*

### 6.7.3 Navigable Waters

The Panel assessed the effect of the Project on navigable waters as it pertains to any navigation use or issue along Lake Ontario or any other body of water that may be affected by the Project.

#### 6.7.3.1 Proponent Assessment

OPG stated that the Project would require authorization by Transport Canada under paragraph 5(1)(a) of the *Navigable Waters Protection Act*, which prescribes that any works built or placed in, on, over, under, through or across any navigable water must be approved by the Minister.

#### 6.7.3.2 Panel Assessment

The Panel notes that Transport Canada has no concerns with the conclusions of the environmental assessment as they pertain to the protection of navigable waters. Transport Canada stated that based on the types of works proposed, the potential interference with navigation could be managed through the normal course of the *Navigable Waters Protection Act* approval process and through the application of standard mitigation measures. Transport Canada expressed that if these conditions were met, the Project would be unlikely to have a significant adverse effect on navigation. The Panel concurs with this assessment.

At the hearing, the Panel questioned the security aspect of placing the intake and diffuser structures for the condenser cooling technology in deeper water. Transport Canada stated that it would evaluate OPG's proposal and require OPG to bury the structures and/or indicate their position on navigational charts.

Based on the assessment from Transport Canada, the Panel is of the view that the Project is not likely to result in significant adverse

environmental effects on navigation, taking into account the implementation of mitigation measures required under the *Navigable Waters Protection Act*.

#### 6.7.4 Marine Safety

The Panel's review of marine safety included consideration of the mandate of Transport Canada regarding this aspect of the Project to help ensure the functioning of a safe and efficient transportation system. Transport Canada's mandate includes the *Canada Marine Act* (S.C. 1998, c. 10), *Canada Shipping Act 2001* (2001, c. 26), and *Marine Transportation Security Act* (S.C. 1994, c. 40).

##### Proponent Assessment

OPG indicated that materials required for the construction of the Project would be shipped to suitable nearby ports, such as the Oshawa harbour, and then barged to the Project site if an appropriate wharf can be constructed, or alternatively, to the St. Marys Cement wharf. OPG noted that these barges would operate close to the Oshawa shore.

OPG stated that the shipment activities would be considered routine activities that would be well managed through existing regulatory requirements, inspection and certification procedures. OPG stated that the risk of accidents, pollution and other adverse effects would be low.

##### Panel Assessment

The Panel is of the view that although the proposed shipping routes do not enter the marine prohibited zone, it is possible that barging operations may require access to this area. As such, the Panel recognizes that according to Transport Canada, permits may be necessary pursuant to the *Vessel Operation Restriction Regulations* (SOR/2008-120) taken pursuant to the *Canada Shipping Act*, if vessels cross the prohibited zone. The Panel notes that the potential for this requirement is considered to be relatively low given that vessels would be operating on behalf of OPG.

The Panel notes the Transport Canada conclusion that the operation of properly certified and inspected vessels and barges associated with the Project would pose no more risk than the shipping activities that already occur on the lake. Therefore, Transport Canada concludes that there would be no significant risks associated with

these activities. The Panel concurs with this assessment.

The Panel notes the Métis Nation of Ontario concern regarding the interaction between barges accessing the site study area and recreational boats that may be used for fishing. The Panel notes that Transport Canada was of the view that the risks associated with the Project would be no different or greater than those present with any other barges or recreational fishing vessels operating on the Great Lakes, and that the *Collision Regulations* (C.R.C., c. 1416) taken pursuant to the *Canada Shipping Act* detail the rules for users on all vessels in Canadian waters. Transport Canada stated that these Regulations, when observed, provide for the safe interaction between vessels, including the barges and recreational fishing boats that would be operating in the vicinity of the Project.

Based on the assessment from Transport Canada, the Panel is of the view that the Project is not likely to result in significant adverse environmental effects on marine safety, taking into account the implementation of mitigation measures required under existing regulatory requirements, inspection and certification procedures.

#### 6.7.5 Recreational Boating Safety

The Panel's review of recreational boating safety included consideration of the *Vessel Operation Restriction Regulations* under the *Canada Shipping Act*, which regulate the operation of vessels on specific bodies of water in Canada.

##### Proponent Assessment

OPG stated that a prohibitive zone is currently in place for a portion of the waters offshore from the existing Darlington Nuclear Generating Station and that the zone would have to be amended to facilitate the placement of the new intake and diffuser structures for the Project. OPG stated that although the Project would result in a larger prohibitive zone, it would not be a measurable effect given its size in relation to the available open waters on the remainder of Lake Ontario.

##### Panel Assessment

Transport Canada explained that the *Vessel Operation Restriction Regulations* set out operational restrictions such as speed limits and maximum horsepower or when and where certain activities, such as water-skiing, are permitted.

Transport Canada noted that any local authority that wishes to implement a restriction must file an application with Transport Canada that meets requirements.

The Panel notes the Transport Canada suggestion that OPG's request for an amendment to the prohibitive zone should be made soon after the selection of a reactor technology, when it will be possible to specify the location and extent of infilling, shoreline alteration and in-water infrastructures.

The Panel considered the concern from the Métis Nation of Ontario regarding the establishment of a new prohibitive zone for boating. The Panel heard from OPG that the indirect impact on recreational boating and fishing would be negligible and Transport Canada noted that the basis for a request for a new prohibitive zone must be weighed against the effect on the boating public. The Panel notes that Transport Canada stated that it would require the Métis Nation of Ontario be engaged as part of the consultation process for OPG's application for the new prohibitive zone.

The Panel is of the view that a larger prohibitive zone could have safety implications for small watercraft, as they would be forced to navigate further offshore at the location of the Project.

The Panel concludes that the Project is not likely to result in significant adverse effects to boating safety, assuming the implementation of mitigation measures required under existing regulatory requirements, along with the following recommendation.

**Recommendation # 51:**

*In the event that a once-through condenser cooling system is chosen for the Project, the Panel recommends that prior to construction, Transport Canada work with OPG to develop a follow-up program to verify the accuracy of the prediction of no significant adverse effects to boating safety from the establishment of an increased prohibitive zone. OPG must also develop an adaptive management program, if required, to mitigate potential effects to small watercraft.*

**6.7.6 Transportation of Dangerous Goods**

The Panel's review of the transportation of dangerous goods included consideration of the

*Transportation of Dangerous Goods Act*, which focuses on the prevention of hazardous incidents when dangerous goods are imported, handled, offered for transport and transported. The transportation of radioactive material is regulated under Class 7 of the *Transportation of Dangerous Goods Act*. It must also comply with applicable Highway Traffic Act(s) of the provinces through which the material travels. The transportation of radioactive materials is also regulated under the *Packaging and Transport of Nuclear Substances Regulations* pursuant to the *Nuclear Safety and Control Act*.

**Proponent Assessment**

Regarding the transportation of dangerous goods, OPG outlined its proposed plans for the transportation of radioactive materials, explaining that the option for off-site storage of radioactive waste would involve transporting waste by truck to an appropriately licensed facility.

OPG explained that, under the bounding scenario for the environmental assessment, all radioactive waste would be shipped off site for processing and storage. For low-level waste this would result in approximately 1,935 truck shipments over a 60 year period of operations, or approximately two to three truck shipments per month. OPG further stated that the transport of intermediate-level waste would also result in approximately two to three truck shipments per month during the operating period. OPG indicated that other shipments of radioactive materials, contaminated equipment and contaminated clothing would also periodically occur, including shipments of tritiated heavy water.

OPG noted that under its present operations, it transports and/or consigns more than 900 shipments of radioactive materials in an average year, or more than 75 per month, so the additional off-site transportation of radioactive material associated with the Project would result in an approximate 2.6 to 4.0 percent increase in the total number of shipments.

OPG provided details regarding the role of its Nuclear Waste Management Division in the transportation of dangerous goods. OPG explained that the transportation of radioactive material is done through a radioactive material transportation program. OPG noted that key components of radioactive material

transportation include packaging designed, fabricated and tested in accordance with applicable regulations and standards; audits and reviews; training; inspections and maintenance; aging management; and a transportation emergency response plan. OPG stated that it plans to expand its existing program as required to meet the needs of Project operations.

OPG stated that in addition to these measures, it maintains an Emergency Response Action Plan that details the response protocol in the event of an incident involving the transportation of radioactive material. OPG explained that this plan includes requirements for personnel training, procedures and equipment, a Mutual Initial Response Assistance Agreement with other nuclear facilities and a service agreement with an external spills contractor.

#### Panel Assessment

The Panel considered the information and analysis presented by Transport Canada. The Panel notes that the conditions of the Emergency Response Action Plan would need to be examined in closer detail as the Project advances and that any changes to the existing transportation plan must be evaluated with respect to OPG's response capability and protocols in the event of a transportation emergency. The Panel further notes that OPG must submit an amended Emergency Response Action Plan and receive approval from Transport Canada if there are changes to the conditions listed in the plan.

Transport Canada also stated that any increase in the transportation of dangerous goods should be disclosed to OPG's partners in the Mutual Initial Response Assistance Agreement.

The Panel notes Transport Canada's conclusion that the information, analysis and conclusion presented by the proponent were adequate for environmental assessment purposes. The Panel further notes that the transportation of dangerous goods must continue to be considered in any further assessments conducted by or on behalf of OPG as the Project advances to a more detailed level of design.

The Panel notes that CNSC staff provided information regarding the regulatory controls detailed in the *Packaging and Transport of Nuclear Substances Regulations* under the *Nuclear Safety and Control Act*. CNSC staff

explained that the packaging and transport of nuclear substances is regulated to ensure the protection of both the material being transported and the health and safety of persons and the environment.

CNSC staff also provided information regarding the radiation dose associated with the transport of dangerous goods. CNSC staff stated that, in general, the maximum dose rate on the surface of a package is limited to two millisieverts per hour on contact and 0.1 millisieverts per hour at a distance of one metre. CNSC staff noted that these measurements take into account all types of radiation emitted from the package, including neutron radiation. CNSC staff further explained that the dose rate is used to determine the number of packages that can be on board a single transport and to segregate packages from persons or other goods.

Based on the information provided by Transport Canada and CNSC staff, the Panel is of the view that the transportation of dangerous goods is sufficiently regulated under the *Transportation of Dangerous Goods Act* and the *Packaging and Transport of Nuclear Substances Regulations* under the *Nuclear Safety and Control Act* to protect the health and safety of persons and the environment. The Panel therefore concludes that the transportation of dangerous goods is not likely to result in significant adverse environmental effects.

## 6.8 Waste Management

This section presents the Panel's assessment of the effects of the proponent's alternative options for the management of low and intermediate-level radioactive waste, used nuclear fuel waste, conventional waste and other hazardous waste.

### 6.8.1 Radioactive and Used Fuel Waste

The Panel's assessment of low and intermediate-level radioactive waste and used fuel waste included a review of the proponent's proposed on-site and off-site waste management practices.

#### Proponent Assessment

OPG stated that low and intermediate-level waste would either be managed on site, which would involve storage in modular buildings, or be immediately shipped to an off-site facility. OPG noted that intermediate-level waste would be stored in self-shielded packaging and low-level

waste would also be packaged, with some materials being compacted prior to packaging.

OPG stated that in the event that the waste were to be stored on site, the eventual plan would be to ship the packaged low and intermediate-level waste to a licensed facility off site.

In its assessment of the environmental effects of these management strategies, OPG concluded that the overall radiation dose to humans and non-human biota would not result in a significant adverse effect on health.

Regarding the on-site storage of used nuclear fuel, OPG indicated that one of its planning assumptions was that only 50 percent of the used nuclear fuel would require interim on-site storage. An underlying OPG assumption was that all of the used fuel would be removed from the site and relocated by 2064 to a used fuel repository managed by the Nuclear Waste Management Organization.

The proponent acknowledged that additional on-site dry storage facilities may be needed for used fuel and that there could be circumstances where requirements may arise for updating safety analyses as part of the licensing process for new used fuel dry storage facilities. OPG stated that regardless of the reactor technology selected, the initial stages of used fuel management would be similar but that differences would arise in the design and physical characteristics of the dry storage containers.

OPG stated that the plant parameter envelope included information on the differences in the design of fuel required by the various reactor technologies. OPG noted that these design differences would require different provisions for dry storage, particularly with the use of enriched uranium fuel. OPG further noted that ensuring criticality safety and adequate cooling for dry nuclear fuel storage would be achieved as a design requirement for all reactor types.

At the hearing, OPG confirmed that radiation doses from the used fuel management operation would not result in significant adverse effects to the workers and the public. The proponent also confirmed that, if necessary, used fuel could be loaded into a new dry storage container in the event of damage or aging degradation of an existing container. OPG indicated that this could be achieved without any significant adverse

effects in the reactor fuel handling bays. The proponent indicated that the dry storage canisters would be robust and would withstand high energy impact loads without release of stored used nuclear fuel components.

#### Panel Assessment

Based on the assessment completed by CNSC staff, the Panel accepts the conclusion that the measures described for the on-site management of low and intermediate-level radioactive waste, used nuclear fuel waste, conventional waste and other hazardous waste will ensure that there will be no significant adverse environmental effects on site from this activity, taking into account the mitigation measures and controls established for the management of waste.

The statement made by the proponent concerning the relocation of used nuclear fuel to an off-site facility is dependent on the outcome of an initiative that has been undertaken by the Nuclear Waste Management Organization. The Panel notes that the availability of the proposed used nuclear fuel repository could be delayed because of a number of factors. There could be difficulties in obtaining a willing host community, an acceptable site from a geotechnical perspective, regulatory approval of the proposed repository, public acceptance of the facility, or public acceptance of provisions for transport of the used fuel to the repository. Given these possibilities, the Panel believes that provisions should be made for on-site storage of the used nuclear fuel for a longer period than is anticipated by the proponent.

The proponent also stated that low and intermediate-level waste would eventually be shipped to off-site facilities for long-term management. The proponent indicated that this waste would likely be transported to the OPG Western Waste Management Facility and eventually be processed for long-term management in the proposed Deep Geologic Repository. At the hearing, the Saugeen Ojibway Nation noted that as no approvals were in place for accommodation of this waste at the Western Waste Management Facility and as the Deep Geologic Repository has yet to receive regulatory approval, the proponent should not be permitted to presume the availability of these two long-term management options. It was recommended that the proponent should be required to demonstrate a capacity to store all this waste on site over the life of the Project. The

Panel agrees with this position regarding the availability of long-term waste management facilities for low and intermediate-level radioactive waste from the new reactors.

OPG confirmed that there would be sufficient space on the Project site to permanently store all of the radioactive waste from the Project. The Panel is of the view that this should be a requirement of the Project.

The Panel concludes that radioactive and used fuel waste is not likely to result in significant adverse environmental effects, taking into account the implementation of controls and measures required under the regulations for radioactive waste management, along with the following recommendations.

**Recommendation # 52:**

*The Panel recommends that prior to construction, the Canadian Nuclear Safety Commission require OPG to make provisions for on-site storage of all used fuel for the duration of the Project, in the event that a suitable off-site solution for the long-term management for used fuel waste is not found.*

**Recommendation # 53:**

*The Panel recommends that prior to construction, the Canadian Nuclear Safety Commission require OPG to make provisions for on-site storage of all of low and intermediate-level radioactive waste for the duration of the Project, in the event that a suitable off-site solution for the long-term management for this waste is not approved.*

**6.8.2 Conventional and Hazardous Waste**

The Panel assessed the effects of the proponent's proposed measures to manage conventional and hazardous waste from the Project.

**Proponent Assessment**

The proponent outlined measures that would be taken to manage conventional wastes. OPG stated that the generation of these wastes would be minimized to the extent practicable and there would be managed programs for reuse and recycling. OPG noted that it would also implement waste audits and management plans.

OPG stated that construction waste would be separated and directed for appropriate reuse rather than landfill. OPG noted that all residual waste would be collected by licensed contractors and transferred to licensed off-site disposal facilities. OPG stated that no conventional waste disposal facilities would be established on the Project site.

OPG stated that any hazardous waste generated on site would be handled—including disposal—at authorized facilities, in accordance with applicable regulations.

**Panel Assessment**

The Panel accepts the approach proposed by OPG regarding the on-site handling of conventional and hazardous wastes as being adequate. The Panel notes that waste management and audit plans would be established and that measures would be taken to minimize waste and to reuse and recycle surplus and waste material. The Panel further notes that OPG has stated that residual waste would be transferred off site for management and disposal at authorized facilities.

The Panel is of the view that the information presented by OPG provides sufficient assurance that conventional wastes generated by the Project would be handled appropriately in accordance with regulatory standards. The Panel therefore concludes that conventional waste from the Project is not likely to result in any significant adverse environmental effects.



## Chapter 7 – Human Health

This chapter evaluates effects of the Project associated with human health under normal operating conditions and in accident scenarios. The purpose of this chapter is to establish if the Project will result in any significant adverse effects on human health after the application of mitigation measures.

### 7.1 Normal Conditions

This section presents the Panel's review of possible effects of the Project on human health. These effects have been reviewed in the context of radiological exposures of workers on site and the public at large. This is supported by a separate review of health effects that could arise due to non-radiological stressors over different phases of the Project. Many of these other effects relate to conditions that could occur in conventional industrial environments.

#### 7.1.1 Radiological Health Issues

The Panel's review of the effects of radiological exposures from the Project under normal operating conditions on human health included an assessment of the effects on workers and members of the public, regulatory oversight and mitigation measures.

##### Proponent Assessment

OPG presented information regarding the radiological exposure of workers and members of the public from the existing Darlington Nuclear Generating Station as baseline information for its assessment of radiation exposures from the Project. In presenting this information, OPG reported that for nuclear energy workers at the existing Darlington Nuclear site, radiation doses have remained below the regulatory effective dose limits of 50 millisieverts per year and 100 millisieverts over five years. OPG further reported that for members of the public, doses have consistently been less than one percent of the regulatory public dose limit of one millisievert per year.

For the Project, OPG predicted that doses to nuclear energy workers would remain below regulatory limits during normal operation, routine maintenance, and refurbishment activities. OPG stated that measures would be taken to control the doses to workers with the

aim of keeping doses as low as reasonably achievable. The proponent indicated that in the cases of non-nuclear energy workers on the site, controls would be in place to ensure that doses remain below the regulatory public dose limit of one millisievert per year.

##### Panel Assessment

The Panel notes that the OPG assessment of likely effects was based on current experience in reactor operations, fuelling outages and refurbishment. CNSC staff questioned whether the existing Darlington Nuclear Generating Station would be an appropriate benchmark for the proposed Project and whether the work environment and work practices would be appropriate analogues for the Project.

The Panel notes that dose estimates from these activities were considered for the Project with allowances being made for differences that could arise with a modern reactor technology. The OPG assessment indicated that the predicted annual effective doses (including committed effective doses associated with annual intakes of radionuclides) to workers during normal operation of the reactors are unlikely to exceed the applicable dose limits given in the *Radiation Protection Regulations* (SOR/2000-203) pursuant to the *Nuclear Safety and Control Act*.

CNSC staff stated that the OPG assessment of likely effects for exposures of members of the public does include consideration of appropriate human receptors. Pathways to human receptors and critical groups were identified and critical groups were selected based on the most exposed members of the public.

CNSC staff reported that OPG indicated that the predicted annual effective doses to persons off site during normal operation over all phases of the Project, including committed effective doses associated with annual intakes of radionuclides, would not be likely to exceed the applicable dose limits of the *Radiation Protection Regulations*.

Many participants raised concerns about health effects associated with radioactive emissions and releases from nuclear generating stations. One of the concerns expressed was with regard to the effects of tritium in drinking water and the fact

that the limit for tritium in drinking water in Ontario is set at 7,000 Becquerels per litre, in contrast to lower limits set in the European Union and the United States.

Many participants referred to health studies that suggested there are risks of health effects from low doses of radiation and other studies that associated the occurrence of leukemia and cancer with the operation of nuclear facilities. The concern about risks at low dose levels was based on reported consensus in the scientific community on the applicability of a linear no-threshold relationship between radiation exposure and risks of health effects. Many participants made reference to a model and data presented in the report *Health Risks from Exposure to Low Levels of Ionizing Radiation, BEIR VII Phase 2*, National Research Council of the National Academies (National Academies Press, 2006) (BEIR VII report), which is on risks from exposure to low levels of ionizing radiation.

Other participants raised questions about the adequacy of the science that forms the basis for the assessment of effective doses. These issues are related to advances in the understanding of health effects of exposure to radiation.

At the hearing, the Panel sought further information regarding the health effects associated with exposure to radiation and consequent health risks, including vulnerability at low levels of exposure. CNSC staff provided information on the current scientific understanding in monitoring of exposures and on conclusions reached in a number of health studies. These included studies of health effects in atomic bomb survivors and people exposed as a consequence of the Chernobyl accident, the German *Epidemiological Study of Childhood Cancer and Nuclear Power Plants (KiKK Study)* (2007), and a number of Canadian epidemiological studies of workers and members of the public exposed to ionizing radiation. CNSC staff stated that numerous experimental and epidemiological studies have established that exposure to doses above 100 millisieverts will increase the risk of developing cancer. CNSC staff further stated that based on the weight of evidence found in the many epidemiological studies of populations living in the vicinity of nuclear facilities, there is no substantive evidence that any adverse health outcomes are related to environmental radiation exposures from these facilities. CNSC staff also stated that

the current levels of environmental or occupational exposures in Canada are low and that there is no evidence of increased birth defects, cancer incidence or mortality in populations due to these exposures.

CNSC staff also reported on the consensus from the international community, including the United Nations Scientific Committee on the Effects of Atomic Radiation and the International Commission on Radiological Protection, regarding reviews of data on health effects of radiological exposure. CNSC staff stated that the outcome of major reviews of biological effects at low doses, as well as epidemiological evidence, is the agreement to use the linear no-threshold model for doses below 100 millisieverts. CNSC staff explained that for radiation protection purposes, this model assumes that the probability of cancer is proportional to dose.

The Panel has considered the issues and concerns raised during the review about potential health effects from the operation of nuclear power reactors. The Panel has also heard different views expressed by participants on the risks of health effects from low levels of radiation exposure and on the findings and limitations of epidemiological studies on health effects in the vicinity of nuclear facilities in Canada and other countries.

On the question of tritium emissions, the Panel considered the information presented by CNSC staff in its review of potential health effects at different levels of tritium exposure. The Panel notes that the CNSC staff conclusion from this review was that there were no observed health effects at tritium exposures below 500 millisieverts. CNSC staff also reported that epidemiological studies in the vicinity of nuclear facilities had not identified health effects from exposure to tritium. CNSC staff noted that these studies involved limited populations and low dose levels, and as such, they were limited as indicators of effects from exposure.

Many participants referred to and supported a 2009 report from the Ontario Drinking Water Advisory Council that recommended the Ontario drinking water standard for tritium be lowered to 20 Becquerels per litre. In a letter to the Panel dated May 10, 2011, the Medical Officer of Health for the City of Toronto requested that the Panel ensure the new nuclear power plant would not result in tritium in drinking water levels

exceeding a running annual average of 20 Becquerels per litre.

The Panel also considered the conclusions presented in the review by CNSC staff in relation to health effects of exposure to ionizing radiation. The Panel notes the CNSC staff statement that no health effects have been observed for acute doses below 100 millisieverts or for chronic doses of up to 200 millisieverts. In light of this statement, the Panel sought to obtain an understanding of the characterization of the risk of health effects at low levels of exposure to ionizing radiation.

The Panel reviewed the conclusions presented in the BEIR VII report because many participants referred to this report as presenting a well-founded assessment on the incidence of solid cancers at low levels of exposure. Risk information presented in the BEIR VII report indicates that at a radiation dose of 100 millisieverts there would be a lifetime risk of one additional cancer in a population of 100 persons. The BEIR VII report also states that other non-radiation causes would likely give rise to lifetime risks of 42 solid cancers in the same population of 100 persons.

Following the model presented in the BEIR VII report, the application of a linear no-threshold model indicates that there would be a lifetime occurrence of one additional cancer in a population of 10,000 persons for an exposure at the Canadian regulatory public dose limit of one millisievert per year. Based on the data in the BEIR VII report, in the same population of 10,000 persons, non-radiation causes would give rise to the lifetime incidence of 4,200 additional solid cancers. From this understanding of the model and data in the BEIR VII report, it may be inferred that for individual exposures up to the annual public dose limit of one millisievert per year, the lifetime incidence of cancers caused by radiological exposure might not easily be identified in the population of cancers that may arise due to non-radiological causes. It also puts the CNSC staff statement concerning evidence of health effects at low levels of radiological exposure into perspective. This assessment acknowledges that there is a risk of the incidence of cancer from low-level exposure to ionizing radiation, albeit a risk that is small in comparison to other causes of cancer in the general population. The Panel notes that OPG predicted that the dose to members of the public during

operation of the reactors would be well below the public dose limit, approximately 0.005 millisieverts per year.

Having considered this information and other assessments of health effects, the Panel agrees with the CNSC staff assessment that the Project is not likely to result in significant adverse environmental effects in the area of human health in normal operation of the reactors.

The Panel acknowledges that the question of health effects due to radiological exposure continues to be an issue of concern to many participants. This is an area for further study to obtain a fuller understanding of possible effects at low levels of radiation exposure. Based on information presented by CNSC staff and in the Canadian Nuclear Safety Commission document INFO-0812, *Setting Radiation Requirements on the Basis of Sound Science: The Role of Epidemiology* (March 2011), the Panel recognizes that an ideal assessment of effects of low levels of exposure would utilize actual data on exposures in very large populations. This indicates a need to extend future studies beyond exposed populations in the vicinity of individual nuclear facilities. One way forward is to obtain and study wider scope population data that may be available in other countries. The Panel notes from the information presented in INFO-0812 that Canada does presently participate in such studies.

The Panel concludes that the Project is not likely to result in significant adverse environmental effects in the area of human health in normal operation of the reactors, taking into account the implementation of the mitigation measures proposed by OPG, such as the Radiation Protection Program.

In the interest of addressing public concerns, the Panel makes the following recommendations.

**Recommendation # 54:**

*The Panel recommends that during operation, the Canadian Nuclear Safety Commission require OPG to implement measures to manage releases from the Project to avoid tritium in drinking water levels exceeding a running annual average of 20 Becquerels per litre at drinking water supply plants in the regional study area.*

**Recommendation # 55:**

*The Panel recommends that Health Canada and the Canadian Nuclear Safety Commission continue to participate in international studies seeking to identify long-term health effects of low-level radiation exposures, and to identify if there is a need for revision of limits specified in the Radiation Protection Regulations.*

**7.1.2 Non-radiological Health Issues**

The Panel's review of the effects of non-radiological issues associated with the normal operating conditions of the Project included a review of the physical, mental and social well-being of workers and members of the public.

Proponent Assessment

The proponent presented baseline information from the existing Darlington Nuclear Generating Station in its assessment of the effects of the Project on the health of workers and members of the public exposed to non-radiological stressors. This information included community health profiles from the local study area with coverage of conditions that affect the physical, mental and social well-being of workers at the current operating plant as well as the off-site public.

The OPG review of physical well-being aspects was focused on the physical aspects of applicable environmental components such as air quality, noise, surface water and groundwater quality. Regarding mental and social well-being, OPG stated that the conditions considered were primarily linked to the socio-economic environment associated with the existence of the nuclear generating facility.

The OPG assessment concluded that the Project would not result in significant adverse effects on physical, mental and social health of workers or the general public.

Panel Assessment

In assessing effects for workers, the Panel noted that occupational health and safety programs would be implemented for the Project as required under provincial regulations. CNSC staff stated that these programs would serve to establish safe working conditions and that the programs are well proven through many years of application at industrial facilities, including nuclear generating stations.

The Panel notes CNSC staff's conclusion that in general, there would be minimal effects from non-radiological stressors from the Project on the health of the public. CNSC staff noted that the OPG human health risk assessment indicated that there would be short-term exceedances of airborne emissions during site preparation and construction activities. CNSC staff further noted that other nuisance-type adverse effects could arise due to noise and dust from activities on site and increased traffic during the site preparation and construction phase.

The Panel assessment of the effects of the Project on the health and safety of workers and members of the public during normal operations indicated that the information provided by OPG was sufficient to determine the potential for and significance of the adverse effects of the Project.

The Panel concludes that the Project is not likely to result in significant adverse environmental effects on human health as a result of non-radiological impacts, provided that the mitigation measures proposed by OPG, such as the Nuisance Effects Management Program and occupational health and safety programs, are implemented along with the following recommendation.

**Recommendation # 56:**

*The Panel recommends that over the life of the Project, the Canadian Nuclear Safety Commission require OPG to conduct ambient air monitoring in the local study area on an ongoing basis to ensure that air quality remains at levels that are not likely to cause adverse effects to human health.*

**7.2 Nuclear and Radiological Malfunctions and Accidents**

This section presents the Panel's consideration of the consequences of a range of malfunctions and accidents that could pose health risks to workers and the public. These events fall into different categories depending on the types of systems involved and the nature of the hazards that arise.

**7.2.1 Proponent Assessment**

OPG stated that safety and safety-related systems that function to prevent and mitigate, when necessary, reactor malfunctions and accidents at an early stage of progression are integral to the design of nuclear power reactors. OPG noted that

design assessments are undertaken to examine the performance of the plant and the effectiveness of the safety systems in the event of postulated accidents.

OPG assessed a number of bounding radiological malfunctions and accidents as part of its evaluation of the environmental effects of the Project. OPG noted that one group of events concerned radioactive substances and components other than those directly associated with the reactor and its auxiliary facilities, such as incidents involving the handling of different categories of radioactive waste.

OPG stated that for low and intermediate-level radioactive waste, the bounding event was considered to be a pool fire that leads to the breach of waste containers and the release of internal gases. OPG stated that for this event, the predicted doses to workers and the public would be well below the dose limits for members of the public and for nuclear energy workers on site.

For refurbishment waste, the bounding scenario was the dropping of a refurbishment waste container. For this scenario, OPG noted that the level of the doses to workers and the public would vary depending on the type of components or material being handled, but in all cases, the predicted doses both on and off site would be well below the dose limits for members of the public and for nuclear energy workers.

The highest source of radioactivity in the handling of waste would involve activities with respect to the management of used nuclear fuel. OPG stated that in this case, the bounding scenario was considered to be dropping of a loaded used fuel dry storage canister. OPG estimated that for this category of event, the consequent doses would be 25 percent of the public dose limit and 68 percent of the limit for a nuclear energy worker.

The conclusion reached for each of these radiological accidents was that the dose to the public and to nuclear energy workers would be less than the regulatory dose limits. On this basis, OPG stated that no significant residual human health effects were expected from similar radiological malfunctions and accidents.

OPG also provided information regarding an inadvertent out-of-core criticality event. OPG stated that the risk of an inadvertent out-of-core

criticality event involving the handling of new nuclear fuel would be mitigated by adherence to a number of controls in the OPG criticality safety program, including design, engineering and administrative requirements, as well as stored inventory controls. OPG noted that among these measures, there would be requirements for assurance of an approved margin of sub-criticality and criticality control plans. OPG stated that it completed a deterministic analysis to assess the off-site consequences of an inadvertent criticality event and found that although such an event was not considered credible, the potential radiation effects on the public beyond the site would be greatly reduced due to the mitigation measures including shielding and distance. OPG stated that the potential consequences of an out-of-core criticality event would not trigger a public evacuation.

OPG also evaluated accidents that could occur in the off-site transportation of low and intermediate-level radioactive waste. In this regard, the proponent outlined its experience over many years with control and mitigation measures that prevent the release of radioactivity in the event of transportation accidents. OPG stated that the off-site transport of radioactive materials is subject to regulation that governs the robustness of packages and other precautions that protect the safety of workers and members of the public. OPG concluded that no significant health effects would be expected from the off-site transportation of low and intermediate-level waste.

Regarding the reactor itself, OPG stated that malfunctions and accidents could—in bounding events—result in damage to fuel bundles and the reactor core, which would result in a release of radioactivity to the environment. OPG stated that the accident scenarios it considered for the environmental assessment were based on the small release frequency and large release frequency thresholds defined in Canadian Nuclear Safety Commission regulatory document RD-337, *Design of New Nuclear Power Plants*. OPG was of the view that this bounding release approach provided reasonable approximations of releases that could require an off-site emergency response. OPG noted that a severe accident scenario, such as a beyond design basis event, would be expected to result in fuel damage and high releases. OPG stated that the effects of these releases off site were analyzed in compliance

with criteria specified in RD-337 and accepted atmospheric dispersion models. OPG noted that the consequences were found to be within bounds at which the implementation of emergency measures would prevent undue doses to the public as a consequence of the postulated accident. The implementation of these measures is discussed later in this report.

The proponent also assessed dose consequences for both anticipated occupational occurrences and design basis accidents as defined in RD-337 at the site boundary for the reactor technologies considered in the development of the plant parameter envelope. OPG reported that in the case of design basis accidents, compliance at the site boundary with the dose criterion set in RD-337 would in some instances depend on the calculation methodology adopted and use of a site-specific atmospheric dispersion factor.

OPG assessed other hazards as possible contributors to risks of reactor core damage, including internal flooding, fire and external hazards such as high winds, tornadoes and seismic events. OPG stated that in all of these cases, the risk of core damage was assessed as being low relative to the safety goals set in RD-337.

OPG stated that no significant residual human health effects were expected from radiological and nuclear malfunctions and accidents.

#### 7.2.2 Panel Assessment

The Panel notes the CNSC staff conclusion that for radiological malfunctions and accidents that do not involve the nuclear reactors and transportation accidents, the dose consequences for nuclear energy workers and the public would be within the bounds of regulatory limits specified in the *Radiation Protection Regulations* for assurance on health effects. The Panel accepts the conclusion that in the cases of these categories of events there are adequate proposed protective and mitigation measures to assure the protection of workers and the public.

An issue of concern to many participants during the review was the possible health consequences of an accident involving a nuclear reactor. The Panel notes that the proponent assessed the consequences of a reactor accident involving a release of radioactivity to the environment. The Panel further notes that the criteria for determining whether nuclear energy workers on

site would experience significant adverse effects during a reactor accident or malfunction are defined in the *Radiation Protection Regulations* and that different criteria apply for the initial response to the event and the subsequent recovery operation. The proponent has indicated that the Consolidated Nuclear Emergency Plan that was established for the existing Darlington Nuclear Generating Station would be expanded to include the Project.

In the OPG assessment of the consequences of a reactor accident, the public dose as a function of distance from the point of release was calculated for two different release timeframes and incorporated mitigation measures that form part of the reactor safety system design requirements specified in RD-337. The pathways of exposure to human receptors and critical groups were identified, and the dose to the public was estimated for credible accidents. The Panel notes that the assessment completed by the proponent indicates a capacity for implementation of emergency measures for protection of workers and the public in the event of these postulated releases.

CNSC staff stated that the bounding approach adopted by OPG for its assessment of the health consequences of a nuclear accident were acceptable for the purpose of the environmental assessment. CNSC staff noted that this approach was acceptable because a reactor that does not meet the specified safety goal-based release limits of RD-337 would not be accepted for operation on the grounds that it would not be compliant with regulatory requirements in Canada.

The Panel accepts the adoption of a safety goal-based approach for the assessment of the consequences of an accident in a situation where there has not been a choice of reactor technology. The Panel notes, however, that once this choice has been made, the proponent must be required to complete an assessment of the off-site effects of a severe accident that could arise for the chosen technology.

CNSC staff stated that a number of uncertainties remained in the proponent's analyses of the consequences of reactor accidents, such as questions concerning compliance at the site boundary with RD-337 dose acceptance criteria for design basis accidents. The Panel is of the view that these concerns require resolution in the

context of consideration of an Application for a Licence to Construct a reactor, once a technology has been selected. The Panel notes that this would be the stage when more complete design information would be available for more accident analyses in the context of conditions at the Project site. The Panel notes that CNSC staff accepted the information presented by the proponent as being a credible demonstration that the objectives of the review of reactor accidents and malfunctions have been met for the purposes of the environmental assessment.

The Panel is of the view that once a technology has been selected for the Project there will be a need for more specific analysis of potential accidents and the consequent releases and health effects. The review of the Application for a Licence to Construct the reactor would require confirmation that the health effects conclusion from the present assessment remains valid for the predicted accident conditions.

CNSC staff concluded that the Project is not likely to result in significant adverse environmental effects to the health and safety of workers and the public during accidents and malfunctions, taking into account the implementation of mitigation measures.

The Panel concludes that the Project is not likely to result in significant adverse environmental effects on the health and safety of workers and the public during accidents and malfunctions, taking into account the implementation of mitigation measures, such as the functioning of reactor safety systems and the on-site Consolidated Nuclear Emergency Plan and off-site emergency measures, along with the following recommendations.

**Recommendation # 57:**

*The Panel recommends that prior to construction, the Canadian Nuclear Safety Commission require OPG to undertake an assessment of the off-site effects of a severe accident. The assessment should determine if the off-site health and environmental effects considered in this environmental assessment bound the effects that could arise in the case of the selected reactor technology.*

**Recommendation # 58:**

*The Panel recommends that prior to construction, the Canadian Nuclear Safety Commission confirm that dose acceptance criteria specified in RD-337 at the reactor site boundary—in the cases of design basis accidents for the Project's selected reactor technology—will be met.*

## 7.3 Emergency Programs

This section presents the Panel's assessment of emergency planning and evacuation measures in the event of an accident at a nuclear power plant. Emergency planning and evacuation require collaborative action on the part of the nuclear facility operator and various levels of government.

### 7.3.1 Proponent Assessment

For emergency events at nuclear facilities, OPG stated that it has established comprehensive plans with the federal, provincial and municipal government departments that have responsibilities in this area. The purpose of these emergency plans is to ensure that workers at these facilities and members of the public affected by these events would be protected from harm.

OPG stated that emergency response plans for a nuclear reactor accident have been established and are implemented by municipal authorities and by departments and agencies in the provincial and federal governments. OPG further stated that in the case of the Darlington Nuclear site, the plans describe the arrangements for cooperation between it, the Government of Ontario, the Region of Durham and its municipalities, the City of Toronto, Health Canada and the Canadian Nuclear Safety Commission.

OPG stated that a detailed evacuation time estimate study was completed for workers and the public in various evacuation zones to demonstrate that an effective evacuation could be undertaken if a nuclear emergency were to occur with radioactive releases to the environment.

OPG stated that in its assessment of the capacity to respond to an accident at the Project, doses to the public for an upper-bound release were computed and compared to protective action

levels established in the Ontario Provincial Nuclear Emergency Response Plan. OPG explained that the outcome was used to determine the need for sheltering, evacuation, and relocation, and to determine the effect on the affected population.

OPG noted that protective action levels, which are based on projected dose, are used as guides for the implementation of various protective actions in the event of a nuclear emergency. OPG stated that for the Government of Ontario to implement sheltering, the lower and upper levels of projected whole body dose to an individual must be one millisievert and 10 millisieverts, respectively. Similarly, the lower and upper levels of projected whole body dose to an individual for the Government of Ontario to implement evacuation are 100 millisieverts and 1000 millisieverts, respectively. Above the projected thyroid doses of 100 millisieverts and 1000 millisieverts, respectively, thyroid blocking would be initiated via the distribution of potassium iodide pills to those affected.

OPG indicated that relocation may be required for residents who are expected to receive a dose of 20 millisieverts or greater during the first year following an accident. OPG stated that the Government of Ontario has also indicated that there could also be a need for ingestion control measures to protect the food chain from contamination and prevent ingestion of contaminated food and water.

In the modelling of the assessed release developed for emergency response purposes, OPG made a number of assumptions concerning the reactor accident source term, the representation of releases from the reactor containment envelope, the model used for analysis of atmospheric dispersion, and treatment of off-site emergency response. OPG stated that the source terms considered were developed based on Canadian Nuclear Safety Commission RD-337 safety goal release thresholds. OPG explained that these source terms were used as bounding releases because they would represent the maximum releases for reactors that would be accepted for licensing in Canada.

OPG further stated that for the analysis of the effects of the accident, the release characteristics were based on an assumed containment hold-up time of 24 hours. OPG noted that after that period releases were modelled as continuous

plumes spread over the course of 72 hours. OPG explained that the assumed release duration was representative of a wide range of possible accidents scenarios. OPG expressed the view that this was a reasonable assumption for the purpose of estimating the effects of releases for the environmental assessment.

OPG stated that mean meteorological conditions were assumed for the modelling of the dispersion of the release. OPG further stated that the dispersion analysis was performed using a computer model that has been adopted in many countries for atmospheric dispersion analysis. OPG noted that this modelling was conducted in a manner that was consistent with a standardized method provided in the Canadian Standards Association guideline CAN/CSA N288.2-M91 *Guidelines for Calculating Radiation Doses to the Public from a Release of Airborne Radioactive Material under Hypothetical Accident Conditions in Nuclear Reactors* (1991).

OPG stated that it evaluated evacuation time estimates to assess the feasibility of this emergency response measure for the modelled accident and release. OPG stated that the study area for the evacuation time estimates was the Emergency Planning Zones around the Darlington Nuclear site, which comprised two evacuation regions extending three kilometres and 10 kilometres from the centre of the Project site. OPG stated that it determined evacuation estimates for population and development data from 2006 and for forecasted conditions in 2025. OPG stated that the studies indicated that the 2025 population projection within a 10-kilometre radius of the site could be evacuated in less than nine hours.

### 7.3.2 Panel Assessment

The Panel notes that CNSC staff performed an evaluation of OPG's emergency response analysis. Based on its review of the information presented by OPG, CNSC staff concluded that the approach adopted by OPG and the assumptions and factors used for modelling the effects of safety goal-based releases were adequate for the purposes of the environmental assessment. Furthermore, CNSC staff stated that consideration of mean meteorological conditions, the assumption of a release duration of 72 hours, and the dispersion analysis computer code used by OPG were all acceptable options for this type of consequence analysis. CNSC staff also accepted that the OPG evacuation time-estimate



study demonstrated that an effective evacuation could be completed within a period prior to the anticipated first release of radioactive products from the reactor containment envelope.

Based on the safety goal-based release assessment completed by OPG and the view of CNSC staff, the Panel accepts that an effective evacuation can be completed as required by criteria established by the Government of Ontario for the ten-kilometre-Primary Zone. This conclusion is based on assumed demographics in the region around the site, the implementation of proposed road improvements and the absence of sensitive groups that might require special assistance to move out of the evacuation zone. Given these cautions, the Panel recommends that measures be taken to assure continued capacity for effective evacuation of the zone around the site.

The Panel notes that the assessment presented by the proponent for a nuclear reactor accident followed by off-site releases focused primarily on protection of the health of workers and the public. Beyond this effect, there could be social and economic effects of contamination from the off-site releases that could impact the surrounding area, including Lake Ontario. These are effects that could require remediation over an extended period of time following an accident. OPG presented information of predicted dose rates at various distances from the Project as well as information on criteria for sheltering, evacuation and for long-term relocation in the event of contamination from the release plumes. The latter consequence is a reason for requiring nuclear liability insurance that would provide coverage of social effects and remediation that may be required in the vicinity of the site. The Panel is of the view that the level of liability insurance should be adequate to cover effects and remediation required in the case of a severe accident at the new reactor site. The Panel will address this matter in a later section of this report.

The Panel concludes that although OPG has developed a reasonable emergency response plan in cooperation with all levels of government, there are a number of areas that should be enhanced. As such, the Panel makes the following recommendations.

**Recommendation # 59:**

*The Panel recommends that the Municipality of Clarington manage development in the vicinity of the Project site to ensure that there is no deterioration in the capacity to evacuate members of the public for the protection of human health and safety.*

**Recommendation # 60:**

*The Panel recommends that prior to construction, the Government of Canada review the adequacy of the provisions for nuclear liability insurance. This review must include information from OPG and the Region of Durham regarding the likely economic effects of a severe accident at the Darlington Nuclear site where there is a requirement for relocation, restriction of use and remediation of a sector of the regional study area.*

## 7.4 Conventional Malfunctions and Accidents

This section presents the Panel's assessment of the environmental effects of conventional malfunctions and accidents. Conventional malfunctions and accidents are events that only involve non-radiological substances with no potential for release of radioactivity, or other events that result in injury to workers.

### 7.4.1 Proponent Assessment

OPG identified a number of potential accident scenarios for each phase of the Project. These scenarios were screened to focus on those that were considered to be credible and had potential to affect workers, the public or the environment. OPG stated that five credible bounding scenarios were assessed for potential effects in the environment. These bounding scenarios included a spill of hydrazine, a spill of oil on land, a spill of fuel in Lake Ontario, a spill of chemicals and a fire or an explosion.

Another category of conventional accident considered by OPG was the occurrence of serious injuries in the workplace. This would apply particularly in the case of workers during the site preparation and construction phase of the Project. OPG noted that activities in workplaces in the Province of Ontario are subject to the Ontario *Occupational Health and Safety Act* (R.S.O. 1990, c. O.1), which serves as a framework for the management of worker safety.

After assessing the anticipated effects and mitigation measures for these scenarios, OPG concluded that conventional malfunctions and accidents would be unlikely to cause long-term residual effects to humans or non-human biota, taking into account the proposed mitigation measures, including preventive measures and emergency response capabilities.

#### 7.4.2 Panel Assessment

The Panel notes the CNSC staff conclusion that OPG appropriately evaluated conventional accidents and malfunctions for the purpose of predicting environmental effects. The Panel is of the view that the proponent considered its experience of abnormal plant operation, accidents and spills to the extent that could be relevant for the proposed Project, and appropriately described credible malfunctions and accidents that may occur during the lifetime of the Project. The Panel is of the view that OPG analyzed the likely emissions and releases of material to the environment.

CNSC staff further concluded that the environmental effects of such accidents and malfunctions were well known and could be mitigated to ensure that there are no significant adverse residual effects on the environment.

Based on the information presented by OPG and the subsequent review by CNSC staff, the Panel concludes that conventional malfunctions and accidents are not likely to cause significant adverse environmental effects, taking into account the proposed mitigation measures, including preventive measures and emergency response capabilities.

### 7.5 Malevolent Acts

This section presents an overview of the Panel's assessment of the environmental effects of malevolent acts. Malevolent acts are those occurrences where the initiating event for a malfunction or accident was an intentional attempt to cause damage to the facility. Due to the nature of the subject, detailed security-related information is not publically available. The Panel received protected documents and held a closed hearing session for its consideration of these matters.

#### 7.5.1 Proponent Assessment

OPG stated that the safety of its existing nuclear facilities has been reviewed against credible

threats and accidents, including the potential consequence of aircraft impact at individual facilities. OPG stated that this review demonstrated that, considering the robust nature of the technologies, the defence-in-depth provisions in various safety systems, and the difficulty of perpetrating a damaging malevolent act, a substantial release of radioactivity to the public in such an event would be unlikely.

OPG noted that assessments of other aspects of vulnerability to malevolent acts were also completed in areas of physical and cyber security. These matters were addressed in more detail in protected documents.

OPG concluded that the consequences of a malevolent act would be encompassed within the range of consequences identified for conventional accidents and malfunctions and malevolent act scenarios.

#### 7.5.2 Panel Assessment

The Panel notes the CNSC staff review of malevolent acts with respect to the Project. An aircraft crash scenario was considered to be a design basis external hazard with a requirement for consideration of impacts from a range of light aircraft to large transport aircraft. CNSC staff noted that additional information on the design criteria for such a hazard would be required for review at the time of an Application for a Licence to Construct a reactor.

A participant at the hearing highlighted potential vulnerabilities in the area of cyber security. Potential vulnerabilities in the areas of cyber and physical security were also discussed at the closed session of the Panel hearing.

The Panel notes the CNSC staff conclusion that based on the preliminary design provisions and proposed mitigation measures, the environmental effects of credible malevolent acts would not be more significant than those for conventional accidents and malfunctions.

Based on the information received from OPG, the subsequent review by CNSC staff and the information presented at the closed hearing session, the Panel concludes that the Project is not likely to result in significant adverse environmental effects, provided that OPG implement the necessary safety and security measures required to protect the Project against malevolent acts.

## Chapter 8 – Environmental Protection and Management

In this chapter the Panel evaluates several aspects of the Project as they pertain to the environmental assessment, including cumulative effects, sustainable development, ethical concerns, environmental protection, monitoring and follow-up programs, and measures to enhance any beneficial environmental effects. The purpose of this chapter is to establish if the Project will result in any significant residual effects from a broad perspective, including mitigation measures and follow-up programs. The Panel also considers policy aspects related to nuclear power generation in Canada.

### 8.1 Cumulative Effects

This section presents the Panel's review of OPG's cumulative effects assessment. The *Canadian Environmental Assessment Agency Cumulative Effects Practitioners Guide* (February 1999) defines cumulative effects as changes to the environment that are caused by an action in combination with other past, present and future human actions, and notes that cumulative effects may occur if local effects on valued ecosystem components occur as a result of the action under review and those valued ecosystem components are affected by other actions.

#### 8.1.1 Proponent Assessment

OPG provided information regarding the Canadian Environmental Assessment Agency guidance documents it used for its cumulative effects assessment. The *Cumulative Effects Practitioners Guide* states that in practice, past actions often become part of the existing baseline conditions and that it is important to ensure that the effects of these actions are recognized. The guide further states that in practice, a scenario in the past often defaults to the year in which the baseline information for the assessment is collected and the future extends no further than to include known actions.

The Canadian Environmental Assessment Agency reference guide *Addressing Cumulative Environmental Effects* (November 1994) notes that federal and other environmental assessments already address cumulative environmental effects to a limited extent. The reference guide further

notes that most environmental assessments examine baseline environmental conditions, which include the cumulative environmental effects of past and existing projects and activities.

OPG described the methodology it used to determine the impact of cumulative effects. OPG stated that it first considered the identified residual environmental effects to determine if there would be a potential for them to act cumulatively, i.e., overlap in type, space and time, with the effects of other projects and activities within the study areas around the Project.

OPG stated that its cumulative effects assessment did not include the potential effects of the malfunction or accident scenarios because these are hypothetical and have a very low probability of occurrence. OPG explained that the practitioner's guide indicates that such events are rare and should be assessed as unique scenarios, as their potential effects are too extreme to be assessed together with the more likely effects of normal operational activities.

OPG stated that a total of 34 other projects and activities within the regional study area were selected for consideration of their potential to contribute to cumulative environmental effects, including the following seven projects and activities existing or planned in the Municipality of Clarington:

- St. Marys Cement operations;
- Durham-York Energy from Waste Facility;
- Clarington Energy Business Park;
- Highway 407-401 East Link;
- Highway 401-Holt Road interchange improvements;
- GO Transit rail service extension – Oshawa to Bowmanville; and
- Growth and development in regional communities.

OPG screened the 34 projects to identify those expected to have effects similar to, and likely to overlap geographically and temporally with, the residual effects of the Project. OPG noted that

residual adverse effects were identified as likely within the aquatic environment, the terrestrial environment, the socio-economic environment and with respect to the visual landscape. OPG further stated that each Project-related residual adverse effect was assessed in combination with the overlapping effects of other projects and activities advanced through the screening step.

OPG stated that no cumulative residual effects were likely to occur in the aquatic and terrestrial environments due to the expected effectiveness of the design and mitigation measures proposed for the Project.

OPG identified several beneficial effects, mostly related to the socio-economic environment. It noted that these would offset both the residual effects of the Project and the limited cumulative adverse effects identified. OPG noted that it was determined in all cases that no further mitigation measures would be necessary to address potential cumulative effects.

OPG stated that although it determined that the Project would not be expected to result in residual adverse effects as a result of radiation dose, it further examined these effects in response to concerns expressed by some members of the public. OPG stated that the cumulative doses to members of the public and workers, including contributions from other on-site and off-site sources such as the Pickering Nuclear Generating Station and the low-level radioactive waste in the Port Hope area, were found to be well below regulatory limits for normal operating conditions.

In addition, OPG stated that although no residual adverse effects on local traffic, air quality, noise, labour market or community infrastructure were determined as likely to result from the Project, these aspects of the environment were also examined further in response to stakeholder feedback. OPG examined the cumulative effects of air quality and noise in a semi-quantitative/semi-qualitative manner because no integrated air quality or noise analysis covering the cumulative effects of the seven projects in the Municipality of Clarington existed at the time of this environmental assessment. OPG noted that its proposal to implement a Dust Management Program and Nuisance Effects Management Plan for residential properties along routes affected by the Project was expected to be useful as an example to the Region of Durham, the

Municipality of Clarington and other organizations addressing the air quality and noise effects of these seven projects.

OPG stated that one potential cumulative effect, the visual impact of the Project, required further assessment to determine its significance. OPG stated that the combined visual and related socio-economic effects resulting from the possible use of cooling towers for the Project and other tall structures existing and foreseeable in the vicinity of the Darlington Nuclear site were based on public concerns about a potential negative impact on community character and reduced enjoyment of private property. OPG stated that while no additional mitigation measures were proposed for this residual cumulative effect, the preliminary scope of the follow-up and monitoring program included public attitude research and surveys of local residents and users of on-site recreational facilities to verify the predicted residual effect and significance determination.

#### 8.1.2 Panel Assessment

The Panel notes that cumulative effects were considered in the CNSC staff assessment, although only two topics were discussed: the aquatic environment with respect to round whitefish, and radiation doses to workers and the public. The Panel is of the view that waste and malfunction and accident scenarios also require further consideration.

##### The Aquatic Environment

CNSC staff noted that three residual adverse effects on the aquatic environment were expected as a result of the Project: habitat loss from lake infill and the construction of the once-through cooling system; biota loss from lake infill and the construction of the once-through cooling system; and biota loss associated with impingement and entrainment from the operation of the condenser cooling system. CNSC staff stated that these effects were expected to be minor and to be offset by the habitat compensation works under the *Fisheries Act* authorization from Fisheries and Oceans Canada. CNSC staff further stated that none of the seven projects and activities existing or planned in the Municipality of Clarington included marine construction so they would not contribute to cumulative effects.

CNSC staff stated that the impingement and entrainment of biota from the operation of the cooling water intake for the Project, combined with the effects from the existing Darlington Nuclear Generating Station, would be relatively minor with no expected population-level effects. CNSC staff noted that cooling water diffuser effects were determined to have no residual adverse effects, and thus no potential for cumulative effects.

CNSC staff stated that because the effects of intake impingement and entrainment would generally be limited to the site study area—with some recruitment from the local study area—spatial interaction with the Pickering Nuclear Generating Stations would be minimal or nil. CNSC staff noted that the affected species were expected to be abundant, lake-wide species. CNSC staff further noted that other industrial and municipal facilities withdrawing and discharging water in the local study area are not known to cause significant impingement or entrainment effects. CNSC staff concluded that a measureable cumulative effect of intake impingement and entrainment would not be likely to occur with any of the seven projects.

CNSC staff stated that effects on Darlington Creek from the adjacent St. Marys Cement quarry expansion could result in a reduced base flow along with dewatering during the construction stage of the Project. CNSC staff stated that this effect would be offset by increased base flow from increased groundwater recharge in the vicinity of the northwest and northeast landfill areas on the Project site.

CNSC staff was of the view that the Project could result in a cumulative effect on round whitefish. CNSC staff noted that although OPG considered individual source effects for the Project and the existing Darlington Nuclear Generating Station, such as intake fish loss, OPG did not consider the combined effects of these and other regional projects on round whitefish, a valued ecosystem component receptor that would be exposed simultaneously to many stressors at one time.

CNSC staff was of the view that these effects may be measureable at the regional study area-level, depending on the genetic spatial structuring of the round whitefish population that spawns at Raby Head and elsewhere along the north shore of Lake Ontario. CNSC staff stated

that these effects are expected to be properly investigated and mitigated through the Round Whitefish Action Plan.

The Ontario Ministry of Natural Resources was also of the opinion that the Project could, through cumulative effects, have a significant impact on the round whitefish population. The Ministry indicated, however, that the risks to the round whitefish population at Raby Head could be appropriately mitigated. The Ministry stated that work would need to be conducted with extreme caution and include all mitigation scenarios, including additional scenarios that were not outlined in the bounding scenario, to ensure minimal impacts to round whitefish. The Ministry indicated that it is working with Fisheries and Oceans Canada, OPG and other stakeholders to develop further mitigation measures.

OPG recognized that the operation of the existing Darlington Nuclear Generating Station and the Pickering A and B Nuclear Generating Stations contributes to the thermal loading of Lake Ontario. OPG also stated that operation of the Pickering A and B Nuclear Generating Stations contributes to fish impingement. The Panel notes that thermal loading was not specifically carried forward in the OPG analysis of cumulative effects on aquatic biota, while impingement and entrainment were carried forward.

The Panel is of the view that a cumulative effect on the aquatic environment would be significant and likely to occur without appropriate mitigation measures in place. The Panel notes that OPG may have to use cooling towers to mitigate these effects. The Panel is of the view that the potential effects from the thermal plume of the Project be established, as proposed earlier in the report, and monitored in conjunction with the thermal plume of the existing Darlington Nuclear Generating Station.

The Panel concludes that if its recommendations to Fisheries and Oceans Canada, the Canadian Nuclear Safety Commission and Environment Canada are implemented, then the Project is not likely to result in significant cumulative adverse effects on the aquatic environment. The Panel makes the following recommendation to further address cumulative effects.

**Recommendation # 61:**

*The Panel recommends that during operation, the Canadian Nuclear Safety Commission require OPG to monitor aquatic habitat and biota for potential cumulative effects from the thermal loading and contaminant plume of the discharge structures of the existing Darlington Nuclear Generating Station and the Project.*

Air Quality

The Panel notes that, as has been discussed in this report, there may be a cumulative effect on the air quality in the region due to several sources, including traffic on Highway 401 and the operation of St. Marys Cement. The Panel is of the view that OPG should take measures to ensure that there are no adverse cumulative effects on air quality as a result of the Project, particularly during the site preparation and construction phases. These measures should include ceasing operation of heavy machinery on days when there are smog alerts and implementing dust abatement strategies.

The Panel notes that it has made recommendations regarding air quality. The Panel is of the view that the effects of the Project on air quality can be mitigated if these recommendations are implemented by OPG. Regarding the potential cumulative effects on air quality, the Panel makes the following recommendation.

**Recommendation # 62:**

*The Panel recommends that prior to site preparation, Environment Canada evaluate the need for additional air quality monitoring stations in the local study area to monitor cumulative effects on air quality.*

Waste

The Panel notes that the proposed Project would result in the generation of radioactive waste that would be stored on site or potentially be shipped off site with that of the existing Darlington Nuclear Generating Station. OPG assessed cumulative effects with respect to the operation of waste management facilities at the Pickering and Darlington Nuclear sites and their expansion and decommissioning. OPG determined that there would be no cumulative effects because the doses to workers and the public would remain well below regulatory limits. OPG assumed that the waste would eventually be moved to facilities off site.

The Panel is of the view that this waste could result in cumulative effects related to doses to workers, the public and the environment if it is not appropriately managed should it remain permanently on site. The Panel recognizes that measures would be in place to ensure that OPG meets and follows regulatory requirements in these regards, and believes that a prudent approach for long-term waste management on site would ensure that there are no adverse cumulative effects on the health and safety of persons and the environment. The Panel would like to stress however that the principle of reversibility in this case could render the cumulative effect significant, if the waste is not properly managed beyond the operating life of the reactors.

Cumulative Radiation Doses to Workers and Public - Normal Operation

CNSC staff stated that cumulative radiation doses to workers were expected to be below regulatory limits and controlled as low as reasonably achievable using administrative and procedural controls. CNSC staff further stated that for non-nuclear energy workers and members of the public, planning would ensure that doses would be kept below the regulatory limit.

OPG stated that airborne concentrations of radioactivity and radiation levels from licensed activities that contribute to radiation doses to the receptors near the Darlington Nuclear site decrease with distance due to atmospheric dispersion and radioactivity decay. OPG stated that there would be a cumulative dose to humans living in the regional study area, which includes the Darlington, Pickering and Port Hope area nuclear sites. OPG determined that the highest combined doses would be expected to occur at the respective site boundaries and would be almost entirely from the immediate adjacent facility. OPG presented estimated cumulative doses to the public from the Project at the site boundary, in combination with other identified projects and activities in the region, and concluded that the highest cumulative dose would be 0.006 millisieverts per year, which is below regulatory limits.

The Panel concludes that with the appropriate controls and mitigation measures in place, the radiological releases from normal operations of the Project, combined with other existing or planned nuclear projects and activities in the

regional study area, are not likely to result in significant adverse cumulative effects.

**Radiation Doses to Workers and the Public - Malfunction and Accident Scenarios**

The Panel notes that the Project would be added to the site with the existing Darlington Nuclear Generating Station, and the resulting cumulative dose should also be evaluated as a cumulative effect, as defined in the *Canadian Environmental Assessment Act*. OPG did not analyze the cumulative effects for malfunction and accident scenarios because they were considered hypothetical and to have a very low probability of occurring. OPG was of the view that this was consistent with guidance from the Canadian Environmental Assessment Agency which states that accidents should be considered as unique scenarios. The Panel notes OPG's interpretation of this aspect of the Canadian Environmental Assessment Agency *Cumulative Effects Practitioners Guide*. The Panel is of the view that a more appropriate interpretation, in this instance, would have been to include a cumulative effects assessment of a common-cause accident involving multiple reactors in the site study area.

The Panel has concluded that conventional malfunctions and accidents are not likely to cause significant adverse environmental effects, taking into account the proposed in-design safety systems, mitigation measures, including preventive measures and emergency response capabilities. However, based on the views expressed by participants during the review and the concerns regarding accident scenarios such as the Fukushima Daiichi nuclear accident, the Panel is of the view that for emergency planning purposes, OPG should perform an evaluation of the cumulative effect of a common-cause severe accident scenario that would include all of the nuclear generating reactors in the site study area.

**Recommendation # 63:**

*The Panel recommends that prior to construction, the Canadian Nuclear Safety Commission require OPG to evaluate the cumulative effect of a common-cause severe accident involving all of the nuclear reactors in the site study area to determine if further emergency planning measures are required.*

**Recommendation # 64:**

*The Panel recommends that the Canadian Environmental Assessment Agency revise the Canadian Environmental Assessment Agency Cumulative Effects Practitioner's Guide to specifically include a consideration of accident and malfunction scenarios.*

## 8.2 Sustainable Development

This section presents the Panel's review of sustainable development as it pertains to the requirements of the review. The EIS Guidelines required that OPG consider the extent to which the Project would contribute to sustainable development with respect to the effects on biodiversity and the capacity of renewable resources to meet the needs of present and future generations. The Panel assessed the effects on biodiversity and ecosystem integrity, community and economic development.

### 8.2.1 Biodiversity and Ecosystem Integrity

The Panel's review of sustainable development included a review of the effects of the Project on biodiversity and ecosystem integrity.

**Proponent Assessment**

OPG described its assessment of the effects of the Project on the ecosystem and biological diversity. OPG stated that the assessment of effects of the Project on biodiversity and ecosystem integrity indicated that there would be a loss of some biodiversity in the site study area due to disturbance to species and habitat during the site preparation and construction phase. OPG noted that these effects would include a loss of cultural meadow ecosystem vegetation, a loss of butterfly habitat, an impact on breeding birds, a loss of Bank Swallow habitat, and impacts on landscape connectivity, affecting wildlife travel along east-west corridor of the site.

OPG anticipated that during the operation and maintenance phase of the Project, much of the disturbance to species and habitat could be restored through remediation activities following construction. OPG noted that these site-specific remediation activities would be expected to contribute to the overall ecosystem integrity at the site, and as such, the effect on biodiversity and ecosystem integrity in the local and regional study areas would be expected to be limited.

#### Panel Assessment

The Panel considered the information provided by CNSC staff regarding its review of terrestrial and aquatic environments. For baseline data, CNSC staff found that the information OPG provided for the various components of the terrestrial environment characterized the existing conditions data at the site and collectively represented the on-site biodiversity. CNSC staff concluded that the information was adequate to evaluate the potential effects of the Project on biodiversity.

The Panel further notes that CNSC staff concurred with OPG that the loss of habitat with respect to vegetation communities could impact biodiversity in the area, but given that these effects would be restricted to the site study area, it would be expected that the overall impact on a local or regional scale would be limited.

With respect to the effects of the Project on biodiversity and ecosystem integrity, the Panel takes into consideration that the disruption to landscape is expected to be reversed following the completion of major construction activities. The Panel notes that CNSC staff was satisfied with the OPG assessment that the effects on the biodiversity and ecosystem integrity in the local and regional study areas would be limited.

The Panel concludes that with mitigation measures in place, the Project is not likely to result in a significant adverse effect on biodiversity and ecosystem integrity.

Notwithstanding the mitigation measures and compensation plans proposed by OPG, the Panel is of the view that there may still be a risk of losing biodiversity if the round whitefish of the north shore of Lake Ontario is a localized, specific genome; if the Bank Swallow compensation plan is not successful; or if the species at risk on the site cannot be adequately protected. In this respect, the Panel is of the view that a prudent approach, including follow-up programs and adaptive management, should be taken to ensure that the mitigation measures used to limit these effects are successful.

#### 8.2.2 Capacity of Renewable Resources

The Panel's review of sustainable development included a review of the capacity of renewable resources to meet the needs of the present and those of the future.

#### Proponent Assessment

OPG described its assessment of the effects of the Project on the capacity of renewable resources to meet the needs of the present and those of the future. OPG stated that in this regard, surface water resources, aquatic biota, terrestrial biota and groundwater could be affected.

Regarding surface water, OPG stated that adverse effects on water quality at water supply plants would not be expected as a result of thermal emissions. Similarly, the effects on water quality resulting from the influence of the thermal plume on biological activity and chemical activity were predicted to be small, with no effects on the ability to treat water for potable purposes. OPG stated that radiological concentrations would be below regulatory requirements. OPG further stated that non-radiological effects from the Project on surface water—such as cooling tower blowdown, surface water runoff, changes to discharge, and intake flow rates—would not be expected to cause a measurable change within Lake Ontario. As a result of this analysis, OPG stated that no Project-related activities were expected to affect the sustainability of surface water as a renewable resource, and therefore this aspect of the Project was expected to maintain progress towards sustainability.

Regarding aquatic biota, OPG stated that changes to the aquatic environment as a result of the Project could affect aquatic biota, specifically the fish population and diversity which have been identified as renewable resources. OPG noted that fish may be lost due to impingement and entrainment, but regional or lake-wide population level effects were not predicted. Furthermore, OPG stated that discharges to the environment would meet regulatory water quality requirements, and as such, no effect to the aquatic environment would be expected. OPG stated that it would be unlikely that there would be any adverse effect on the sustainability of fish populations and diversity as a result of the Project, and as such, this aspect of the Project is expected to maintain progress towards sustainability.

With respect to terrestrial biota, OPG noted that because no adverse effects on Lake Ontario were expected, the sustainability of Lake Ontario as a renewable resource for waterfowl would likely not be affected by the Project. OPG further stated



that radiation and atmospheric emissions arising from the Project were not expected to have a measurable effect, nor would it be likely that there would be any effect on the sustainability of vegetation communities and species or surface water resources and, subsequently, wildlife communities and species.

OPG stated that during site preparation, the Project may result in losses to vegetation communities and the loss of rare plant species. OPG noted that restoration measures would be effective in addressing likely effects on vegetation communities and species to a degree; however, a net loss of approximately 40 to 50 hectares of mostly cultural meadow ecosystem would be expected. OPG stated that in the context of the amount of natural habitat available across the regional study area, the long-term sustainability of vegetation communities and species may not be affected, but this loss could diminish progress towards sustainability.

With regards to groundwater, OPG stated that although the Project may change groundwater flow on the site as a result of dewatering during construction and alterations to the existing topography and recharge/discharge conditions, the drawdown of groundwater levels was expected to be largely limited to the Darlington Nuclear site, with a minor change in the shallow water on the St. Marys Cement property.

OPG noted that since the groundwater flows toward Lake Ontario, groundwater supplies—in particular those to local farms—would not likely be affected. OPG further stated that industry-standard stormwater management practices could be in effect such that changes in groundwater quality would not be expected to represent an adverse effect in the geological and hydrogeological environment. In addition, OPG stated that its analysis of potential radiological releases from the Project that may deposit on soil surfaces and transfer to groundwater determined that the Project is unlikely to adversely affect the geological and hydrogeological environment.

OPG stated that the Project is not likely to affect progress towards sustainability across the regional study area, and as such, progress towards sustainability would be maintained. OPG noted that the Project would have a greater adverse effect on progress towards sustainability if it were implemented with natural draft cooling towers.

#### Panel Assessment

The Panel notes that CNSC staff found the OPG assessment of the sustainability of renewable resources to be satisfactory.

With respect to surface water resources, the Panel is of the view that there would be a change to surface water quality in Lake Ontario in relation to tritium due to the increase in tritium releases from the Project. The Panel notes that although the increase in tritium is expected to be below and within current regulatory requirements, the Panel—recognizing the concerns of the public with respect to tritium—has recommended that the Project be operated under more restrictive standards.

Regarding aquatic biota, the Panel notes that OPG submitted that while impingement and entrainment may cause losses of fish, the predominant species affected would be round goby, an invasive species commonly found in the local study area, and alewife, for which lake-wide population-level effects were not predicted. The Panel is of the view that the significance of an effect is not diminished if it occurs with respect to an invasive species.

Furthermore, the Panel notes that effects on round whitefish may be greater than were originally predicted by OPG. The Panel notes that CNSC staff and Fisheries and Oceans Canada have identified the need to characterize the habitat and population of round whitefish and that further studies are expected to be performed to ensure that there are no significant effects to this species, particularly if it is determined that there may be a potential loss of a specific genome.

Regarding terrestrial biota, the Panel is of the view that restoration measures would be effective in addressing likely effects on vegetation communities, although there would be a disruption period of several years during the site preparation and construction phase before the restoration measures could be implemented. The Panel notes that these measures would only be effective on the Project site if a once-through cooling system is used; if cooling towers are installed there may not be sufficient space on the site to fully accommodate the restoration measures. The Panel is of the view that OPG may have to develop an appropriate compensation plan to ensure that these restoration measures would be in place.

The Panel is of the view that with appropriate mitigation measures in place, including restoration, significant, residual adverse effects are not likely.

Regarding groundwater, the judgement of the Panel is based on conclusions regarding tritium deposits on soil surfaces and the subsequent transfer to groundwater. The Panel is of the view that groundwater monitoring should be established to confirm that concentrations of contaminants of potential concern do not exceed the levels predicted in the environmental assessment and has made a recommendation in this regard. The Panel concludes that with appropriate mitigation measures in place, significant adverse effects are not likely.

#### 8.2.3 Community

The Panel's review of sustainable development included a review of the effect of the Project on the communities in the local and regional study areas.

OPG stated that the sustainability goal for the Project was to promote balanced growth and healthy, liveable communities. In this regard, OPG indicated that the Project would enhance: balanced development; the efficient use of infrastructure and access to services; the ability of communities in the regional study area to 'live, work and play'; and community pride, identity and well-being. OPG noted that community pride and identity would be diminished if natural draft cooling towers were to be used.

The Panel concurs with OPG's assessment and also heard from several local governments who confirmed the views of OPG in this respect.

The Panel agrees that the use of natural draft cooling towers could result in an adverse effect on community well-being, as explained by OPG. The Panel notes, however, that this would not preclude the use of another type of cooling tower, such as a mechanical draft cooling towers with plume abatement.

#### 8.2.4 Economic Development

The Panel's review of sustainable development included a review of the effect of the Project on economic development in the local and regional study areas.

OPG stated that a sustainability goal of the Project was to promote economic development. In this regard, OPG indicated that the Project would promote new job opportunities and business retention, expansion and creation; contribute to the Region of Durham energy sector; promote diversification of the skills base in the regional study area; and promote healthy municipal finance. OPG stated that the Project would meet its goal of promoting economic development and would enhance these aspects.

The Panel notes that several participants concurred with OPG that the Project would promote and likely enhance economic development in the region and in Ontario. The Panel is satisfied with the sustainability assessment performed by OPG in this regard.

### 8.3 Greenhouse Gas Emissions

The Panel's assessment included a review of the effects of greenhouse gas emissions from the Project.

OPG provided information regarding the expected greenhouse gas emissions to the atmospheric environment for the various phases of the Project. OPG stated that greenhouse gas emissions were considered to be negligible in any given year, i.e., less than 0.01% of carbon dioxide-equivalent emissions from Ontario sources in 2005.

Although the mandate of the Panel does not include a review of the nuclear fuel cycle from cradle to grave, the Panel acknowledges the views expressed by participants in this regard. Some participants suggested that although there may be low greenhouse gas emissions during the operation of a nuclear generating station, many greenhouse gases are emitted throughout the nuclear lifecycle due to the mining, processing and fabrication of the fuel, as well as during site preparation, construction and decommissioning.

Other participants were of the view that when the entire lifecycle of a nuclear generating station is taken into account, these emissions would be lower than other baseload energy sources like coal and natural gas, and comparable to wind and solar generation on a per kilowatt-hour basis. This was confirmed by the Ontario Ministry of Energy.

Based on the information presented, the Panel is of the view that greenhouse gas emissions from the Project are not likely to cause significant adverse environmental effects.

## 8.4 Transboundary Effects

The Panel considered information regarding Canada-United States air and water quality agreements and the role of the International Joint Commission. The Panel heard representations from Environment Canada, the Department of Foreign Affairs and International Trade and other participants regarding the possible application of the *Canada-United States Air Quality Agreement* (1991), the *Boundary Waters Treaty* (1909) and the *Great Lakes Water Quality Agreement* (1978).

The Panel notes that Environment Canada indicated that only discharges of ammonia could potentially meet or exceed the one tonne threshold that triggers notification requirements under the *Canada-United States Air Quality Agreement*. The Panel further notes Environment Canada's commitment to re-evaluating the list of substances to be released once a detailed design is available. The Panel is satisfied with the assessment of potential notification obligations and the commitment from Environment Canada to revisit the complete list of substances in the context of a detailed design.

A participant noted that sections 46 and 47 of the *Canadian Environmental Assessment Act* could be invoked to require the assessment of transboundary effects by the Canadian Government and to trigger notification requirements under the *Canada-United States Air Quality Agreement*. However, the Panel notes that sections 46 and 47 of the Act are only applicable when no environmental assessment of a project is required before a federal body exercises its authority.

The Panel notes that regulation of water withdrawals from Lake Ontario balances the needs of those on Lake Ontario with other downstream interests. The *Boundary Waters Treaty* establishes a framework for the review and approval of sizeable withdrawals of water that could potentially have an effect on levels and flows across the international line. The Panel also notes the information presented concerning the possible effects of a water withdrawal of 4.5 cubic metres per second for the Project if cooling

towers are selected for the Project. The Panel further notes the advice that such a withdrawal, in the context of the overall levels of Lake Ontario, would be very small and the expected effect on the lake water levels would not be measurable. The Panel recognizes, however, that the Project water withdrawal may trigger the provisions of the *International Boundary Waters Treaty Act* (R.S.C., 1985, c. I-17) and require either a Canada-United States agreement or Order of Approval from the International Joint Commission, followed by a licence from the Department of Foreign Affairs and International Trade.

## 8.5 Ethical Concerns

This section presents the Panel's assessment of matters that could be considered ethical concerns. These matters included the legacy of nuclear waste from the Project, nuclear liability and sustainability assessment.

### 8.5.1 Nuclear Legacy

Due to the views of many participants, the Panel's review included a consideration of the nuclear legacy of the Project as it relates to the management of nuclear fuel waste and decommissioning. The Panel considered whether the Project would place a burden on future generations that did not have the advantage of using the energy producing this waste.

OPG stated that waste management and decommissioning would not burden future generations because, in accordance with regulatory requirements, both activities would be funded concurrent with the operation of the reactors. OPG explained that it would expand its segregated funds for its existing nuclear generating stations to cover the eventual decommissioning and the long-term management of nuclear wastes arising from the Project. OPG further explained that the funds associated with decommissioning are strictly controlled and subject to oversight by the Government of Ontario.

OPG further stated that the Nuclear Waste Management Office is in place under the Government of Canada *Nuclear Fuel Waste Act* to ensure that the long-term management of radioactive waste would not burden future generations. OPG noted that the *Nuclear Fuel Waste Act* also governs how the nuclear waste funds are established and governed.

The Panel acknowledges the concerns of participants who felt that a long-term solution for waste management should be found before the Project can proceed. The Panel also acknowledges the concerns of those who felt that the Project would place a burden on future generations.

The Panel accepts that the OPG segregated funds would cover the costs of decommissioning and waste management to ensure that they are not a burden on future generations. The Panel also recognizes the Government of Canada's position in this regard is to proceed with the Adaptive Phased Management approach recommended by the Nuclear Waste Management Office under the provisions of the *Nuclear Fuel Waste Act*.

The Panel concludes that with the funding requirements and provisions of the *Nuclear Fuel Waste Act* in place, the Project is not likely to result in a financial burden on future generations. However, the Panel has a recommendation regarding research in this area.

**Recommendation # 65:**

*The Panel recommends that the Government of Canada make it a priority to invest in developing solutions for long-term management of used nuclear fuel, including storage, disposal, re-processing and re-use.*

**8.5.2 Nuclear Liability**

The Panel's review included a consideration of the requirements for nuclear liability insurance in Canada and the Canadian legislation on the matter.

OPG stated that the *Nuclear Liability Act* covers the off-site liabilities for nuclear activities. OPG noted that it also has an insurance program that covers on-site liabilities, including damage to the facilities.

The Panel notes that many participants expressed the concern that the \$75 million liability insurance under the current federal *Nuclear Liability Act* would not be sufficient to cover the damages incurred as a result of a severe nuclear accident. Some participants suggested that the cost of damages of such an accident could far exceed \$1 billion.

Some participants suggested that if the Project were to go ahead, the Panel should require that

the Canadian *Nuclear Liability Act* be updated to assign increased liability to the operator. Some participants also suggested that the federal legislation should be aligned with the polluter pays principle, where all of the compensation resulting from a nuclear accident should be paid by the nuclear operators and not the Government of Canada.

At the request of the Panel, CNSC staff provided an overview of the *Nuclear Liability Act*. CNSC staff explained that the federal *Nuclear Liability Act* was put into force in 1976 to provide compensation in the event of an accident that could occur from a sustained chain reaction, with an operator liability up to \$75 million. CNSC staff noted that the federal government has a re-insurance agreement with the insurance industry to provide additional coverage beyond the \$75 million.

CNSC staff explained that Parliament would have to authorize any federal government funding over and above the \$75 million liability limit of the operator if that limit was not adequate in the case of an accident covered by the *Nuclear Liability Act*.

CNSC staff further stated that the government had tabled on several occasions a new proposed Act called the *Nuclear Liability and Compensation Act*, which would have increased the liability to the operator for accident events from \$75 million to \$650 million. CNSC staff noted that where the current *Nuclear Liability Act* only addresses uncontrolled sustained chain reaction fission events, the proposed *Nuclear Liability and Compensation Act* would have addressed damage from any ionizing radiation and from any initiating event. CNSC staff further noted that the proposed *Nuclear Liability and Compensation Act* had gone through a second reading in Parliament but died on the Order Paper due to the 2011 federal election. CNSC staff noted that the *Nuclear Liability and Compensation Act* is expected to be back on the federal government order paper.

CNSC staff also provided an overview of the financial liability limits for several nuclear countries, including Canada, the United States, the United Kingdom, France, Germany, Japan and Sweden, as can be seen in Table 10: Overview of Nuclear Civil Liability Regime Compensation Amounts for Nuclear Power Reactors in Select Countries.

Table 10: Overview of Nuclear Civil Liability Regime Compensation Amounts for Nuclear Power Reactors in Select Countries (all funds in Canadian dollars)

Country	Operator Insurance Amount	Public Funds <sup>(1)</sup>	Contributions from International Nuclear Liability Convention Member Countries	Operator Funds	Pool	Total Compensation
Canada	\$75 million	Not applicable <sup>(2)</sup>	Not applicable	Not applicable		\$75 million
United States	\$360 million	Not applicable	Not applicable	\$11.17 billion <sup>(3)</sup>		\$11.5 billion
United Kingdom	\$220 million	\$50 million	\$190 million	Not applicable		\$460 million
France	\$130 million	\$140 million	\$190 million	Not applicable		\$ 460 million
Germany	\$350 million	Not applicable	Not applicable	\$3.1 billion <sup>(3)</sup>		Unlimited
Japan	\$1.4 billion	Not applicable	Not applicable	Not applicable		Unlimited <sup>(4)</sup>
Sweden	\$460 million	\$475 million	Not applicable	Not applicable		\$930 million

- (1) Governments could decide to appropriate funds for compensation if the damages exceeded the limits imposed by their respective nuclear civil liability legislation.
- (2) Parliament would have to authorize any federal government funding over and above the \$75M liability limit of the operator if that limit was not adequate in the case of an accident covered by the Nuclear Liability Act.
- (3) To the extent that the operator's insurance amount was insufficient to compensate damage from an accident, this is the maximum amount of funds that would be made available from the contributions of all operator/reactors to the pool.
- (4) It is recognized that in these jurisdictions that have an unlimited liability regime, any given operator would have finite resources.

CNSC staff noted that the total compensation values comprise various forms of funding, including operator insurance, public funds, contributions from international nuclear liability convention member countries and operator pool funds. CNSC staff stated that the operator insurance amounts outside of Canada range from \$130 million to \$1.4 billion.

The Panel has considered the interest and concerns of participants regarding the *Nuclear Liability Act*. The Panel notes that most participants agreed that the current *Nuclear Liability Act* is out of date. The Panel is of the view that participants also agreed that the proposed increase to the operator liability of \$650 million would be an improvement over the existing legislation, although some participants felt that the liability should be even greater. The Panel agrees with this position. Table 10 illustrates this view.

The Panel is of the view that the federal government should carry out a complete review

of the level of coverage provided under the future *Nuclear Liability and Compensation Act* or its equivalent. The Panel believes that the level of coverage should be updated to reflect the present situation regarding nuclear power plant operations and the costs associated with nuclear accidents. The Panel is of the view that this new legislation must be in place before the Project can proceed to the construction stage.

**Recommendation # 66:**

*The Panel recommends that the Government of Canada update the Nuclear Liability and Compensation Act or its equivalent to reflect the consequences of a nuclear accident. The revisions must address damage from any ionizing radiation and from any initiating event and should be aligned with the polluter pays principle. The revised Nuclear Liability and Compensation Act, or its equivalent, must be in force before the Project can proceed to the construction phase.*

### 8.5.3 Sustainability Assessment

A participant suggested that a sustainability assessment would be a better tool than an environmental assessment to evaluate the legacy of a project because it would evaluate issues beyond adverse effects and mitigation measures. Many participants felt that the requirements for sustainable development in the review of the Project had too narrow a scope.

The Panel considers that nuclear projects in Canada could be evaluated within a broader sustainability assessment framework and not just in terms of biodiversity and capacity of renewable resources to meet the requirement of future generations. It is also of the view that in such a case, there would be greater emphasis on the legacy in terms of waste legacy and nuclear liability. To achieve this, an environmental assessment would need a framework that looks at the sustainability of a project starting with the preparation of the EIS Guidelines, at minimum. In this regard, the Panel is of the view that the Government of Canada should provide direction regarding the assessment and criteria for sustainable development with respect to future nuclear projects.

**Recommendation # 67:**

*The Panel recommends that the Government of Canada provide clear and practical direction on the application of sustainability assessment in environmental assessments for future nuclear projects.*

### 8.6 Monitoring and Follow-up Programs

This section presents the Panel's assessment of OPG's proposed monitoring and follow-up programs for the Project. The purpose of a follow-up program under the *Canadian Environmental Assessment Act* is to verify the accuracy of the environmental assessment of a project and to determine the effectiveness of any measures taken to mitigate the adverse environmental effects of a project.

OPG's monitoring and follow-up programs were considered and reviewed by CNSC staff. The Panel has evaluated the adequacy of these programs and has made recommendations in this report where it deems appropriate.

CNSC staff recommended that a condition of the Licence to Prepare Site be that OPG shall have

an environmental assessment follow-up program prior to commencing applicable licensed activities. CNSC staff expected that subsequent licences under the *Nuclear Safety and Control Act* would have a similar commitment with respect to environmental assessment follow-up.

Under the *Canadian Environmental Assessment Act*, the responsible authorities, in this case the Canadian Nuclear Safety Commission, Fisheries and Oceans Canada and Transport Canada, are responsible for ensuring that follow-up is implemented. CNSC staff stated that as the lead responsible authority, the Canadian Nuclear Safety Commission would coordinate this matter.

The proposed approach of CNSC staff for developing the details of the follow-up program was as follows:

1. identify program elements through a multi-stakeholder consultative process;
2. determine the scope and timing of each of the identified program elements, including details of the monitoring parameters, locations, frequency and duration;
3. identify how the proposed program elements might be incorporated into or coordinated with the Project site monitoring programs that would be implemented to meet the requirements of the *Nuclear Safety and Control Act*;
4. determine the frequency and the method of reporting results to the Canadian Nuclear Safety Commission, the public and other stakeholders;
5. review the details of all proposed program elements with the Canadian Nuclear Safety Commission and other regulatory agencies, as appropriate;
6. review and discuss the program with other stakeholders, as appropriate;
7. incorporate appropriate elements of the program into the Project site monitoring programs;
8. determine decision points at which monitoring and mitigation measures may need to be revised based on exceeded thresholds, occurrence of unforeseen effects and other established criteria; and
9. identify appropriate measures that may be taken to rectify unacceptable results, such as mitigating any unpredicted adverse effects or improving the effectiveness of specific aspects of monitoring and reporting.

CNSC staff also provided information regarding its consultative stakeholder process to develop the final follow-up program. CNSC staff stated that part of this process would include a workshop to outline risk management options for all adverse effects such that all monitoring would be designed to be relevant to discriminating between these options, including no risk management intervention. CNSC staff noted that designing monitoring to allow discrimination between management alternatives is a key aspect of applying the planned adaptive management approach to follow-up monitoring and mitigation.

The Panel agrees with what was proposed by CNSC staff except for where adaptive management is proposed. The Panel is of the view that adaptive management should only be used when there are thresholds that can be defined, and that it should not be used to overcome uncertainty or absence of scientific data. The Panel notes that monitoring and compensation plans should also be included in the follow-up plan.

## 8.7 Measures to Enhance Beneficial Environmental Effects

This section includes the Panel's assessment of measures to enhance beneficial environmental effects of the Project.

### 8.7.1 Proponent Assessment

OPG indicated that this requirement of the EIS Guidelines was dealt with through its assessment and mitigation of likely environmental effects. OPG stated that the primary beneficial environmental effects that would be enhanced by the Project included the economic effects as well as the enhancement of the ecosystem and wildlife habitat on the site following remediation.

OPG referred to the positive contributions it has made to the local and regional communities, including the recreational use of the Darlington site and the enhanced natural state of the site. OPG indicated it made a similar commitment to restore the northeastern part of the site following site preparation and construction to enhance the area of wildlife habitat beyond that which currently exists at the site. In addition, OPG noted that the economic benefits of the Project would be substantive.

### 8.7.2 Panel Assessment

The Panel notes that this issue was not discussed by other participants, although some participants concurred with OPG about the benefits of the Project. The Panel also notes comments provided by OPG on this matter. As such, the Panel recognizes that while the enhancement of benefits is a factor to be assessed in accordance with the EIS Guidelines, the conclusions presented by OPG in this regard were not disputed by participants.

The Panel is of the view that the beneficial effects referred to by OPG and some participants are principally related to economic benefit, including employment and business opportunities, and municipal taxes. The Panel agrees with the sustainability analysis of OPG with respect to economic development.

The Panel concurs that the Project is likely to increase the population associated with, or directly dependent on, Darlington Nuclear site-related employment, and as such, the Project is considered to be a positive contributor to the anticipated population growth across the regional and local study areas. The Panel recognizes that the Municipality of Clarington has a Host Municipality Agreement, which will enhance its benefits.

The Panel observed that the number of available jobs may not be as high as it would have anticipated. It accepts, however, OPG's targets for local job creation. The Panel notes that there is no arrangement to enhance the beneficial socio-economic effects for Aboriginal persons.

Regarding the ecosystem on the Project site and its use for recreational purposes, the Panel is of the view that compensation plans and mitigation measures constitute requirements to mitigate potential adverse effects and are not measures to enhance beneficial environmental effects. The Panel concurs with OPG that any improvement of the site ecosystem beyond that which currently exists at the site would be an enhancement of a beneficial environmental effect.

The Panel is satisfied that measures are in place to enhance the beneficial environmental effects of the Project.





## Conclusion

The Panel concludes that the Project is not likely to cause significant adverse environmental effects, provided the mitigation measures proposed and commitments made by OPG during the review and the Panel's recommendations are implemented.

The Panel directs recommendations to responsible authorities and federal authorities, as well as to the Government of Canada, the Government of Ontario, the Municipality of Clarington and OPG.

In this report, the Panel highlights actions that are required to address issues regarding land use, health, waste management, the consequences of a severe accident, and the choice of a reactor technology.

It is important that the Government of Ontario and local governments take measures to control land development in the vicinity of the Project to ensure that adequate emergency response measures can be maintained over the lifetime of the Project.

On the matter of health effects, the Government of Canada through Health Canada and the Canadian Nuclear Safety Commission should continue to conduct research and participate in international studies to identify long-term health effects of low-level radiation exposures and to identify if there is a need for revision of dose limits specified in the *Radiation Protection Regulations*.

The Panel is of the view that the Government of Canada should make it a priority to invest in developing solutions for the long-term

management of used nuclear fuel, such as storage, disposal, re-processing and re-use.

The consequences of a severe accident are expected to be within bounds that would permit the implementation of emergency measures to prevent undue doses of radiation to the public. However, the Panel maintains that it is necessary to continually improve emergency preparedness and response measures and revise emergency planning zones. In addition, the Panel deems it necessary that the Government of Canada revise the *Nuclear Liability Act* to ensure that appropriate coverage is in place.

Once a reactor technology has been selected by the Government of Ontario, it must be determined if the specific aspects and parameters of that technology are fundamentally the same as those considered in this review. If the technology is fundamentally different, then this review does not apply and a new environmental assessment must be conducted.

The Panel has made certain recommendations on matters that are not specific to the Project but are relevant to important issues raised during the review, particularly regarding sustainability assessment.

The Panel's recommendations appear throughout the preceding chapters and are arranged by responsible organization and Project stage in the summary at the beginning of this report. Where OPG must perform an action, it is understood that this action be a requirement of the appropriate responsible authority. The implementation of these recommendations is subject to the response of the Government of Canada to this environmental assessment report.



## Appendix 1 – Joint Review Panel Agreement

**AGREEMENT  
TO ESTABLISH A JOINT REVIEW PANEL  
FOR THE NEW NUCLEAR POWER PLANT PROJECT BY ONTARIO POWER  
GENERATION (DARLINGTON)  
WITHIN THE MUNICIPALITY OF CLARINGTON, ONTARIO**

**BETWEEN**

**THE MINISTER OF THE ENVIRONMENT  
-and-  
THE CANADIAN NUCLEAR SAFETY COMMISSION**

**PREAMBLE**

**WHEREAS** the Minister of the Environment has statutory responsibilities pursuant to the *Canadian Environmental Assessment Act*;

**WHEREAS** the Commission has statutory responsibilities pursuant to the *Nuclear Safety and Control Act* and to the *Canadian Environmental Assessment Act*;

**WHEREAS** Ontario Power Generation has applied to the Commission to seek approval to prepare a site for the construction and operation of nuclear power reactors;

**WHEREAS** the Minister and the Commission acknowledge that a duty to consult arises when the Crown has knowledge, real or constructive, of the potential existence of Aboriginal rights, title or Treaty rights, and contemplates conduct that might adversely affect it;

**WHEREAS** an environmental review of the Project by a Joint Review Panel is an important source of information about effects the Project may have on potential or established Aboriginal rights, title or Treaty rights and would therefore support any consultations between the Crown and potentially affected Aboriginal groups related to the Project;

**WHEREAS** the Project is within the jurisdiction of the Commission under the *Nuclear Safety and Control Act* and requires an environmental assessment pursuant to the *Canadian Environmental Assessment Act*;

**WHEREAS** the Commission, Fisheries and Oceans Canada, the Canadian Transportation Agency and Transport Canada are the Responsible Authorities for the Project pursuant to the *Canadian Environmental Assessment Act*;

**WHEREAS** the Project requires a licence pursuant to the *Nuclear Safety and Control Act*;

**WHEREAS** the Commission has recommended, in accordance with section 25 of the *Canadian Environmental Assessment Act*, that the Minister of the Environment refer the Project to a review panel;

**WHEREAS** the Minister of the Environment has referred the Project to a review panel in accordance with section 29 of the *Canadian Environmental Assessment Act*;

**WHEREAS** the Parties to this Agreement have determined that a review of the Project by a joint review panel will ensure that the Project is reviewed in a manner that will provide for an effective and efficient environmental assessment and regulatory process;

**AND WHEREAS** the Minister of the Environment has determined that a joint review panel should be established pursuant to subsection 40(2) of the *Canadian Environmental Assessment Act* to consider the Project;

**NOW THEREFORE**, the Parties hereby establish a Joint Review Panel for the Project in accordance with the provisions of this Agreement and the Terms of Reference attached as an Appendix to this Agreement.

## **1. DEFINITIONS**

In this Agreement:

**“Aboriginal group”** means a community of Indian, Inuit or Métis people that holds or may hold Aboriginal or treaty rights under section 35 of the *Constitution Act, 1982*.

**“Agency”** means the Canadian Environmental Assessment Agency;

**“CEAA”** means the *Canadian Environmental Assessment Act*;

**“Commission”** means the Canadian Nuclear Safety Commission;

**“Environment”** has the same meaning as set out in section 2 of the CEAA;

**“Environmental Effect”** has the same meaning as set out in section 2 of the CEAA;

**“Environmental Impact Statement”** means the document that the Proponent has prepared in accordance with the Environmental Impact Statement Guidelines issued by the Parties pursuant to Part II of the Appendix to this Agreement.

**“Federal Authority”** has the same meaning as set out in section 2 of the CEAA;

**“Follow-up program”** has the same meaning as set out in section 2 of the CEAA;

**“Intervenor”**, means a person appearing at a Joint Review Panel Hearing pursuant to rule 18 of the *Canadian Nuclear Safety Commission Rules of Procedure*, a person participating as an intervenor in a Joint Review Panel Hearing pursuant to rule 19 of the *Canadian Nuclear Safety Commission Rules of Procedure* or a person who establishes an interest to participate in the Joint Review Panel Hearings by way of a written submission and/or an oral presentation.

**“Joint Review Panel”** means a Joint Review Panel (JRP) established through this Agreement;

**“Joint Review Panel Agreement”** means this Agreement to Establish a Joint Review Panel for the Darlington New Nuclear Power Plant (Darlington NNPP) Project by Ontario Power Generation within the Municipality of Clarington, Ontario and the attached Appendix;

**“Joint Review Panel Hearing”** means the public hearing process followed by the Joint Review Panel to hear information and evidence required for the Review;

**“Joint Review Panel Report”** means a report which sets out the rationale, conclusions and recommendations of the panel relating to the environmental assessment of the project, including any mitigation measures and follow-up program, and a summary of any comments received from the public in the course of the Joint Review Panel Hearings;

**“Jurisdiction”** has the same meaning as set out in subsection 40(1) of the CEAA;

**“Licence Application”** means the documentation filed by the Proponent under the NSCA for a Licence to Prepare Site prior to the construction of the Project.

**“NSCA”** means the *Nuclear Safety and Control Act*;

**“Parties”** mean the signatories to this Agreement;

**“Project”** means the preparation of a site for, and the construction, operation, decommissioning and abandonment of, up to four new nuclear power reactors on the existing Darlington Nuclear Site within the Municipality of Clarington, Ontario described in Part I of the Appendix to this Agreement;

**“Proponent”** means Ontario Power Generation (OPG);

**“Public Registry”** means the Canadian Environmental Assessment Registry established under section 55 of the CEAA, to facilitate public access to records relating to the environmental assessment of the Project;

**“Responsible Authority”** has the same meaning as set out in section 2 of the CEAA and includes for this Project the Commission, Fisheries and Oceans Canada, the Canadian Transportation Agency and Transport Canada; and

**“Review”** means the assessment by the Joint Review Panel of the environmental effects of the Project to be conducted pursuant to the CEAA and the consideration of the Licence Application under the NSCA to determine whether the Project will pose an unreasonable risk to the health and safety of persons, the environment and national security.

## **2. ESTABLISHMENT OF THE JOINT REVIEW PANEL (JRP)**

- 2.1** A process is hereby established to create a Joint Review Panel (JRP) that will:
- a) Constitute a review panel pursuant to sections 40, 41 and 42 of the CEAA for the purposes of carrying out an environmental assessment of the Project; and
  - b) Constitute a panel of the Commission, created pursuant to section 22 of the NSCA, for the purposes of the review of the Licence Application pursuant to section 24 of the NSCA.
- 2.2** Nothing in this JRP Agreement shall be construed as limiting the ability of the JRP to have regard to all considerations that appear to be relevant pursuant to section 24 of the NSCA and to include a consideration of the factors set out in sections 16 and 16.1 of the CEAA.

## **3. CONSTITUTION OF THE JOINT REVIEW PANEL**

- 3.1** The JRP will consist of three members. Two members will be appointed by the President of the Commission with the approval of the Minister of the Environment.
- 3.2** The Minister of the Environment will propose to the President of the Commission a candidate as a third member of the JRP who may also serve as a temporary member of the Commission.
- 3.3** The Minister of the Environment will choose which member will serve as the Chair of the JRP.
- 3.4** Upon approval by the President of the Commission of a candidate as a third member of the JRP who may also serve as a temporary member of the Commission, the President of the Commission will recommend to the Minister of Natural Resources that the Minister of Natural Resources recommend the proposed candidate to the Governor in Council for the appointment of that proposed candidate as a temporary member of Commission.
- 3.5** If appointed by the Governor in Council as a temporary member of Commission, the selected candidate will then be appointed by the Minister of the Environment as a member of the JRP.

- 3.6** The members of the JRP are to be unbiased and free of any conflict of interest in relation to the Project and are to have knowledge or experience relevant to the anticipated environmental effects of the Project.

#### **4. CONDUCT OF THE REVIEW**

- 4.1** The JRP shall conduct the Review in accordance with the Terms of Reference attached as an Appendix to this JRP Agreement in a manner that:
- a) Discharges the requirements set out in the CEAA;
  - b) Permits it to obtain the information and evidence required for it to consider the Licence Application under the NSCA; and,
  - c) Permits it to obtain information and evidence about the adverse effects the project may have on potential or established Aboriginal rights, title or Treaty rights as identified to the JRP by potentially affected Aboriginal groups and enables it to bring any such information and evidence to the attention of the Minister of the Environment and the Responsible Authorities for the Project in support of consultation between the Crown and potentially affected Aboriginal groups.
- 4.2** The JRP shall have all the powers and duties of a review panel described in section 35 of the CEAA.
- 4.3** As a panel of the Commission, the JRP shall also have the powers and duties of the Commission described in section 20 of the NSCA.

#### **5. SECRETARIAT**

- 5.1** A Secretariat will be formed consisting of professional, scientific, technical or other Agency and Commission personnel necessary for the purposes of the Review.
- 5.2** The Secretariat will provide information to the JRP orally and in writing during the JRP Hearings.
- 5.3** The personnel who comprise the Secretariat shall not be considered to be Intervenors.
- 5.4** The Secretary of the Commission, and/or his designate, will act as Secretary to the JRP and as co-manager of the Secretariat.
- 5.5** The Agency shall appoint a panel manager as co-manager of the Secretariat.

## **6. RECORD OF THE REVIEW**

- 6.1** Subject to section 55 and subsections 35(4), and 35(4.1) of the CEAA, the Public Registry will include all submissions, correspondence, hearing transcripts, exhibits and other information received by the JRP and all public information produced by the JRP relating to the Review.
- 6.2** The internet site component of the Public Registry will be maintained by the Secretariat during the course of the Review in a manner that provides for convenient public access, and for the purposes of compliance with sections 55 to 55.5 of the CEAA.
- 6.3** A project file will be maintained by the Secretariat during the course of the Review in a manner that provides for convenient public access, and for the purposes of compliance with sections 55 and 55.4 of the CEAA. This project file will be located in the offices of the Secretariat.

## **7. JOINT REVIEW PANEL REPORT**

- 7.1** On completion of the assessment of the Project, the JRP will prepare a JRP Report.
- 7.2** The JRP will convey the JRP Report in writing in both official languages to the Minister of the Environment. The JRP Report will be published and made available through the Public Registry.
- 7.3** Responsible Authorities will take a course of action with respect to section 37 of the CEAA and the JRP, as a panel of the Commission, may also make a decision with respect to the Licence Application pursuant to section 24 of NSCA.

## **8. OTHER FEDERAL DEPARTMENTS AND JURISDICTIONS**

- 8.1** At the request of the JRP, federal authorities having specialist information or knowledge with respect to the Project shall make available that information or knowledge in a manner acceptable to the JRP.
- 8.2** Subject to article 8.1, nothing in this JRP Agreement shall restrict the participation of a Jurisdiction by way of submission to the JRP.

## **9. PARTICIPANT FUNDING**

- 9.1** Participant funding for the Review will be provided and administered by the Agency pursuant to the Participant Funding Program.



## **10. AMENDING THIS JOINT REVIEW PANEL AGREEMENT**

- 10.1** The terms and provisions of this JRP Agreement may be amended by written memorandum executed by both the Minister of the Environment and the President of the Commission.
- 10.2** Subject to section 27 of the CEAA, upon completion of the Review, this JRP Agreement may be terminated at any time by an exchange of letters signed by both Parties.

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The Honourable Jim Prentice  
Minister of the Environment

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Michael Binder  
President, Canadian Nuclear Safety  
Commission

## APPENDIX

### Terms of Reference for the Review

#### Part I - Project Description

Pursuant to subsections 15(1)(b) and 15(3)(b) of the *Canadian Environmental Assessment Act*, the Minister of the Environment is proposing that the scope of the project include the site preparation, construction, operation, decommissioning and abandonment of the project components and activities proposed by OPG as described in *OPG New Build Project Environmental Assessment – Project Description*.

The scope of the Darlington NNPP Project includes site preparation, construction, operation, decommissioning and abandonment of up to four new nuclear power reactors for the production of up to 4,800 megawatts of electrical generating capacity for supply to the Ontario grid.

Operations would involve activities required to operate and maintain the Darlington NNPP, including management of all conventional and radioactive wastes. The Province of Ontario is considering a range of reactor designs. It is anticipated that each new reactor constructed would have an approximate 60-year operating life and could include a mid-life refurbishment depending on the reactor design technology chosen by the proponent.

The project includes up to four units, consisting of the following principal components:

- Reactor Building – contains the reactor vessel, fuel handling system, heat transport system, moderator, reactivity control mechanisms, shut down systems and containment.
- Turbine Generator Powerhouse – contains the turbines, generators and related systems and structures that convert steam from the operation into electrical energy.

The project also includes the following shared facilities between reactors:

- Condenser Cooling Systems and Structures: including cooling towers or the once-through cooling system with all of its associated submerged intake, forebay and discharge systems.
- Low and Intermediate Level Waste Management Facility (on or off-site)
- Expansion of the existing Darlington Waste Management Facility for storage of used nuclear fuel or construction of a new facility.

Ancillary activities that may be required include the transportation of low and intermediate level waste to be managed offsite at an appropriate licensed facility.

The following describes activities expected to be undertaken:

*Preparation Phase:*

Site preparation includes the following activities needed to construct the new nuclear reactors and associated physical works listed above:

- construction and enhancing of on-site roads, which would connect to local roads and provincial highway 401 as appropriate, to provide access to the site;
- re-establishment of a rail line spur if required;
- construction of a wharf if required;
- construction of parking lots and laydown areas;
- construction site fencing;
- removal of existing trees and vegetation if necessary;
- shoreline stabilization and lake infilling, coffer dam construction;
- realigning intermittent stream channels and draining some wet areas across site;
- earthmoving activities including cutting, filling, grading construction areas, creating berms and stockpiles;
- installation of necessary infrastructure such as power, water main, sewage systems, surface water drainage, storm water sewers; and
- bedrock excavation for foundations.

*Construction:*

Construction includes the following activities needed to construct the new nuclear reactors and associated physical works listed above:

- installation of bedrock piles;
- expansion of the switchyard;
- receipt and management of materials and components for installation;
- installation of the intake and outfall to Lake Ontario;
- construction of cooling towers if required;
- construction of the reactors, power house buildings, structures, and systems;
- removal of construction debris to a licensed facility, including any hazardous waste created during construction;
- testing and commissioning of systems and structures;
- landscaping; and
- final site fencing and security system installation.

*Operation and Maintenance Phase:*

The operation phase includes all of the work and activities that occur during routine operation and maintenance of the new nuclear reactors and associated buildings, structures and systems. This phase consists of the 60-year timeframe over which the nuclear power station is expected to generate electricity.

Commissioning a new nuclear power plant consists of the following general activities: verification and qualification of systems, pressure testing of vessels, fuelling of reactor; pressure testing of containment building, approach to criticality, approach to full power; testing of the reactor core physics, verification of control systems, connection to the grid, operational testing and full power operation. Some commissioning activities, specifically those that take place without fuel in the reactor core, may be authorized during the construction phase.

Following commissioning, the activities to be undertaken include the operation and maintenance of plant systems including nuclear steam supply systems, turbine generator and feedwater systems, electrical power systems, nuclear safety systems, ancillary systems, systems for maintaining facility security, activities associated with the maintenance program, materials handling systems, solid waste handling systems and administration and support systems.

Operation and maintenance activities can be categorized as follows:

- operation of equipment for production of electricity;
- verification, sampling, testing and maintenance during operation at power;
- maintenance, repairs, cleaning, and decontamination during planned shutdowns and outages;
- on-site transportation and handling of fuel, including defueling and refuelling of the reactor;
- management of low and intermediate waste and spent fuel waste within the reactor building, and the transfer of wastes and used fuel for interim or long-term storage;
- management of hazardous substances and hazardous waste; and activities relating to environmental protection and radiation protection programs; and
- activities required to achieve a safe state of closure prior to decommissioning.

During this phase, the assessment would include consideration of the effects associated with mid-life refurbishment for CANDU-type reactors as well as the effects relating to outages to refuel or refurbish boiling water and pressurized water-type reactors.

#### *Decommissioning and Abandonment Phase:*

Decommissioning activities will commence after the last reactor has permanently ceased operation, all the fuel has been transferred out of the reactor to storage, and the reactor drained and dried. Decommissioning will then begin with a period of safe storage activities to allow the radioactivity of reactor components to decrease. Decommissioning may commence with a period of safe storage activities to allow the radioactivity of reactor components to decrease. Decommissioning activities can be conceptually summarized as follows: transfer of fuel and associated wastes to interim storage; decontamination of plant; flush purging of equipment and systems; removal of surface decontamination of facilities or equipment; dismantling and removal of equipment and systems; demolition of building; and site restoration.

Few activities are expected to be carried out for the abandonment phase of the project, since the purpose of this phase is to move from the achieved “end-state” of the decommissioning phase to the abandonment phase, which is basically an “unlicensed state”. The activities related to this phase are basically to provide the results of the decommissioning and the results of the environmental monitoring programs to demonstrate that the “site” can be made available for re-use and will no longer be under CNSC regulatory oversight.

## **Part II - Components of the Review**

1. Within 30 days of the close of the public comment period regarding the draft Environmental Impact Statement Guidelines, the Minister of the Environment shall, following consultation with the President of the Commission and after taking into account the comments received by the public and Aboriginal groups, issue the Environmental Impact Statement Guidelines.
2. The Parties shall require the Proponent to prepare the Environmental Impact Statement (EIS) in accordance with the Environmental Impact Statement Guidelines issued by the Minister.
3. Upon receiving the EIS, and provided that the Joint Review Panel (JRP) has been struck and that participant funding pursuant to section 58(1.1) of the CEEA has been awarded, the JRP will have a period of up to fourteen (14) days to announce the commencement of the EIS public review and comment period and to issue instructions and a timetable for the review that will include opportunities for public comment.
4. A maximum six (6) month period is provided for review and analysis of the EIS followed by a one (1) month period for the JRP’s consideration of the comments received on the sufficiency of the EIS to proceed to the JRP Hearing phase. This seven (7) month time period is in addition to any time required by the Proponent to respond to any information requests from the JRP.
5. At any time following submission of the EIS to the JRP, during the EIS public comment and review period, or in considering of any comments received during or following the public comment period, JRP may request any additional information it deems necessary from the Proponent.
6. The JRP shall schedule and announce the start of the JRP Hearings once it is satisfied that the Proponent’s EIS and any additional information has adequately responded to the EIS Guidelines.
7. The JRP shall provide public notice of the JRP public hearings 90 days prior to the start of the Hearings.
8. Written comments obtained pursuant to the EIS public review and comment period shall be made public on the Public Registry.
9. At the request of the JRP, the Secretariat shall provide written and oral professional, scientific, technical or other assessment to the JRP.
10. The JRP may secure the services of additional independent experts to provide information on and help interpret technical and scientific issues and issues relative to community knowledge and Aboriginal traditional knowledge.

11. The JRP shall hold the Hearings within the Municipality of Clarington and elsewhere as it deems appropriate.
12. The JRP shall deliver its Report to the Minister of the Environment within 90 days following the close of the Hearings. Paper and electronic copies of the report will be provided upon request. Copies will also be available on the Internet.

### **Part III – Procedure**

13. The JRP will issue directions on procedures in accordance with the CEAA, NSCA and the provisions of the JRP Agreement. The directions on procedures will include the JRP's procedures for the review process including the conduct of the EIS review, communication with the JRP, hearing procedures and/or any other matter the JRP deems appropriate. The JRP may issue separate public hearing procedures prior to the hearings.
14. The JRP may consult with the public prior to finalizing its directions on procedures.
15. The JRP Hearings will be conducted in accordance with the CEAA, NSCA and this Agreement and will ensure that opportunities are provided for timely and meaningful participation by the public and Aboriginal groups; that technical sessions are scheduled for specific matters of concern; and, that Aboriginal and traditional knowledge is appropriately considered.
16. For the purposes of the CEAA or the NSCA, the JRP Hearings shall be public unless the JRP is satisfied after representations made by a witness that specific, direct and substantial harm would be caused to the witness or specific harm to the environment by the disclosure of the evidence, documents or other things that the witness is ordered to give or produce, or that information to be presented involves national or nuclear security; the information is confidential information of a financial, commercial, scientific, technical, personal or other nature that is treated consistently as confidential and the person affected has not consented to the disclosure; or the disclosure of the information is likely to endanger the life, liberty or security of a person.
17. The JRP public hearing procedures will establish timelines for presentations to the JRP. Each presentation may be followed by a question and answer period led by the JRP, followed by questions from other Intervenors.
18. Questions will be directed through the JRP Chair who may subsequently allow a participant to put questions directly to the presenter. Where a person does not adhere to the procedures and the direction of the JRP Chair, the JRP Chair will have the authority to refuse to permit further questioning from that person.
19. The JRP Chair may limit or exclude questions or comments that fall outside the mandate of the JRP, are repetitive, irrelevant, or immaterial.
20. The JRP Chair may limit discussion that exceeds the time limits established by the JRP procedures.

#### **Part IV – Scope of the Environmental Assessment and Factors to be Considered in the Review**

The Review will include a consideration of the following factors listed in paragraphs 16(1) (a) to (d) and in subsection 16(2) of the CEAA:

- a. The environmental effects of the project, including the environmental effects of malfunctions, accidents or malevolent acts that may occur in connection with the Project and any cumulative environmental effects that are likely to result from the project in combination with other projects or activities that have been or will be carried out;
- b. The significance of the effects referred to in (a);
- c. Comments that are received during the Review;
- d. Measures that are technically and economically feasible and that would mitigate any significant adverse environmental effects of the Project;
- e. Purpose of the Project;
- f. Need for the Project;
- g. Alternatives to the Project;
- h. Alternative means of carrying out the Project that are technically and economically feasible and the environmental effects of any such alternative means;
- i. Measures to enhance any beneficial environmental effects;
- j. The requirements of a follow-up program in respect of the Project;
- k. The capacity of renewable resources that are likely to be significantly affected by the Project to meet the needs of the present and those of the future; and
- l. Consideration of community knowledge and Aboriginal traditional knowledge.

#### **Part V – Scope of Assessment of the Application for Licence to Prepare Site**

Pursuant to section 24 of the NSCA and its regulations, the JRP process will include consideration of:

- Whether the applicant is qualified to perform the activity to be licensed; and
- Whether in carrying on that activity the applicant will make adequate provisions for the protection of the environment, the health and safety of persons and the maintenance of national security and measures required to implement international obligations to which Canada has agreed.





## Appendix 2 – Participants in the Review Process

### Federal Departments and Agencies:

Canadian Environmental Assessment Agency  
Canadian Nuclear Safety Commission  
Canadian Transportation Agency  
Environment Canada  
Fisheries and Oceans Canada

Foreign Affairs and International Trade Canada  
Health Canada  
Natural Resources Canada  
Transport Canada

### Provincial Ministries and Agencies:

Emergency Management Ontario  
Ontario Ministry of Energy  
Ontario Ministry of the Environment  
Ontario Ministry of Health and Long-Term Care  
Ontario Ministry of Labour

Ontario Ministry of Municipal Affairs and Housing  
Ontario Ministry of Natural Resources  
Ontario Ministry of Transportation  
Ontario Power Authority

### Municipal Governments:

City of Oshawa  
City of Pickering  
City of Toronto  
Municipality of Clarington

Municipality of Kincardine  
Municipality of Port Hope  
Regional Municipality of Durham

### Aboriginal Groups:

Alderville First Nation  
Hiawatha First Nation  
Métis Nation of Ontario

Mississaugas of New Credit First Nation  
Saugeen Ojibway Nations  
Williams Treaties First Nations

### Elected Officials:

Wayne Arthurs, MPP for Pickering-Scarborough East  
Joe Dickson, MPP for Ajax-Pickering  
Mark Holland, MP for Ajax-Pickering  
Dan McTeague, MP for Pickering-Scarborough East

Bev Oda, MP for Durham  
John O'Toole, MPP for Durham  
Peter Tabuns, MPP for Toronto Danforth

### Organizations:

Ajax-Pickering Board of Trade  
Association québécoise de lutte contre la pollution atmosphérique  
Atomic Energy of Canada Limited (AECL)  
Beyond Nuclear  
Black & McDonald Ltd.  
Bruce Peninsula Environment Group  
Canadian Association of Nuclear Host Communities  
Canadian Association of Physicians for the Environment  
Canadian Coalition for Nuclear Responsibility  
Canadian Environmental Law Association (CELA)  
Canadian Manufacturers & Exporters  
Canadian Nuclear Association  
Canadian Nuclear Workers' Council (CNWC)  
Canadian Unitarians For Social Justice  
Canadian Wildlife Federation  
Central Lake Ontario Conservation Authority  
Citizens Against Radioactive Generators in Owen Sound  
Citizens for Renewable Energy

Citizens Resistance at Fermi Two  
Clarington Board of Trade  
Clean North  
Coalition for a Nuclear Free Great Lakes  
Community Coalition Against Mining Uranium  
Cottagers Against Uranium Mining and Exploration  
County Sustainability Group  
Crossby Dewar Inc.  
Cuttler & Associates Inc.  
David Suzuki Foundation  
Devolica Society  
Don't Waste Michigan  
Durham College  
Durham Region Field Naturalists  
Durham Strategic Energy Alliance  
DurhamCLEAR  
East Toronto Climate Action Group  
Environment North

## Darlington Joint Review Panel

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Environmental Coalition of PEI  
Families Against Radiation Exposure (FARE)  
Greater Oshawa Chamber of Commerce  
Green & Clean Energy Co.  
Green Party of Canada  
Green Party of Ontario  
Greenpeace  
Greens and Gardens  
International Institute of Concern for Public Health (IICPH)  
Just One World  
Lake Ontario Waterkeeper  
Leeds County Conserver  
Les victimes du nucléaire  
Mouvement Vert Mauricie  
National Council of Women of Canada (NCWC)  
National Farmers Union Waterloo/Wellington Local  
North American Young Generation in Nuclear  
Northwatch  
Nuclear Information and Resource Service  
Nuclear Waste Advisory Associates  
Ontario Clean Air Alliance  
Ontario Nuclear New Build Council  
Ontario Power Site Committee  
Ontario Sustainable Energy Association  
Organization of CANDU Industries

Pacific Northwest National Laboratory (PNNL)  
Pembina Institute  
Physicians for Global Survival  
Pickering East Shore Community Association (PESCA)  
Pickering Nuclear Community Advisory Council  
Port Hope Community Health Concerns Committee (PHCHCC)  
Power Workers' Union  
Promotion Nuclear Ltd.  
Provincial Council of Women of Ontario  
Registered Nurses' Association of Ontario  
Safe and Green Energy (SAGE) Peterborough  
Scientists in School  
Sierra Club Canada  
Sierra Club Québec  
Society of Energy Professionals  
Society of Professional Engineers and Associates  
St. Marys Cement Inc.  
The Blacklab  
Transition Oakville Steering Committee  
Trent University  
United Church of Canada  
University of Network of Excellence in Nuclear Engineering  
University of Ontario Institute of Technology  
Whitby Chamber of Commerce  
York University Faculty of Environmental Studies

## Individuals:

Sage Aaron  
Jeff Abell  
Jim Abernethy  
Victoria Adams  
William R. Adamson  
Chris Aitchison  
Manzur Alam  
Abuzafar Ali  
Marta Allen  
Lowell Allison  
Lorne Almack  
Nasser Aly  
A Carol Anderson  
Debbie J. Anderson  
Russell Anderson  
James Araujo  
Sohail Ateeq  
Peter Aulich  
Robert Azzopardi  
Mitch Backx  
Leta Bailey  
Kathryn Barnes  
Nad Barsoum  
Brian Beare  
Mélanie Beaudoin  
Nancy Beiman  
Aline Belec  
Arlene Bell  
France Benoit  
Liz Bernstein  
Louis Bertrand  
George Biro  
Angela Bischoff  
Randy Blake  
Ronald Boardman  
Jean-Paul Bourque  
Jeff Brackett  
Craig Brant  
James Brookes  
Janine Brossard  
Sandra Bruderer

Karen Buck  
Darlene Buckingham  
Mike Buckthought  
Jennifer Bundock  
Adam Burns  
Karen Burns  
Ron Burns  
Vanessa Butterworth  
Helen Caldicott  
Ian Cameron  
James Carmichael  
David Carter  
Ellen Carter  
Janine Carter  
Mary Chi  
Dennis Choptiany  
Alan Christie  
Kathleen Chung  
Diana Clark  
Kirk Clark  
Sarah Climenhaga  
Gail Cockburn  
Graham Cohen  
Michael Cohen  
Justin Cole  
Marion Coppleston  
Stephen Cornwell  
Daniel Cote  
Dave Councilman  
Colin Crawford  
Stephen S. Crawford  
Phyllis Creighton  
Suzanne Crellin  
Jay Cuthbertson  
Gita D'Souza  
Saad Dahdouh  
Rasesh Dalal  
Arunkumar Dalaya  
Scott Darling  
Debasish Das  
Matthew Davidson

Ashish Deb  
Brad Dennis  
Richard Denton  
Mark DeWolfe  
Ruth di Giovanni  
Neil Dobson  
Brett Dolter  
David Done  
Erwin Dreessen  
Dwayne Ellis  
Maryann Emery  
John Etches  
Rob Evans  
Mary Everrett  
Wanda Ewachow  
Keith Falconer  
David Faltenhine  
Pippa Feinstein  
Michael Ferrarelli  
Cristian Filisanu  
Dara Finney  
Kim Fogtmann  
Matthew Fracalanza  
Trevor Fraser  
Tim Fry  
John Fusco  
Vishnu Gandhi  
Morris Gemmiti  
Alan Gerth  
Paul Gervan  
Lyla Gharib  
Ruxandra Gheorghe  
Alexandra Gilbert  
Hugh Gillies  
Rena Ginsberg  
Catherine Giorgetti  
Jack Goering  
Dorothy Goldin Rosenberg  
Bette-Ann Goldstein  
Blanner Gomez  
Doug Goodman

Lisa Grande  
Mathieu Gravel  
Daniel Gravelle  
Janet Gregor  
Wayne Groot  
Ahmed Hafez  
Joanne Hamilton  
Lisa Harrington  
James Harris  
Scott Harris  
Linda Harvey  
James Hasler  
Gary Hauser  
Nadine Hawkins  
Jo Hayward-Haines  
Curtis Henderson  
Jan Heynen  
Karen Hickson  
Dale Hildebrand  
Simon Ho  
Chris Hooymans  
Chris Horne  
Guy Hoskins  
Sharon Howarth  
Elaine Hughes  
Michael Hunter  
David Huntley  
Robin Hutcheon  
Sunil Ingle  
Tahir Iqbal  
Lynn Jacklin  
Kristina Jackson  
Patricia Jackson  
Monica Jain  
Eric Jelinski  
Jean Johnston  
Kristin Kagerer  
Satish Kanaujia  
Vlado Karan  
George Karpas  
Lannie Keller

## Environmental Assessment Report

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Donald J. Kerr	Sandra McKee	Terry Price	Konrad Szymanowski
Phyllis Ketcheson	Richard McKinlay	Michael Pugh	Bruce Tanaka
Graham Ketcheson	Susan McLaine	Will Quibell	Paul Tasovac
Marlene Khalil	Jeffrey McLarty	Ellen Quigley	Mahmod Terro
Raihan Khondker	Jim McLellan	Ira Rabinovitch	Martin Tessler
Karen King	Janet McNeill	Libby Racansky	Sarah Thomas
Gerry Kirk	Tony McQuail	Zeina Rachele	Brenda Thompson
Ziggy Kleinau	Emad Mehboob	Ron Rancourt	Scott Thomson
Berta Klooster	Jason Melnychuk	Paul Razvi	Mark Tipperman
Dianne Knight	Dave Mercier	Annemarie Reimer	Donna Topping
Peter Kofler	Kerry Meydam	Walter Robbins	Yvette Towrie
Kurt Koster	Nagy Mikhael	Jeff Roberts	Victor Trifan
Sergey Kotenyov	Liz Miller	Yan Roberts	Luba Trim
Eva Kralits	Renata Misra	John Mark Robertson	Richard Troy
Olga Kremko	Derek Mitchell	Peter Roche	William Tufts
Dariusz Kulczynski	Peter Moore	James Ronald	Kerry Turcotte
Alice Kuzniar	Julia Morgan	Don Ross	Zahid Uppal
Janet Kuzniar	Heather L. Morigeau	Jenna Ross	Joseph van Langen
Larry Lack	Rosemarie Morris	Heather Ross	Joy Vaneyk
Steve Lapp	Barbara Muller	Tanya Ross	James Walsh
Patricia Lawson	Keith Mullins	Ian Rowberry	Guanjun Wang
Tom Lawson	Daniel Murphy	Dan Rudka	Michael Wang
Stephen Leahy	Krista Murphy	Zach Ruiter	Rachel Western
Pierrette LeBlanc	Lauralee Myers	Stewart Russell	Eryn Wheatley
Fritz Lehmborg	John Mynott	Stephanie Rutherford	Kelly White
Raymond R. Leistner	Raymond Naidu	Muhammad Saleem	Brian Whitehead
Wayne Lessard	Yatin Nayak	Jim Salmon	Todd Whyte
Carrie Lester	Mandy Newby	Carla Sbert	Deborah Wiggins
Amanda Lickers	Siamak Nikzadeh	Elena Schacherl	Robert Williams
John Liss	Liam O'Doherty	Susan Schellenberg	Derek Wilson
Randi Luster	Nicole O'Hagan	Mike Schleiffer	Hamish Wilson
Frithjof Lutscher	Alexia Oprean	Tim Seitz	Mark Wilson
Jay Macpherson	Grant Orchard	Michelle Shahoud	Carol Winter
Khondaker Mahtabuddin	Ahmad Osgouee	Peter Shepherd	J. Wright
Debra Mair	Marc Paiment	William Shore	Karen Wright
Khalid Malik	Angela Palladino	Martin Siegle	Kathryn Wrong
Brenda Mann	Justine Panchuk	Ellen Silverglen	Lukas Wywrot
Liliana Manolache	Rick Patenaude	Leon Simeon	Rachid Yaici
John Martin	Mira Pavan	Barry Simmons	Chunzhen Ye
Lisa Maxwell	Matt Pelks	Shelly Simpson	T. Rosemary Yeremian
Tom Mayberry	Jim Penna	Peter Smith	Paul York
Marlena McBrien	Michael Pereira	Laina Smith	Dan Young
Denis McCallum	Patricia Petric	Robert Smith	Allan Yull
Karen McCallum	Paul Phillips	Josh Snider	Samer Zabana
Sean McConnell	Daniel Pluard	Dale Stewart	Polad Zahedi
Shirley McCormick	Andrew Polanyi	Bob Stuart	John Zaikow
Julia McCrea	Michael Polanyi	Miriam Stucky	Sanjin Zeco
Anca McGee	Danny Polifroni	Richard Swayze	Dragana Zivkovic
Ian McIntosh	Tienco Posthumus	Tania Szablowski	Vuk Zrnica
			Rachel Zurof



## Appendix 3 – Ruling by the Joint Review Panel on Procedural Preliminary Matters

At the beginning of the public hearing, the Panel considered the procedural preliminary matters raised by Lake Ontario Waterkeeper, the Canadian Environmental Law Association and Northwatch. In addition to the written submissions filed by the participants, the Panel heard the participants and OPG's response. The Panel adjourned to consider these matters and provided an oral summary of its decision at the start of the evening session of the same day. Written reasons were to follow.

This document provides the decision on A) the request to suspend the hearing in light of the events unfolding at Fukushima Daiichi – Japan, B) the request to adjourn the hearing until such time as the record before the Panel is complete and the public is given adequate time to review and respond to the complete record, C) the request that the environmental assessment of the Project must begin anew if the Enhanced CANDU 6 (EC6) technology by Atomic Energy of Canada Limited is to be considered by the Panel D) the request that the Panel receive the information from the proponent and agencies as sworn evidence, clarify its approach regarding how questions will be handled during the hearings and provide opportunity to participants to submit final comments and, E) the request to provide public transit to the hearing location, translation of documents and visual presentations, and translation of the transcripts.

### A) Request to suspend the hearing in light of the events unfolding at Fukushima Daiichi - Japan

A number of intervenors requested that the hearing proceedings be suspended and adjourned as they believed that it would be insensitive and impractical to proceed with the hearing under these circumstances. Intervenors argued that proceeding with an environmental assessment of a nuclear facility that did not include lessons learned from the nuclear crisis in Japan would be incomplete. Further, intervenors stated that the Panel should wait before considering the impact of the events in Japan until verifiable and complete evidence is available and only after that information has been provided to the intervenors for review and further submissions allowed to be filed should the hearing proceed.

Other intervenors were concerned with a message released by the CNSC on March 16, 2011 that was interpreted as suggesting that the Darlington review process was the venue to take into account relevant lessons learned from the events unfolding in Japan and potential implications on Canadian facilities. Intervenors were concerned that the Panel would consider new information and take into account lessons learned from the incident in Japan despite the fact that this information was not yet publicly available. Intervenors wanted to know if they would be provided with extra time and resources to review any new information being considered by the Panel with regard to the said incidents.

The Panel is fully aware of the tragic and complex events that are unfolding in Japan. The relevant lessons learned will no doubt inform the regulatory regime of the nuclear facilities in Canada and around the world in the years to come. The Panel recognizes that the outcomes will be analyzed, evaluated and applied at the time of the detailed reviews of design requirements and safety features and will continue to guide and inform the regulatory oversight of the proposed facility throughout its lifecycle. Further, the Panel is cognizant of the fact that these elements will be rigorously examined if and when OPG applies to the Canadian Nuclear Safety Commission for a licence to construct and operate. Lessons learned from previous incidents have and will continue to inform review processes, technology requirements and safety standards in the future. The Panel is of the opinion that it would be premature and inappropriate to bring the proceeding to a standstill and adjourn the review process, which objective is specifically to gather all of the relevant information that the Panel deems necessary to fulfill its mandate and prepare its report. The Panel is of the view that it would not only be inappropriate to delay its proceedings on the basis that information and lessons learned in relation to an existing nuclear facility will be available in the future but that it would amount to a wrongful refusal to exercise its mandate.

Further, the Panel recognizes the potential confusion that the message released by the CNSC with regard to the events in Japan has generated and wants to clarify the approach that will be followed for the review process and rectify any confusion. As fully independent decision-makers, it is only the members of this Joint Review Panel that will determine whether new information emanating from the events unfolding in Japan will be required within the context of this hearing. The issues of seismicity and safety are already included in this review process and information has been filed with the Panel for its consideration and will be discussed and reviewed during this hearing; these aspects are not new requirements based on the incidents in Japan.

The Panel has requested that a broad factual presentation of the situation in Japan be made to all participants and the public for context purposes. If the Panel determines, after that presentation or during the course of the hearing, that new information is required for the discharge of its mandate, then the Panel will provide appropriate direction for the filing and consideration of the information. This could, as appropriate, include further opportunities for written submissions or for further hearing days. The Panel will continue to review the project until it is satisfied that it has all the relevant information for appropriate and informed decision making.

Having heard all the participants on this particular issue and given the matter careful thought, the Panel has decided that at this point in time, there is no need to adjourn the hearing because of the events unfolding in Japan or to amend its hearing procedures.

B) Request to adjourn the hearing until such time as the record before the Panel is complete and the public given adequate time to review and respond to the complete record

Intervenors requested that the hearing be adjourned on the grounds that there is insufficient or inadequate information before the Panel on which to base an environmental assessment or a licensing decision or that the scope of the review is too restrictive and insufficient under the *Canadian Environmental Assessment Act*. Intervenors suggested that the absence of a specific technology to be pursued deprived the public to adequately participate in the review and the Panel to make informed recommendations. Further, it was argued that a plant parameter envelope or bounding approach is not an appropriate or recognized approach for an environmental assessment hearing.

The mandate of the Panel, as described in the *Agreement to Establish a Joint Review Panel*, is to conduct the review in a manner that discharges the requirements set out in the *Canadian Environmental Assessment Act* in carrying out the environmental assessment of the complete lifecycle of the project, obtaining the information and evidence required to consider the licence application under the *Nuclear Safety Control Act* and obtaining the information and evidence about the adverse effects the project may have on potential or established aboriginal rights, title or treaty rights as identified to the Panel by potentially affected Aboriginal groups.

The Terms of Reference do not state that the Panel is to announce or hold the public hearing portion of the review process only after it has obtained all the information it needs to make its environmental assessment recommendations. If that were the case, it would effectively invalidate the need of holding a public hearing. The Panel views the public hearing as a very important forum to continue to gather and test all of the information including information relating to the plant parameter envelope approach. The Panel is of the opinion that it would be premature and inappropriate to adjourn the hearing on the basis that there is not enough information or that it does not have all of the information it needs to complete its report before embarking in the hearing process. The main objective of the public hearing is to allow the Panel to hear from all of the participants and to gather relevant information to complete the record and to fulfill its mandate. Once it has heard from all participants, the Panel will review all of the information gathered throughout the review process including the information relating to the plant parameter envelope framework for the environmental assessment of this proposed Project and make a decision with regard to the sufficiency of information provided.

For those reasons, the Panel rejects the intervenors' preliminary request that the hearing be adjourned on the basis that there is not enough information on the record on which to proceed at this point in time.

C) Request that the environmental assessment of the Project must begin anew if the EC6 technology is to be considered by the Panel

Intervenors objected to the inclusion and consideration of the EC6 technology as part of this environmental assessment process. They mentioned that the addition of a fourth potential reactor design, absent formal notice and at the end of the public review period, would render the public consultation meaningless and deprive them of the opportunity to spend the necessary time and resources to assess additional design options.

The Panel notes that on October 8, 2010, the Panel responded to a similar request raised by Northwatch, Safe and Green Energy, Mouvement Vert Mauricie, Lake Ontario Waterkeeper and the Canadian Environmental Law Association. In its response, the Panel stated that it failed to see how asking for additional information and considering various technologies including the EC6 in an environmental assessment process that is technology neutral, amounts to a change in the scope of the project being considered. It has been known since the beginning of the review process that, absent a specific chosen technology, the environmental review process would follow a plant parameter envelope approach.

The technologies considered in the development of the plant parameter envelope were selected to establish a set of design parameters and associated limiting values used to describe bounding features but never with the intent of excluding other technologies. The Panel is cognizant of the fact that the technologies that could ultimately be selected for the Project, should OPG be granted the authorization to proceed, might be different than those specifically mentioned in the proposal or the EIS. The most important aspect of the review process is that the approvals that may be granted with regard to a specific technology or design that will ultimately be chosen will have to be weighed, assessed and be bounded by the plant parameter envelope.

The Panel disagrees with the intervenors' assertions that they did not have sufficient time or notice to prepare. The Panel provided direction to that effect in October 2010 and reiterated its views in March 2011. As stated, the review process is and has always been technology-neutral. The Panel, as was mentioned in the oral portion of the ruling will, if it determines that further information or clarification is required on this specific issue, provide the participants with an opportunity to file additional submissions or schedule further hearing days. Having given this matter careful thought, especially considering that the Panel provided direction as early as October 2010, the plant parameter and the technology neutral approach used for the environmental review process, the Panel is of the view that it does not have to adjourn the hearing on the basis that the EC6 technology is to be considered by the Panel in the course of this hearing.



D) Request that the Panel receive the information from the Proponent and agencies as sworn evidence, clarify its approach regarding how questions will be handled during the hearings and provide opportunity to participants to submit final comments

As part of its submission to the Panel, the Canadian Environmental Law Association (CELA) requested that the Panel should receive the information from the proponent and agencies as sworn evidence. CELA went further and stated that this may be true of participants as well, depending upon the nature of the participation. CELA alleged that sworn or affirmed evidence carries more weight, is more credible and requires the person providing the information to take more care in terms of showing its veracity. CELA and Northwatch asked the Panel for clarification on how questions would be handled during the hearing. Northwatch further requested the opportunity to provide final comments.

The Panel is not a court of law and as such is not bound by the legal rules of evidence and has the discretion to review and accept evidence and information it considers appropriate. The Panel's task, as an expert panel, is to consider all the information it deems relevant and come to a reasonable conclusion. Both the *Canadian Environmental Assessment Act* and the *Nuclear Safety and Control Act* contain specific dispositions directing decision-makers to ensure that they obtain all the information required but that in doing so, they are not required to accept or reject evidence based on the formal rules of evidence applicable to a civil or criminal trial. Under those circumstances and especially considering that this request has been presented after all participants have already filed their information, the Panel considers it unnecessary to require that participants file sworn information.

With regard to how questions will be handled during the hearing, the Panel will follow the procedures as described in section 3.5 of its *Public Hearing Procedures*. This section sets out a non adversarial opportunity for a presenter to ask questions to other presenters through the intermediary of the Panel Chair. It specifically states that intervenors may seek leave of the Chair to put a question to a presenter. This provision details limits on such questions including availability of time. Intervenors who wish to present a question shall inform a member of the Panel secretariat. The Panel has the authority to direct a question to a presenter and the consent of that presenter is not required. All presenters will be treated equally.

The Panel has agreed to allow the participants the opportunity to file written final comments. Procedural details will be provided.

E) Request to provide public transit to hearing location, translation of documents and visual presentations, and translation of the transcripts

With regard to providing public transport to the hearing location, this request is denied. The Panel wishes to mention that every effort was made to accommodate everyone in the scheduling process to help people make their travel arrangements.

With regard to the request to have all written, visual materials including having the transcripts translated to French, this request is denied. There are no legal requirements imposed on a panel such as this Panel, to provide translation of all the written and visual material provided to it. Subsection 4.12 of the Panel *Public Hearing Procedures* stipulates that, “written transcripts will be made of all public hearing sessions in the official language in which they were recorded.” The Panel has made numerous arrangements to provide simultaneous translation and to ensure that the proceedings are accessible to the members of the public both in French and in English. Transcripts and audio recordings of the proceedings will be available, as quickly as possible, on the Canadian Environmental Assessment Registry internet site.



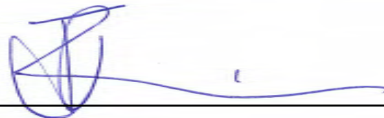
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Alan R. Graham, Chair



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Jocelyne Beaudet, Member



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Joseph Kenneth Pereira, Member

