Canadian Nuclear Laboratories | Laboratoires Nucléaires Canadiens

Near Surface Disposal Facility
Environmental Impact Statement

EXECUTIVE SUMMARY
Revision 3

May 2021

Atomic Energy of Canada Limited, circa 1964

For more than 70 years CNL has been making advances in nuclear science and technology in the interest of Canadians. This includes the production of medical isotopes that have treated over 1 billion patients worldwide, as well as developments in clean energy which help ensure clean air to breathe and reduced greenhouse gas emissions.

1940's Waste Management Area, Chalk River Laboratories

CNL's History

For more than 70 years, Atomic Energy of Canada (AECL) and now Canadian Nuclear Laboratories (CNL) have been making advances in nuclear science and technology in the interest of Canadians. CNL is Canada's leading nuclear science and technology organization and a world leader in developing innovative applications from nuclear technology. CNL is committed to ensuring that Canadians and the world receive energy, health and environmental benefits from nuclear science and technology with confidence that nuclear safety and security are assured.

CNL is delivering clean, safe environments for Canadians. To secure the social licence for the continued utilization of nuclear energy, the nuclear sector must demonstrate responsible environmental stewardship. CNL is advancing its waste and decommissioning effort for effective and efficient elimination of nuclear liabilities.

Interactive Features

In order to provide more context we have made this document interactive.

There are 50+ interactive features in this document.

You may not recognize all of the terms used in this Environmental Impact Statement Summary. **All text in dark blue** has a definition that will pop up if you roll your mouse over the text.

Additionally, look for these symbols:

- these are stickers on the corner of some images which denote an interactive element that provides more information
- these are integrated in the brochure's text and denote links to videos (opens a web browser)
- these are integrated in the brochure's text and denote links to websites (opens a web browser)"

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Canadian Nuclear Laboratories (CNL) is proposing the construction and operation of a Near Surface Disposal Facility (NSDF) for the disposal of solid, low-level radioactive waste at the Chalk River Laboratories (CRL) site.

Canadian Nuclear Laboratories (CNL) is proposing the construction and operation of a Near Surface Disposal Facility (NSDF) for the disposal of solid, **low-level radioactive waste** at the Chalk River Laboratories (CRL) site. The NSDF Project is based on the mandate of Atomic Energy of Canada Limited (AECL), a federal Crown corporation, to manage the Government of Canada's radioactive waste and decommissioning liabilities. The NSDF Project will substantially reduce the risks associated with the low-level waste and to create conditions for the revitalization of the CRL site. Canadian Nuclear Laboratories is a private-sector company that is contractually responsible for the management and operation of nuclear sites, facilities and assets owned by AECL.

For more than 70 years, AECL, and now CNL, have been making advances in nuclear science and technology in the interest of Canadians. This includes the production of medical isotopes for the diagnosis and treatment of over one billion patients worldwide, as well as developments in clean energy which help reduce greenhouse gas emissions. Through investments in the revitalization of the CRL site, that mission and innovative science will continue into the future. However, this proud history has created nuclear liabilities in the form of waste. Furthermore, past waste management practices, which met the standards of the day, are no longer acceptable. Specifically, the historic waste management areas lack robust containment, which in some instances has led to contamination of the surrounding environment.

In accordance with *Canada's Radioactive Waste Policy Framework* the waste producers and owners of radioactive waste are responsible for the funding, organization, management and operation of disposal and other facilities required for these materials. Responsible nuclear waste management includes management of the full life cycle of the material, from generation to disposal. Canadian Nuclear Laboratories and AECL are working actively at both the strategic and operational levels to identify strategies and solutions for waste management of the entire life cycle of all **radioactive waste classifications** including low-level waste, intermediate level waste and high-level waste. Canadian Nuclear Laboratories' high-level waste is in safe, secure and suitable storage facilities until a national deep geological repository designed for used fuel becomes available. The current strategy for intermediate level waste from all CNL managed sites is safe, secure, and in suitable temporary storage facilities at the CRL site until a suitable permanent disposal facility is available. The exceptions to this are the Nuclear Power Demonstration Reactor and Whiteshell Reactor 1 facilities which are proposed to be decommissioned in situ.

The purpose of the NSDF Project is to provide the permanent disposal of current and future low-level waste at the CRL site, as well as a small percentage of waste volume from off-site locations, in a manner that is protective of both the public and the environment.

The practice of continuing to build additional temporary storage systems at the CRL site for low-level waste is not consistent with modern waste management principles. Further, the NSDF Project would enable the remediation of historically contaminated lands and legacy waste management areas, as well as the decommissioning of outdated infrastructure to facilitate the CRL site revitalization.

The proposed NSDF Project is considered a "designated project" in accordance with paragraph 37(b) of the *Regulations Designating Project Activities*. Under section 15 of the *Canadian Environmental Assessment Act*, 2012, the Canadian Nuclear Safety Commission is the Responsible Authority for this proposed project.

A key element of the regulatory approvals process is the completion of an environmental assessment under the *Canadian Environmental Assessment Act,* 2012, the results of which are documented in this Environmental Impact Statement (EIS). The EIS describes the analysis of alternatives, a process of public and Indigenous engagement, studies of baseline conditions, and assessment of project activities during the construction, operation, closure and post-closure phases of the NSDF Project. All these aspects of the EIS are summarized below in this executive summary.

2019 Waste Management Area, Chalk River Laboratories

Analysis of Alternatives

Canadian Nuclear Laboratories undertook a comprehensive analysis of **alternatives** for the location of the facility, the type of facility, the design of facility, and the approach for treatment of wastewater to meet the needs of the NSDF Project. Consideration was given to technical, economic and environmental factors. Of the **alternatives considered**, the construction of a near surface disposal facility for the disposal of low-level waste at the CRL site was the preferred alternative. International nuclear industry guidance notes that this model has been found suitable for the disposal of low-level waste. The engineered containment mound design is the best available technology when taking into consideration the proposed waste which consists mostly of contaminated soils and demolition debris.

The Chalk River Laboratories site is the most suitable as more than 90% of the waste to be managed by the NSDF Project is already located there.

This site eliminates the additional time and cost of transporting the waste to another location (an effort which would require approximately 45,000 transport truck trips) and reduces the generation of greenhouse gas emissions.

Fifteen potential sites within the CRL site were initially screened to see how they met mandatory criteria such as the minimum space required. Sites that passed this initial screening were then evaluated to see if they met other criteria such as location in relation to the floodplain, geological characteristics and the presence of plants and animals. Based on this review two sites were identified for further evaluation. Both sites were technically feasible, however they differed in how each would be affected environmentally.

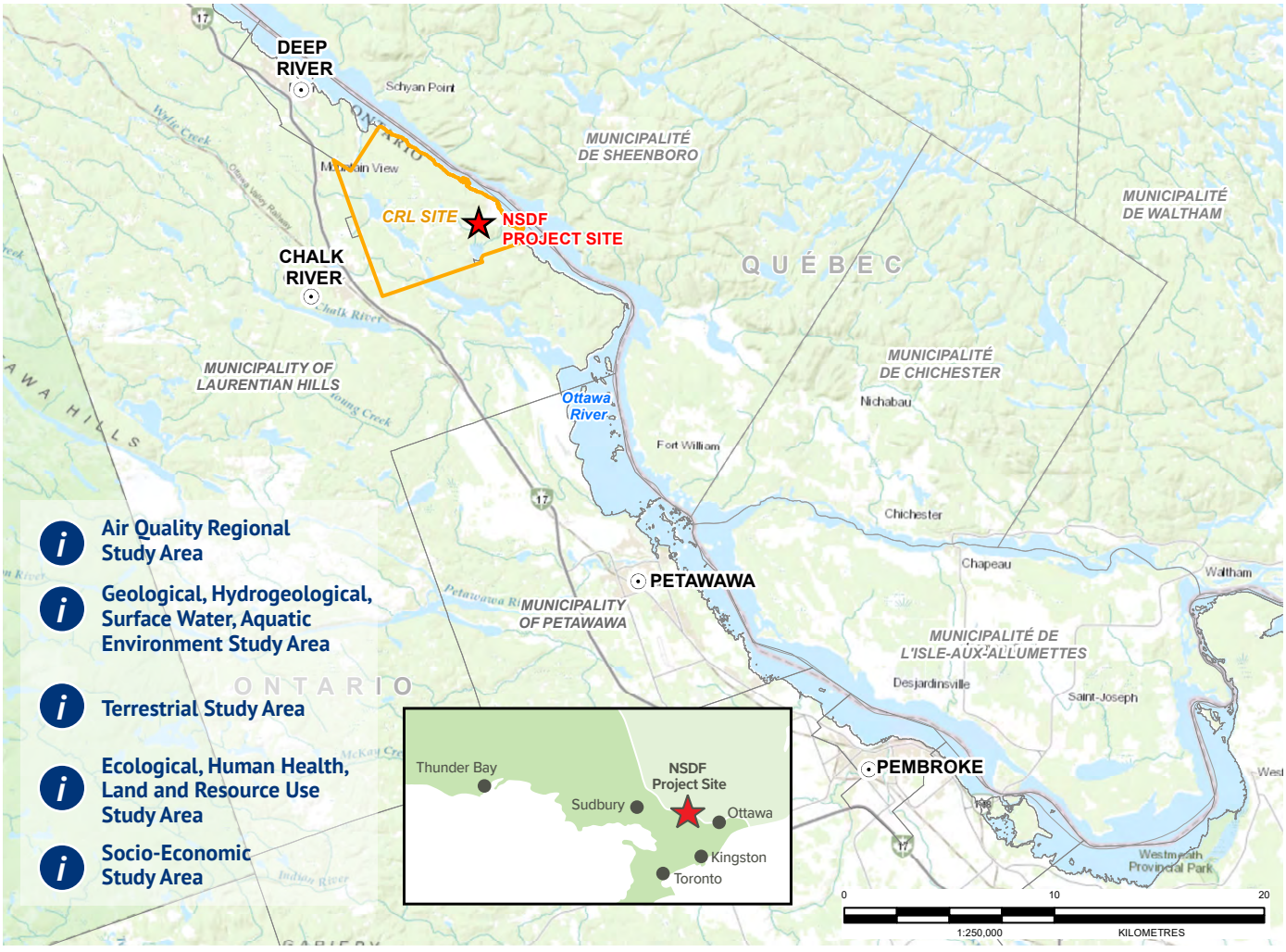
The preferred site for the NSDF is closest to the CRL site main campus and thereby eliminating the need to build new support services infrastructure for electricity, water, and heat. The preferred site is located within the Perch Creek and Perch Lake Watershed, which, in the past, have been affected by historic waste management practices. Groundwater flow and contaminant migration at the CRL site has been studied for over six decades and the Perch Creek and Perch Lake Watershed are well understood, allowing CNL to accurately predict environmental effects based on history and to prepare mitigation measures. Protection of the Ottawa River was a key factor in considering the NSDF Project location. The **preferred site** is located along a bedrock ridge that naturally forces water directly away from the Ottawa River, and it creates a foundation for the engineered containment mound which has been used in the overall design.

Project Description

The NSDF Project is a proposed waste disposal facility using an engineered containment mound design built at ground surface that will hold up to 1,000,000 cubic metres (m^3) of low-level waste. The facility will feature ten **waste disposal cells**, built in two phases. The engineered containment mound includes a multilayer base liner and cover system, where waste will be placed in between. The waste in each cell is covered after the cell is full. It is similar to a hazardous waste landfill but with much more robust engineering features. The proposed facility would be licensed under the Nuclear and Safety Control Act thus subject to the associated regulations and independent regulatory oversight from the Canadian Nuclear Safety Commission.

Location

The CRL site is in Renfrew County, Ontario on the shore of the Ottawa River, approximately 200 km northwest of Ottawa. The CRL site contains several nuclear and non-nuclear facilities such as research laboratories and waste management facilities. The CRL site has a total area of approximately 4,000 hectares (ha) and is within the boundaries of the Corporation of the Town of Deep River. The Federal Department of National Defence Garrison Petawawa borders the CRL site to the southeast, and the Village of Chalk River in the Municipality of Laurentian Hills is to the southwest. The Ottawa River forms the northeastern boundary of the CRL site. The NSDF Project is located entirely within the CRL site and the footprint of the NSDF Project site is approximately 37 hectares, which is less than 1% of the total area of the CRL site. The NSDF Project has also been graded to minimize visibility from the Ottawa River and the nearest Village of Chalk River.



Building being demolished at the CRL site which will be disposed of in the proposed NSDF.

Waste Inventory

The NSDF will hold only low-level waste which contains primarily **short-lived radionuclides** with a restriction on waste containing long-lived radionuclides. This material will require isolation and containment for up to a few hundred years. The engineered containment mound design life of 550 years has been established to meet the required time period to allow for radiologic decay of the waste inventory. The radioactivity of the inventory will decrease about 2,000 times in **the first 100 years**, and then begin to approach natural levels of radioactivity shortly thereafter.

The types of waste destined for the NSDF Project include contaminated soils from remediation activities, demolition debris from decommissioning work and general waste such as used personal protection clothing or equipment. These items are considered low-level waste as they can be safely handled with limited precautions.

The NSDF will primarily contain waste currently in storage at the CRL site, waste generated during environmental remediation and decommissioning activities now underway, as well as future waste that is expected to be produced as a result of on-going nuclear science and technology activities. A small percent of the waste volume will come from other AECL-owned sites (e.g., Whiteshell Laboratories), or from sources such as hospitals and universities.

Facility Design

The NSDF Project has been designed in accordance with regulatory and international design principles for radioactive waste disposal. This includes the incorporation of multiple safety functions, containment and isolation of the radioactive waste as well as incorporation of surveillance and control of the passive safety features. The long-term safety performance of the NSDF Project depends on many safety features which include the following engineered barriers:

- **Base liner system**, which has a primary and secondary liner to contain the waste and to limit the potential release of contamination to the subsurface and groundwater.
- **Final cover system**, which will isolate the waste, provides radiation shielding and an intrusion barrier, and prevents precipitation from infiltrating the waste.
- **Perimeter berm**, which provides structural stability and is designed to withstand natural physical events therefore ensuring containment of the waste.

The base liner and final cover systems are composed of a combination of natural materials (e.g., compact clay liner) and synthetic materials (e.g., high density polyethylene geomembranes) designed to work together to prevent the release of contaminants into the environment. Long-term performance tests demonstrate that the synthetic high density polyethylene geomembrane component of the liner systems will meet the 550-year design life thus complementing the compact clay layer which will provide a hydraulic barrier for thousands of years. Since the perimeter berm is constructed exclusively from natural materials, it is expected to remain intact and performing its function for thousands of years. Further, the waste material placement and compaction are part of the design basis to ensure structural stability in order to avoid settling and subsidence. Similar structures, such as human-made mounds built with earthen materials and limited engineering or construction knowledge, have existed for more than 550 years (e.g., **Monks Mound** in Illinois, United States of America).

In addition to the engineered barriers, the NSDF Project site is well above the **Ottawa River flood levels** on a bedrock ridge that naturally forces water to flow in the opposite direction, away from the river.

The location and design of the NSDF Project have taken into consideration the physical characteristics of the CRL site to protect the environment and the public with features that will contain and isolate the waste.

Included in the proposed design of the NSDF Project are **wastewater collection and treatment systems**. The NSDF Project will contain systems within the engineered containment mound to collect and pump **leachate** as well as other wastewaters to the Wastewater Treatment Plant (WWTP). The wastewater will be treated through conventional processes to remove radiological and chemical contaminants so that the treated effluent meets discharge targets established to be protective of the environment. After treatment, the effluent will be discharged to ground via an exfiltration gallery. In the event that the exfiltration gallery does not have sufficient capacity to manage the treated effluent (e.g., under spring conditions), a portion of the treated effluent will be piped directly to Perch Lake. Only effluent that meets the discharge targets will be released. Consistent with CNL practices and regulatory requirements, all discharges will be monitored and reported.

Other supporting infrastructure for the NSDF Project includes a vehicle decontamination facility, an administration building, as well as surface water management ponds.

Liam fishing in the Ottawa River – Katie Parker, NSDF Project team

Timeline

The NSDF Project is divided into several phases: construction, operations, closure and post-closure.

The **construction phase**, which includes site preparation, is anticipated to start in 2022 or as soon as the relevant regulatory permits and approvals are in place. This phase will include activities such as site clearing and construction of the engineered containment mound and WWTP.

The operations phase is expected to begin in 2025 and last approximately 50 years. Activities associated with the operations phase include those necessary for placement of wastes, treatment of wastewater, maintenance of facilities and establishment of long term monitoring.

The closure phase follows cessation of operations and is scheduled to last 30 years. Activities includes closure of the engineered mound which involves the installation of the final cover and the decommissioning of infrastructure.

The post-closure phase is defined by two distinct periods: **institutional control** and post-institutional control. For planning purposes, the institutional control period was assumed to last 300 years, however the institutional control period will continue as long as necessary as determined by regulatory agencies. During institutional control, inspection and surveillance activities will verify the integrity of the disposal facility system, while environmental monitoring activities will verify that the performance continues to demonstrate compliance with the environmental assessment predictions. Controls on land usage would include recognition of a waste disposal facility on the property title or deed to ensure the appropriate zoning restrictions, including buffer or attenuation zones, are enforced by the applicable regulatory agency.

Public Engagement Activities

Engagement is a key component of the environmental assessment process. Canadian Nuclear Laboratories operates an on-going Public Information Program to inform groups about activities at CNL managed sites and the potential effects of these activities on the public, Indigenous Peoples and on the environment.

This **Public Information Program** forms the basis of communication efforts with the public and Indigenous Peoples and helps to direct the establishment of long term, mutually beneficial working relationships with their communities in proximity to CNL sites.

The NSDF Project has provided current project information in both English and French to communities in Ontario and Quebec which are most likely to be affected or interested in the NDSF Project. Public engagement activities related to the NDSF Project include:

- presentations, information sessions and site visits;
- distribution of public information (e.g., webpage content, infographics and factsheets, community newsletters, etc.);
- participation in public events and as well as media relations;
- use of social media to advertise events as well as share project information (e.g., Facebook, webinars and YouTube videos).

In March 2020, the COVID-19 pandemic impacted in-person engagement activities. Canadian Nuclear Laboratories has adapted to the restrictions providing online platforms for virtual meetings, workshops, webinars, project updates and open houses. Canadian Nuclear Laboratories remains committed to ensure engagement activities are ongoing and in alignment with current pandemic restrictions.

During regularly scheduled meetings of the **Environmental Stewardship Council** for the CRL site, members are presented with information about CNL and CNL environmental practices, and these meetings provide opportunities for open dialogue between various stakeholder groups, local communities and CNL. Environmental Stewardship Council members share meeting information with their respective constituents. This open dialog and sharing of information is essential to CNL, ensuring that perspectives from our closest neighbours and non governmental organizations are heard.

These **engagement activities** have helped inform stakeholders and have enabled the public to provide valuable feedback into the NSDF Project, which helps CNL understand areas of public concern and improve the NSDF Project design and EIS. Key themes of the feedback received to date for the NSDF Project includes:

- justification for the NSDF Project;
- protection of the Ottawa River;
- waste inventory;
- design/engineering;
- long-term accountability;
- alternative means assessment (including site selection); and
- environmental events (e.g., flooding, earthquakes).

This **feedback** has been incorporated into the EIS where applicable, for example through inclusion of additional analysis or modification of assessment boundaries. A significant change incorporated into the EIS based on feedback was the change in waste inventory to include only low-level waste. In an effort to improve access and transparency CNL continues to post key EIS technical support documents on the NSDF Project's website as they are available.

Canadian Nuclear Laboratories has also engaged with applicable Federal and Provincial regulatory agencies who reviewed and provided comments on each of the drafts of the EIS. Canadian Nuclear Laboratories has worked with these agencies to understand their concerns and where required, has updated the EIS to provide additional information to address their concerns.

Canadian Nuclear Laboratories appreciates all **feedback** received to date on the NSDF Project and remains committed to continuing discussions with the public, Indigenous Peoples and non-governmental organizations on the NSDF Project. Canadian Nuclear Laboratories will continue engagements throughout the environmental assessment process but encourages interested members of the public to contact the NSDF Project directly with their questions about the NSDF Project (ERMStakeholder@cnl.ca).

Indigenous Engagement Activities

In consultation with the Canadian Nuclear Safety Commission, and using tools provided through the Aboriginal and Treaty Rights Information System, CNL identified a proposed list of Indigenous Peoples with potential interest in the NSDF Project. Engagement with Indigenous Peoples started in October 2015 and is on-going with CNL carrying out information sessions for the NSDF Project within Indigenous communities and organizations. Engagement methods have been largely similar to those for public engagement, and have also including webinars and working group meetings with each identified Indigenous community or organization. CNL has considered and provided capacity funding to specific Indigenous communities and organizations to further their ability to participate in the environmental assessment process.

Canadian Nuclear Laboratories has proactively addressed key concerns raised by interested Indigenous Peoples, using open and transparent communication to share information in regard to protection of the environment, specifically Kichi-Sìbì (Ottawa River), traditional land use and impact on valued components of Indigenous interest, as well as opportunities for involvement in future environmental monitoring.

During engagements with Indigenous Peoples, concerns raised include the historical occupancy of the lands, long term operations and future operations and scenarios which are not necessarily specific to the NSDF Project. Canadian Nuclear Laboratories respects and understands these concerns and has approached Indigenous engagement in such a way as to answer and address some of these broader questions as well as engaging specifically on the NSDF Project.

Algonquin cultural ceremony at the CRL site.

Birch bark harvested by Indigenous peoples from the proposed NSDF site.

Canadian Nuclear Laboratories is working towards developing long term relationships with Indigenous Peoples who occupy and have traditional territories and modern day interests near its operations. Canadian Nuclear Laboratories recognizes that such relationships may take a long time to form but believes this is consistent with the Government of Canada's approach to reconciliation with Indigenous Peoples.

Environmental Assessment Approach

The environmental assessment approach for the NSDF Project was developed to meet the requirements of **Canadian Environmental Assessment Act, 2012** and the Generic EIS Guidelines developed by the Canadian Nuclear Safety Commission, which provide an outline of the information to be included, along with a high-level description of the methods to be implemented for the environmental assessment.

The assessment started with defining the overall **scope of the assessment** including identifying the **valued components** for each environmental discipline, such as atmospheric environment, hydrogeology, terrestrial biodiversity, human health and the socio-economic environment. Valued components refer to environmental features that may be affected by a project and that have been identified to be of concern by the proponent, government agencies, Indigenous Peoples, the scientific community or the public. Examples of valued components identified include air quality, groundwater quality, migratory birds and public health.

The next step for the assessment was to define the physical boundaries, the time-related phases of the project and then to identify scenarios which would describe predicted effects of the projects.

Study areas (spatial boundaries) – Three spatial boundaries were considered: the site study area, the local study area, and the regional study area.

The site study area includes the area where NSDF Project activities would be undertaken which include the NSDF Project's proposed facilities, building and infrastructure. A local study area was selected for each environmental component to represent where the NSDF Project would have a direct affect. This most often includes the land and water immediately surrounding the site study area and portions of the downstream environment (e.g., Perch Lake). The largest section is the regional study area is where the NSDF Project may interact with other existing infrastructure. For many environmental components, the regional study area extends to the full CRL site boundary.

Temporal boundaries (project phases) – These establish the timeframe during which NSDF Project effects were assessed. The assessment phases align with those of the NSDF Project: construction phase (2022 to 2024), operations phase (approximately 50 years, i.e., 2025 to 2070), closure phase (approximately 2070 through to 2100), and post-closure phase (from 2100 and into the future).

A walk on one of the many trails in the Ottawa Valley – Sandra Faught, NSDF Project team

The next step was to describe the existing conditions. **A description of the environment** subsection was developed for each environmental component and includes a description of the baseline conditions. **Potential effects** of the NSDF Project on the environment were then identified and mitigation was developed to reduce adverse effects on the environment. **Residual effects** (i.e., effects that remain after the application of mitigation) were classified (e.g., low to high magnitude, short-term duration, etc.) so that it could be determined if each residual effect was significant or not. Cumulative effects (i.e., the combined impact of the NSDF Project with other reasonably foreseeable developments) were also evaluated to determine significance of these effects. Any uncertainty in the assessment and the general confidence in the predictions from the assessment were also evaluated. Finally, **monitoring programs** were proposed to verify the predictions and assumptions from the environmental assessment and to confirm that the proposed mitigation is effective.

Atmospheric Assessment Results

The climate in the region surrounding the NSDF Project site is classified as humid continental, with **warm summers, cold winters**, and no distinct dry season. The average daily temperature is 5.6°C while the daily average temperature in the winter season is 9.3°C and the daily average temperature in the summer season is 19.1°C. Annual precipitation of 859 millimetres equivalent (mm[eq]) is calculated for the region, with the highest precipitation typically occurring in the summer. The wind conditions at the NSDF site are considered to travel predominantly along the Ottawa River. When air quality is measured, contaminants are well below provincial and federal criteria, suggesting that the region has generally good air quality.

NSDF Project activities have the potential to release air emissions that could contribute to changes in air quality and incrementally to climate change. During the construction and operations phases, NSDF Project activities will result in emissions, including dust associated with construction activities such as the operation of vehicles and equipment. Examples of mitigation practices implemented to limit potential effects on air quality and climate change include:

- implementation of the Dust Management Plan developed for the NSDF Project, which includes appropriate management techniques to control dust generated by the NSDF Project;
- maintenance of on site vehicles and equipment; and
- limiting idling of vehicles and equipment on site.

With the implementation of these measures, the predicted changes to air quality as a result of the NSDF Project during both construction and operations phases do not exceed air quality guidelines and/or standards with one exception (1-hour nitrogen dioxide Canadian Ambient Air Quality Standard). However, the exceedance of the 1-hour nitrogen dioxide standard is not likely to occur given the conservative nature of the air quality assessment modelling. For example, in the model, heavy equipment is assumed to run simultaneously and continuously during working hours, which is unlikely to be the case.

With the implementation of CNL's robust environmental protection program, including the Dust Management Plan for the NSDF Project, residual effects from the NSDF Project on air quality are not significant.

A **slight residual effect to** greenhouse gas **emissions was identified because of the NSDF Project.** The change is estimated to be less than a 0.02% increase in total provincial greenhouse gas emissions and a 0.005% increase in total national greenhouse gas emissions. **Consequently, the residual effect from the NSDF Project on greenhouse gases is not significant.**

Monitoring of air quality at the CRL site is conducted under CNL's Effluent Verification Monitoring Program, which is compliant with the CSA Group standard *N288.5-11 Effluent Monitoring Programs at Class I Nuclear Facilities and Uranium Mines and Mills*. Air quality monitoring for the NSDF Project is intended to verify that mitigation is being implemented effectively and to verify the predictions of the assessment.

Geology and Hydrogeology Assessment Results

The CRL site is located within the Canadian Shield. **Bedrock outcrops** in several locations in the region, and a widespread but thin deposit of glacial sediment covers the bedrock in most areas where soil is present. Soil layers generally consist of well drained sandy soils in the area. Groundwater table depth varies significantly throughout the NSDF Project site and changes with the seasons. The average groundwater depths range from approximately 0.06 m in the vicinity of the wetlands to 15.95 m in the northern section of the study area, which corresponds to the thickest overburden. Groundwater flow from the NSDF Project site is to the adjacent wetlands, and ultimately discharges to the Ottawa River via Perch Lake and Perch Creek. However, as mentioned previously the NSDF Project has been designed to prevent the release of contaminants into the environment, including groundwater, to protect local waterbodies.

Without mitigation, NSDF Project activities have the potential to alter soil quantity, quality, and distribution, as well as **geomorphology** as a result of construction and closure activities. Blasting activities, site grading, excavating and emissions of air contaminants could change soil quality during construction. The construction of the NSDF Project will physically alter groundwater levels and flows, and surface drainage. During operations, discharge of treated effluent could cause changes to groundwater quality, levels and flows. During the post-closure phase, without mitigation, leakage of leachate could cause changes to groundwater quality. Examples of design features and mitigation implemented to limit these potential effects to geology and **hydrogeology** include:

- physical changes to the bedrock from blasting will be limited to the local area within the engineered containment mound footprint;
- the base liner design includes both primary and secondary liner systems that are designed to have redundancy in case of premature failure and are designed to be suitable for the disposal of low-level waste; and
- implementation of the Surface Water Management Plan developed for the NSDF Project, which includes appropriate management techniques for erosion and sediment control.

The residual effects of the NSDF Project on geology are related to changes in soil quantity and quality and geomorphology as a result of construction of the NSDF Project, and changes to soil quality from blasting activities and air emissions. Mitigation and environmental design features implemented for the NSDF Project include existing practices at the CRL site and those used at similar facilities. Consequently, changes in geology are not expected to result in significant adverse effects to other valued components (e.g., terrestrial environment).

The residual effects of the NSDF Project on hydrogeology are related to the alteration of groundwater levels and flows due to the construction of the NSDF Project. For groundwater quality, releases from the engineered containment mound are not anticipated during operations. Potential releases during post-closure (after the design life of the facility safety features) are not anticipated to result in significant residual effects because the inventory is sufficiently decayed and environmental concentrations are negligible. Therefore, changes in groundwater quality and quantity are not expected to result in significant adverse effects to other valued components (e.g., aquatic environment and human health).

Operational monitoring will be implemented to verify predictions from the environmental assessment for geology.

For example, visual inspections of surface water management systems will be completed to confirm erosion control measures are effective. Groundwater monitoring will be integrated into the overall CNL Groundwater Monitoring Program, and will be compliant with CSA Group standard *N288.7-15 Groundwater Protection Programs at Class I Nuclear Facilities and Uranium Mines and Mills*. Groundwater monitoring is intended to verify that the environmental assessment predictions on groundwater during the operations phase are accurate, and to verify the effectiveness of mitigation. Groundwater monitoring will continue through operations, closure and post-closure phase.

Surface Water Environment Assessment Results

The CRL site is located in the Allumette Lake and Lac Coulonge reach of the Ottawa River. The distance from the centre of the NSDF Project site to the closest point on the Ottawa River shoreline is approximately 1.1 km. The NSDF Project is located entirely within the Perch Creek and Perch Lake Watershed, which drain into the Ottawa River. Surface drainage from approximately 18% of the CRL site flows through Perch Creek and subsequently into the Ottawa River. The drainage basin slopes from a highpoint ridge along the eastern limit of the CRL site, westerly towards Perch Lake and the wetlands located on the western boundary. Surface water monitoring at on site lakes and streams, off site streams, and locations in the Ottawa River upstream and downstream of the CRL site is routinely conducted to describe the surface water quality, in accordance with CNL's *Environmental Monitoring Program*.

Without mitigation, NSDF Project activities have the potential to change water levels, flows and channel and bank stability due to discharge of treated effluent and non-contact water into **adjacent wetlands** or downstream locations during operations. Also, the construction and installation of the engineered containment mound will physically alter drainage patterns, and intaking water from the Ottawa River could change its hydrology. Without mitigation, changes to local hydrology, discharge of treated effluent, air and dust emissions, surface water runoff, leakage of leachate or other releases of substances may affect surface water quality at downstream locations.

Examples of mitigation practices that will be implemented to limit predicted effects to surface water include:

- implementation of the *Surface Water Management Plan* developed for the NSDF Project, which includes appropriate management techniques to collect and direct surface drainage, including stormwater management ponds, and erosion and sediment control practices (e.g., silt fences, runoff management) will be used during construction around disturbed areas, where appropriate;
- treated effluent will be sampled to confirm it meets the effluent discharge targets before release; and
- the final cover system will be constructed to promote the shedding of surface water to mitigate infiltration into the mound and minimize leachate generation.

Residual effects to hydrology were identified because the installation of the engineered containment mound will physically alter drainage patterns and may change downstream discharge, water levels in adjacent wetlands, and channel and bank stability. Residual effects to surface water quality were predicted because the discharge of treated effluent from the WWTP to ground via the exfiltration gallery and via a transfer line to Perch Lake could cause changes to downstream surface water quality, and leakage of leachate from the engineered containment mound during the post-closure phase could cause changes to downstream surface water quality. Changes in hydrology and surface water quality were provided to other environmental components for inclusion in their assessment (e.g., aquatic biodiversity).

Overall, changes in hydrology and surface water quality are not expected to result in significant adverse effects to other valued components (e.g., aquatic biodiversity and human health).

Monitoring and follow up programs for surface water hydrology will focus operational performance and environmental monitoring (e.g., monitoring of water levels in the stormwater management ponds to verify they are performing as designed). Stormwater management pond monitoring will be integrated into the NSDF Project *Environmental Protection Plan*, while water level monitoring of the wetland system will be integrated into the current **CNL Environmental Monitoring Program**.

Routine surface water quality monitoring for the NSDF Project will be included in CNL's current Environmental Monitoring Program, which is compliant with CSA Group standard *N288.4-10 Environmental Monitoring at Class I Nuclear Facilities and Uranium Mines and Mills*. Effluent water quality from the surface water management ponds and wastewater treatment facility will be monitored in accordance with CNL's Effluent Verification Monitoring Program, which is compliant with the CSA Group standard *N288.5-11 Effluent Monitoring Programs at Class I Nuclear Facilities and Uranium Mines and Mills*. Together, these programs will be used to verify environmental assessment predictions related to surface water quality, verify the surface water management ponds are performing as designed, and demonstrate compliance with effluent discharge targets developed for the NSDF Project. The water quality monitoring will continue through operations, closure and post closure (institutional control).

Aquatic Environment Assessment Results

Aquatic habitat in the local study area is found largely in Perch Lake and Perch Creek. Several fish species have been identified in the Perch Creek and Perch Lake Watershed during field programs since the 1980s through 2018. Major changes to fish productivity and community structure over time have not been observed, since the introduction of northern pike to Perch Lake in the mid-to-late 1980s, suggesting that the historical effects of past operations on water quality pose minimal risk to the fish community and populations in Perch Lake. Specifically, Perch Lake continues to support a large bodied fish community that includes northern pike, yellow perch, brown bullhead and pumpkinseed. Based on historical reports of fish sampling in the Ottawa River, four fish species of conservation concern occur or have the potential to occur in the river reach adjacent to the CRL site (e.g., Allumette Lake). These species include lake sturgeon, American eel, river redhorse and northern brook lamprey. To the north of Perch Lake are extensive wetlands, notably Perch Lake Swamp, South Swamp and East Swamp. The fish habitat potential of wetlands such as Perch Lake Swamp and East Swamp is predicted to be low.

Without mitigation, the potential for effects to aquatic biodiversity are primarily related to changes in groundwater, surface water, and air quality. NSDF Project activities have the potential to affect water levels, flows, water quality and therefore fish habitat quality, and fish survival and reproduction. Activities that could affect fish habitat quality include changes to local hydrology, installation of treated effluent transfer line, discharge of treated effluent, leakage of leachate, release or deposition of harmful substances into downstream waterbodies, and physical changes to fish habitat such as along the riverbank. As well, blasting near fish bearing waterbodies may result in pressure changes, vibrations and affect fish survival and reproduction. Examples of mitigation practices that will be implemented to limit predicted effects to aquatic biodiversity include:

- work will be completed within the in water work timing window to avoid spawning and egg/larval development periods for spring spawning fish species;
- runoff will be managed to avoid adverse environmental effects in downstream waterbodies; and

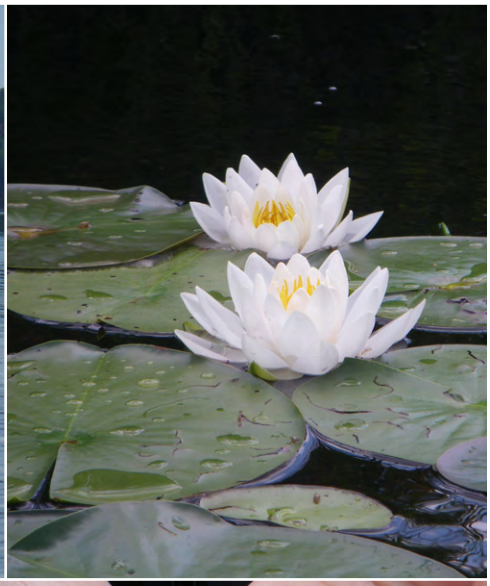
- clearing of any vegetation and organic materials along the riverbank will be minimized. Disturbed shorelines and wetlands will be re vegetated and restored to the original stable gradient and contour.

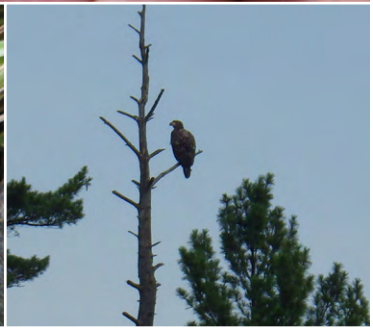
Canadian Nuclear Laboratories is prepared to implement mitigation and environmental design features for the NSDF Project that are well understood and include existing practices at the CRL site. Therefore, it is not expected that residual effects from the NSDF Project on aquatic biodiversity will be significant.

As mentioned above for surface water, planned monitoring will include routine monitoring of surface water quality which is protective of aquatic biodiversity. If the environmental monitoring program for surface water quality identifies that adverse environmental effects are greater than predicted, then CNL will evaluate the need for revised mitigation actions and management practices to manage effects related to aquatic biodiversity.

Terrestrial Environment Assessment Results

The CRL site is characterized by deciduous and coniferous forest and the Ottawa River. The NSDF Project is in a primarily undisturbed area adjacent to heavily disturbed areas, including the CRL site main campus and various waste management areas. The area is a mix of forested vegetation communities and wetlands (South Swamp, East Swamp, and the marsh wetlands) surrounding Perch Lake and Perch Creek. The area provides suitable habitat for numerous migratory birds, including **species at risk** such as the Canada warbler, eastern whip-poor-will, eastern wood-pewee, golden-winged warbler and wood thrush. Likewise, the area provides suitable habitat for several wildlife species of mammals, reptiles, amphibians and invertebrates including species at risk such as bats (little brown myotis, northern myotis and tri-colored bat), Blanding's turtle, eastern milksnake, and monarch butterfly.





During all phases of the NSDF Project, there are some activities such as the clearing of vegetation, use of heavy equipment, and discharge of treated effluent, that – without mitigation – have the potential to affect vegetation and wetland communities and could have an effect on wildlife habitat, influencing abundance and distribution, or survival and reproduction. Activities that cause changes to other valued components, such as surface water quality, soils and vegetation communities (including wetlands), could in turn affect wildlife habitat availability and distribution, and survival and reproduction. Construction activities could also result in injury or mortality to wildlife. These effects may apply to terrestrial species at risk and their habitats as well.

Examples of mitigation practices to be implemented to limit residual effects to terrestrial biodiversity include:

- avoiding activities with highest levels of noise and habitat disturbance during the most sensitive life history phase (i.e., breeding and nesting for birds) to limit effects on nesting birds;
- a comprehensive **Sustainable Forest Management Plan** will be implemented at the CRL site to ensure the long-term retention of trees serving as maternity roosts for bat species; and
- Canadian Nuclear Laboratories is currently implementing a detailed Blanding's Turtle Road Mortality Mitigation Plan to eliminate road mortality at the CRL site and increase connectivity between habitats. This existing plan will continue to be implemented during the NSDF Project.

The assessment predicted residual effects to vegetation communities (including wetlands), Canada warbler, eastern whip-poor-will, eastern wood-pewee, golden-winged warbler, wood thrush, bats, Blanding's turtle, eastern milksnake and monarch butterfly. The residual effects to vegetation are due to loss of forest, change to forest distribution and edge effects. The residual effects to wildlife species primarily result from loss of suitable habitat (e.g., due to clearing), avoidance due to sensory disturbance (e.g., noise), change in movement of wildlife species, risk of injury or mortality (e.g., on roads due to traffic).

With the implementation of appropriate mitigation, residual effects of the NSDF Project on the terrestrial environment (vegetation communities and wildlife species) are not significant.

Monitoring and follow up programs are recommended for Canada warbler, eastern whip-poor-will, eastern wood-pewee, golden-winged warbler, wood thrush, bats, Blanding's turtle and eastern milksnake. These will be integrated into CNL's existing Species at Risk Program and will be used to confirm the predictions made in the terrestrial biodiversity assessment, including the effectiveness of mitigation. Monitoring will be on-going during the construction and operations phases, and closure where appropriate.

Blanding's Turtle Road Mortality Mitigation Plan

In 2018, CNL developed a Blanding's Turtle Road Mortality Mitigation Plan to limit adverse effects on blanding's turtles. The plan is currently being implemented at the CRL site and includes priority culvert replacements (allows turtle passage under roads), nest habitat creation and reptile fencing (e.g., limit access to areas where road mortality may occur).

Ambient Radioactivity and Ecological Health Assessment Results

Background radiation and radioactivity is present in the environment due to natural and anthropogenic (human made) sources which include, legacy operations at the CRL site. The main natural sources of radiation are cosmic rays; naturally occurring radionuclides in air, water and food; and naturally occurring radionuclides in the soil, rocks and building materials used in homes. Some radionuclides released from the CRL site are already present in the environment due to natural and human activities. The CRL site Environmental Monitoring Programs includes sampling and analysis of surface water, groundwater, sediment, soil, vegetation, ambient air, milk, garden produce, game animals, farm animals and fish at the CRL site boundary and at relevant off site locations. Environmental concentrations are compared to expected background levels or measurements of samples to distinguish the effect of the CRL site operations from radiological contamination that is present due to other sources.

Without mitigation measures, NSDF Project activities have the potential to affect ecological health during the operations and closure phases through the release of dust when handling bulk materials, emissions of gases during storage and disposal of radioactive materials, and changes to groundwater quality and downstream surface water quality. As well, effects could result from the release of volatiles or leakage of leachate during the post-closure phase. The robust NSDF design provides containment for hundreds of years allowing for radiologic decay of the waste inventory. Once the NSDF **engineered barriers** degrade, after 550 years, the levels of radioactivity released to the environment is quite small.

Controls will be in place to minimize the generation of wastewater in the engineered containment mound. For example, waste will be covered as each disposal cell is filled. A WWTP has been designed to remove both radiological and chemical contaminants. Through pilot testing CNL has demonstrated that the effluent discharge targets which are protective of the public and the environment can be achieved. Furthermore, the plant is designed for batch releases, which means all treated effluent must be sampled and proven to meet targets before being discharged to the environment.

During the operations and closure phases, airborne emissions are negligible, and waterborne emissions result in environmental concentrations that are below levels that would result in potential adverse effects on aquatic life. During the post-closure phase, airborne and waterborne releases are below the dose benchmark values.

Therefore, residual effects of the NSDF Project on ambient radioactivity and ecological health are not significant.

Monitoring air quality (i.e., dust), treated effluent, ambient radioactivity and groundwater for the NSDF Project will be integrated into CNL's existing Environmental Monitoring Program, Groundwater Monitoring Program, and Effluent Verification Monitoring Program, as well as NSDF-specific environmental monitoring activities. For example, the Effluent Verification Monitoring Program includes continuous monitoring of airborne radiological particulates from applicable operational facilities on the CRL site. These programs will verify effects predictions for ecological health and effectiveness of mitigation. Monitoring will be on-going during operations, closure and during the institutional control period as needed based on annual reviews of monitoring data.

Dust monitors located at the NSDF site.

Human Health Assessment Results

Radiation occurs naturally from cosmic and terrestrial sources as well as from man-made materials, independent of the CRL site operations. Natural background radiation can vary depending on location and within Canada the **average dose** from natural background radiation is 1.8 mSv in a year (mSv/yr). The Canadian regulations for radiation protection also set limits on the amount of radiation the public or nuclear energy workers may receive from licensed activities to manage nuclear substances. In Canada the public dose limit is 1 mSv/yr and the dose limit for a nuclear energy worker is 50 mSv in any one year and 100 mSv in five consecutive years.

Access to the CRL site is restricted, however, without mitigation, there may be instances where the public may receive a dose as a result of potential waterborne or airborne emissions from the NSDF Project. Dose to the public from waterborne emissions is calculated during the operations phase, as well as during the post-closure phase for the NSDF Project. Canadian Nuclear Laboratories limits public dose through the establishment of effluent discharge targets, which are protective of the public's drinking water and based on Health Canada Drinking Water guidelines. Airborne releases of dust are controlled during operations thus mitigating airborne releases. The dose to the public during the operations phase is expected to be negligible and is almost 50 times lower than the regulatory public dose limit of 1 mSv/yr. The dose to the public during the post-closure phase was conservatively calculated using the hypothetical case of a farmer with a family living directly on the engineered containment mound who would be exposed to any potential contamination released from the facility. Under that scenario, the robust NSDF design provides containment for hundreds of years, so it will continue to isolate the waste inventory during radiologic decay. As well, the levels of radioactivity released to the environment will continue to decrease after 550 years even if the NSDF engineered barriers degrade. Even with a most **disruptive event**, such as unintentional intrusion, the radiological dose to a member of the public will still be at least 60 times lower than the regulatory public dose limit of 1 mSv/yr, meaning that residual effects from the NSDF Project on public health are not significant.

Therefore, residual effects from the NSDF Project on the public health are not significant.

Radiological dose to an on-site worker will mainly occur during the operational phase as the result of carrying out tasks related to the placement of waste and activities within the WWTP, and will be kept **as low as reasonably achievable**. For the on-site worker, the maximum estimated dose is 5 times lower than the regulatory nuclear energy worker limit of 50 mSv/yr, thus residual effects from the NSDF Project on worker health are not significant.

Monitoring of airborne and waterborne emissions at the CRL site is conducted under CNL's Effluent Verification Monitoring Program, which is compliant with the CSA Group standard *N288.5-11 Effluent Monitoring Programs at Class I Nuclear Facilities and Uranium Mines and Mills*. Air and water quality monitoring for the NSDF Project is intended to verify that mitigation is being implemented effectively and to verify predictions for public dose. Radiation dose monitoring for nuclear energy workers will verify predictions for worker dose.

Land and Resource Use Assessment Results

The NSDF Project is located entirely within the CRL site, on federal lands. Aside from the operations and activities undertaken by CNL, other land uses of the CRL site are prohibited and public access is restricted. The NSDF Project area is bordered by the remaining CRL site to the north, east and west, the Garrison Petawawa (which is another federal land with restricted public access) to the south, and the Ottawa River to the northeast. Therefore, there are limited land and resource uses that have the potential to be disturbed by the NSDF Project. The adjacent Ottawa River is valuable for recreational and tourism-based fishing industries, and it is not expected that the NSDF Project will have any interaction with these activities as it is in a restricted area. Potential trapping has been identified in the southern and western portions of the study area outside the boundary of the CRL site.

An **archaeological assessment** for the NSDF Project was conducted. The areas of archaeological potential have been fully excavated and documented to the extent required under the *Standards and Guidelines for Consultant Archaeologists*. No cultural heritage value or interest remains and the locations have been fully documented; therefore, no further archaeological work is required.

Without mitigation efforts, NSDF Project activities have the potential to affect land and resource tenures and other registered interests (i.e., land use designations, mining and aggregates, forestry and agriculture), outdoor tourism and recreation (i.e., parks and protected areas, fishing, hunting, trapping and non-consumptive tourism and recreation), during the construction and operations, closure, post-closure phases as a result of change in access or opportunities for these activities. In addition, there is potential for unanticipated archaeological sites to be affected during construction. Examples of mitigation practices implemented to limit potential effects to land and resource use include:

- Canadian Nuclear Laboratories will consult with trappers about their use of the surrounding areas for trapping activities and to understand any concerns; and
- implementation of CNL's Cultural Resource Management Program to protect unexpected archaeological resources encountered during construction activities and implement adaptive management.

The NSDF Project is not predicted to have any terrestrial effects beyond the CRL site, and results of the aquatic environment assessment identified only negligible residual effects on aquatic biodiversity valued components as a result of the NSDF Project. Access along the Ottawa River will continue to occur and not be restricted because of the NSDF Project. No effect to archaeological resources is expected as most mitigation for archaeological resources are applied and completed in advance of ground disturbance activities.

The assessment concluded that no residual effects on land and resource use are anticipated as a result of the NSDF project.

Monitoring and follow-up programs are not specifically identified for land and resource use; however, monitoring for environmental pathways (i.e., for air quality, surface water quality and groundwater quality) will be integrated into CNL's existing Environmental Monitoring Program. The programs will be used to verify effects predictions for land and resource use, and to promote land user comfort with regard to the safety of the surrounding areas for traditional land use, **outdoor tourism and recreation**, and commercial (i.e., tenured) land use activities. Monitoring will be on-going during operations, closure and post-closure (institutional control) as needed based on annual reviews of monitoring data.

Socio-economic Environment Assessment Results

The NSDF Project is located on the CRL site in **Renfrew County**, approximately 12 km southeast of the Town of **Deep River**, 9 km northwest of the Garrison Petawawa, and 7 km east of the Village of Chalk River. The two largest employers within the vicinity of the NSDF Project are Garrison Petawawa and CNL. As of May 2019, the CRL site employed approximately 2,850 people. Future economic growth and development opportunities are a key concern for communities in the area. The major arterial highway that connects the NSDF Project to the local communities and other regions of Ontario is Highway 17, which is the longest highway in Ontario. In 2010, annual average daily traffic counts found that traffic levels between the Village of Chalk River and Deep River ranged from 6,700 and 8,150 vehicles per day. A study of the existing traffic to and from the site indicated that the traffic volumes were between 700 and 800 vehicles during peak hours in the morning and afternoon. The nearest hotel or motel accommodations are available in the Town of Deep River, **Petawawa** and **Pembroke**.

Near Surface Disposal Facility Project activities have the potential to positively affect employment and income, economic development and government finances through the employment of personnel, **procurement of goods and services**, and expenditures. These positive residual effects to the **socio-economic environment** were identified, primarily from activities that occur during the construction phase, because the NSDF Project could provide employment of personnel in the region, provide contracting and supplier opportunities to local and regional businesses, and make some use of services such as commercial accommodations. Overall, the NSDF Project may result in small positive effects to local Indigenous Peoples through potential contracting or employment opportunities. Indigenous Peoples have expressed an interest in potential opportunities and CNL will continue to engage with Indigenous Peoples on potential employment and contracting opportunities for the NSDF Project. Therefore, residual effects of the NSDF Project on the labour market, economic development, and housing and accommodation are positive.

Therefore, residual effects of the NSDF Project on the labour market, economic development, and housing and accommodation are positive.

On the other hand, there is the potential for the NSDF Project to have certain negative socio-economic effects. It could put pressure on commercial accommodations, increase public transportation and road degradation (both on an off the campus of Chalk River Laboratories) and increase demand for community services such as health, education, protective and emergency services. For these adverse effects, with the implementation of appropriate mitigation, residual effects of the NSDF Project on housing and accommodation, and services and infrastructure are not significant.

Examples of mitigation practices implemented to limit predicted residual effects to socio economic valued components include:

- Canadian Nuclear Laboratories will competitively procure material and services for the NSDF Project;
- continued implementation and maintenance of compliance with all applicable health and safety standards and CNL's existing environmental, safety and security programs; and
- coordinate transportation of construction materials during construction phase to minimize overlap with peak employee traffic times.

Monitoring for environmental pathways (i.e., for air quality, surface water quality and groundwater quality) will be integrated into CNL's existing Environmental Monitoring Program to verify effects predictions, including as they relate to predicted socio-economic effects. In addition, recognizing people's interest in understanding and participating in decisions that affect them, CNL will proactively seek, engage, and support meaningful discussion on issues and opportunities related to the NSDF Project as part of the Public Information Program. Canadian Nuclear Laboratories will continually evaluate both the process and the outcome of the on-going engagement and communication activities to address and manage issues as they arise. This will be on-going during construction, operations, closure phases, as needed based on annual reviews of monitoring data. The level and nature of engagement with the communities will depend on the feedback received.

Indigenous Interests

Indigenous interests expressed to CNL during engagement with the identified Indigenous communities or organizations with potential or established Indigenous or treaty rights in the vicinity of the NSDF Project have been considered in the environmental assessment. This includes the Algonquins of Ontario, Algonquins of Pikwaknagan First Nation, Métis Nation of Ontario, Algonquin Anishinabeg Tribal Council (AANTC) which includes Kitigan Zibi Anishinabeg and Keboawek First Nations; Williams Treaties First Nations which includes Chippewas of Beausoleil, Georgina Island and Rama First Nations and the Mississaugas of Alderville, Curve Lake, Hiawatha, Scugog Island First Nations; Anishinabek Nation; and, Mohawks of the Bay of Quinte First Nation. It should be noted that the Mohawks of the Bay of Quinte are not identified on CNL's engagement list but have provided correspondence on the NSDF Project.

The closest Indigenous community is the Algonquins of Pikwakanagan First Nation, located at Golden Lake, approximately 50 km southeast of the CRL site. The Algonquins of Pikwakanagan First Nation are part of the larger Algonquins of Ontario organization, which has reached an Agreement-In-Principle with the Governments of Ontario and Canada regarding a land claim in the Ottawa Valley, which they consider their traditional homelands. The area that is subject of the Algonquin claim in Ontario includes the National Capital Region, all of Renfrew County and most of Algonquin Park, which is a provincial park. In addition, the CRL site falls within the Métis Nation of Ontario's Ottawa River traditional harvesting territory.

Information on traditional land use activities by Indigenous Peoples has been drawn from: existing studies and reports; Indigenous community and organization websites; the Métis Nation of Ontario Traditional Knowledge and Land Use Study; the Algonquins of Ontario Algonquin Knowledge and Land Use Study; the Algonquins of Pikwakanagan First Nation Algonquin Knowledge and Land Use Study; formal and informal consultation activities; and general knowledge of the region. In the absence of specific feedback from other Indigenous communities and organizations, traditional land and resource use is assumed wherever there are accessible lands, which is a conservative approach to the assessment and also to reflect the dynamic practice of traditional land and resource use by Indigenous Peoples in time and space.

The NSDF Project is located entirely within the CRL site boundary, on federal lands. Therefore, aside from the operations and activities undertaken by CNL, other land uses of the CRL site are prohibited due to restricted public access. The NSDF Project is not predicted to have any terrestrial effects beyond the CRL site, and results of the aquatic environment assessment identify that measurable residual effects on aquatic biodiversity are not predicted as a result of the NSDF Project. Traditional access to the Pointe au Baptême and Oiseau Rock sites along the Ottawa River will continue to occur and will not be restricted because of the NSDF Project. There are no effects anticipated to archaeological resources as most mitigation for archaeological resources is applied and completed in advance of ground disturbance activities.

Consequently, the residual effects from the NSDF Project on traditional land and resources use are not significant.

Indigenous Peoples have expressed a general concern about the potential effect of the NSDF Project on their health and a perception of risk of harvesting near the CRL site. This has partially arisen from the understanding that they have a greater degree of reliance on foods obtained from traditional land and resource use than the general public. Although these concerns are not specific to the NSDF Project, CNL acknowledges its role as providing education opportunities and undertaking communications with Indigenous Peoples to alleviate such concerns and fears. The potential dose to an Indigenous person was conservatively calculated using the hypothetical case of a self sufficient Indigenous person completely reliant on local traditional food sourced from the NSDF Project site and surrounding areas. The results indicated that the estimated radiological dose to this individual would be more than 13 times lower than the current regulatory dose limit of 1 mSv/yr., meaning that residual effects from the NSDF Project on Indigenous health are not significant.

Furthermore, CNL is willing to involve all Indigenous communities and organizations who have interest in the NSDF Project environmental monitoring and have shared the draft Environmental Assessment Follow-Up Monitoring Program with Indigenous communities and organizations for input. The Environmental Assessment Follow-Up Monitoring Program will not be finalized until after a regulatory decision is rendered by the Canadian Nuclear Safety Commission, thus there remains opportunity for direct involvement in its development and implementation. As well, CNL's robust environmental protection program will be used to identify protect unexpected archaeological resources encountered during construction activities and implement adaptive management.

Recognizing Indigenous Peoples interest in understanding and participating in decisions that affect them, CNL will continue to proactively seek, engage and support meaningful discussion on issues and opportunities related to the NSDF Project through Indigenous engagement activities. Where there are differences of opinion or concerns that need to be addressed, CNL is willing to explore mitigation measures and formulate commitments with Indigenous communities and organizations with the intention of trying to remove or lessen the concern. The Indigenous Engagement Report, as a living document, will include any updates related to the progress of these commitments in support of a regulatory decision for the NSDF Project.

Accidents and Malfunctions

To identify potential accident and malfunction events during the construction and operation phases, as well as their potential health and environmental effects, the NSDF Project used a systematic and comprehensive approach. Credible events were identified through a review of project activities to identify hazards, which were assigned frequency, severity and risk rankings. The **bounding** or key potential accidents and malfunctions during the operations of NSDF include:

- dropped load during waste placement which could result in the potential spread of contamination;
- dropped load during wastewater treatment operations (i.e., dewatering of filter press) which could result in the potential spread of contamination;
- fire within the engineered containment mound resulting in the ignition of combustible waste which could result in an airborne release;
- fire within the WWTP, such as from flammable gas, which could result in an airborne release; and
- spill of contaminated resin during the wastewater treatment operations which could result in the potential spread of contamination.

Each of these events underwent an analysis to determine the dose estimate for the on site workers as well as the public. The assessment considered both radiological and non-radiological contaminants. The dose consequences to the on-site workers and the public for all potential accidents and malfunctions meet the respective regulatory limits thus residual effects from accidents and malfunctions of the NSDF Project are not significant.

Conventional occupational hazards are anticipated to be typical of a major construction project and evaluated to be controlled by human performance, thus CNL has put in place provisions including training, procedures and oversight of contractors to achieve as-low-as-reasonably possible accident and malfunction rates.

If an accident or malfunction situation occurs, CNL has procedures in place that address requirements for immediate response and post-event clean-up or remediation.

Effect of the Environment on the Project Assessment Results

In addition to assessing the potential effects of the NSDF Project on the environment, the EIS also considers how the environment could adversely affect the NSDF Project. This included an evaluation of how climate change, severe weather and other environmental events may interact with and potentially alter the condition and function of the NSDF Project, resulting in effects on the environment or public safety. Due to the recognized long timeframe of the NSDF Project as a permanent disposal facility for low-level waste, the potential magnitude and severity of future environmental events were taken into account.
For example, natural hazards such as extreme weather caused by climate change, flooding, tornados, forest fires, **seismic events** and glaciation were all assessed.

To ensure the effects of the NSDF Project are minimized, the design basis of the NSDF accounts for expected and extreme environmental conditions of the site. Some of the events considered and the design features which mitigate against their consequences include:

- Extreme rainfall events are considered in the design of the wastewater collection and treatment systems. The storage capacity and maximum flow rate of the WWTP was based on two back-to-back, 100 year, 24-hour storm events. Within the engineered containment mound, stormwater features such as drainage, ditches, culverts and surface water management ponds have been designed appropriately for peak flows that accounted for climate change.
- Flooding of the Ottawa River as well as nearby creeks and wetlands has been taken into consideration in the siting of the NSDF Project. The base of the proposed NSDF is located approximately 163 meters above sea level which is approximately 50 meters above the current water levels of the Ottawa River. Other design features provide additional mitigation to flooding including the topographical slopes of the engineered containment mound.
- Significant seismic events and the potential for damage to the safety features are considered in the design of the engineered containment mound. The design of the engineered containment mound is robust enough to withstand significant seismic events beyond what have been recorded for the Ottawa Valley (i.e., once in 10,000 years). The use of earthen materials and specifications for waste material placement and compaction are part of the design basis of the engineered containment mound that provide the necessary structural stability. The WWTP and other infrastructure required only for the operations phase have followed current national building codes and will withstand typical seismic events for the Ottawa Valley (i.e., once in 2,475 years).
- Tornadoes are recognized as a hazard to the facilities on the CRL site, including the NSDF Project. It is acknowledged that the NSDF Project is in a geographical area that could reasonably expect a tornado strike, because of this, the design of the WWTP and other infrastructure will be robust – built to withstand potential tornadoes and high winds. The effects of a tornado or extreme winds on the engineered containment mound are expected to have negligible consequences.

Since the next predicted glaciation event may not occur until 100,000 years into the future, far beyond the hazardous lifetime of the NSDF inventory, an assessment of the consequences as the result of glaciation was not warranted. The NSDF Project incorporates design features to minimize its effect on the environment during facility operation as well as into the post-closure phase thus residual effects from the effects of the environment on the NSDF Project are not significant.

If an extreme environmental event occurs, **CNL has procedures** in place for an immediate response and post-event clean-up or remediation.

Monitoring and Follow-up Programs

A **conceptual follow-up and monitoring program** was developed to verify that mitigations are being implemented effectively and to confirm environmental assessment predictions. This plan provides a preliminary description of the activities and framework for monitoring proposed for the NSDF Project. The details of this program will be further developed into detailed monitoring and follow-up programs as the environmental assessment process continues, with input from the public, Indigenous Peoples and regulatory agencies.

If an environmental monitoring and follow-up program identifies that adverse environmental effects are greater than predicted, then CNL will evaluate whether they result in changes to the conclusions in this EIS. If changes are confirmed, then CNL will evaluate the need for revised mitigation actions and management practices to manage effects. Canadian Nuclear Laboratories' evaluation process for monitoring data include environmental performance criteria that are based on statistical measures and ecological health benchmarks.

Conclusion

This EIS describes the NSDF Project and the existing environmental conditions on the CRL site and assesses the likely effects of the NSDF Project on the environment. The EIS also includes an assessment of likely cumulative effects of the NSDF Project in combination with other previous, existing or reasonably foreseeable developments, as required. It describes the effects for normal conditions and as a result of accidents and malfunctions. The EIS also describes and assesses the likely effects of the environment on the NSDF Project. Throughout the environmental assessment process, CNL has solicited input from the public and Indigenous Peoples and incorporated this feedback into the EIS where appropriate. Examples of this include changes to the waste inventory (i.e., only low-level waste) and expansion of the EIS study areas to include a larger downstream portion of the Ottawa River. Further, CNL is working to develop long-term relationship agreements with Indigenous Peoples to work collaboratively to meet the needs of the individual communities in the context of the NSDF Project as well as the broader operations of the CRL site into the future.

The development of a near surface disposal facility for low-level waste at the CRL site will reduce potential risks associated with AECL's legacy wastes liabilities. The NSDF Project will enable the remediation of historically contaminated lands and legacy waste management areas, as well as decommissioning of outdated infrastructure to facilitate the CRL site revitalization. The current CRL site waste management practice is to safely store radioactive waste on-site in individual facilities in accordance with current licence conditions. However, appropriate nuclear waste management includes full life cycle management from generation to disposal. The NSDF Project will accommodate the permanent disposal of current and future low-level waste at the site. The EIS demonstrates that the NSDF Project can be constructed, operated and closed in a manner that is protective of human health and the environment.

Residual adverse effects were identified for air quality, greenhouse gases, hydrogeology, hydrology, surface water quality, terrestrial biodiversity ecological health, human health and socio-economics (housing and accommodations, and services and infrastructure). Beneficial effects were identified for socio-economics (labour market, economic development, Indigenous interests).

Canadian Nuclear Laboratories has addressed key issues raised by interested Indigenous Peoples, after open and transparent communication to share information in regard to traditional land use, biodiversity and archaeology. Overall, it is CNL's conclusion that with the identified mitigation, the implementation of the NSDF Project is not likely to result in significant residual adverse effects.

All predicted effects for human health are well below regulatory criteria during the life of the NSDF Project, including post-closure. The maximum estimated dose during the operations period for an on-site worker is 5 times lower than the regulatory limit of 50 mSv/yr and for the public is almost 50 times lower than the regulatory dose limit of 1 mSv/yr. During post-closure, the maximum estimated dose associated with the most likely future state of the facility is more than 60 times lower than the regulatory dose limit of 1 mSv/yr. Residual effects on Ottawa River water quality are determined to be negligible during operations and post-closure phases and may result in a net benefit due to remediation of legacy waste storage areas.

Chalk River Laboratories employees live in the Ottawa Valley and use the Ottawa River as a source of drinking water and for recreation. As such, its protection is as important to us as it is to you and considerable effort has been spent on the design of the NSDF Project to ensure it is suitable to contain the proposed inventory and protect the environment. The engineered containment mound is designed to contain and isolate the wastes from the environment for 550 years. Since the NSDF only accepts low-level waste and most of the radioactivity, thus, the hazard, **decays in the first 100 years** after closure, the design of the NSDF is commensurate with the hazard. The safety of the NSDF during post-closure is provided by means of passive features (e.g., berm, base liner and cover systems) that will end the need for active management, in alignment with regulatory requirements and international nuclear industry guidance.

Canadian Nuclear Laboratories has a comprehensive environmental and effluent monitoring program in place which includes monitoring of the Ottawa River water quality and fish. This environmental and effluent monitoring program will be expanded to include waste water treatment plant effluent from the NSDF Project, surface water in the Perch Lake Basin, and groundwater to confirm performance of the engineered containment mound and on-going monitoring of the Ottawa River. The details of this program will evolve into detailed **monitoring and follow-up programs** as the environmental assessment process continues, with input from the public, Indigenous Peoples and regulatory agencies. The facility will be a licenced nuclear facility under the *Nuclear Safety and Control Act* with regulatory oversight as long as required.

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