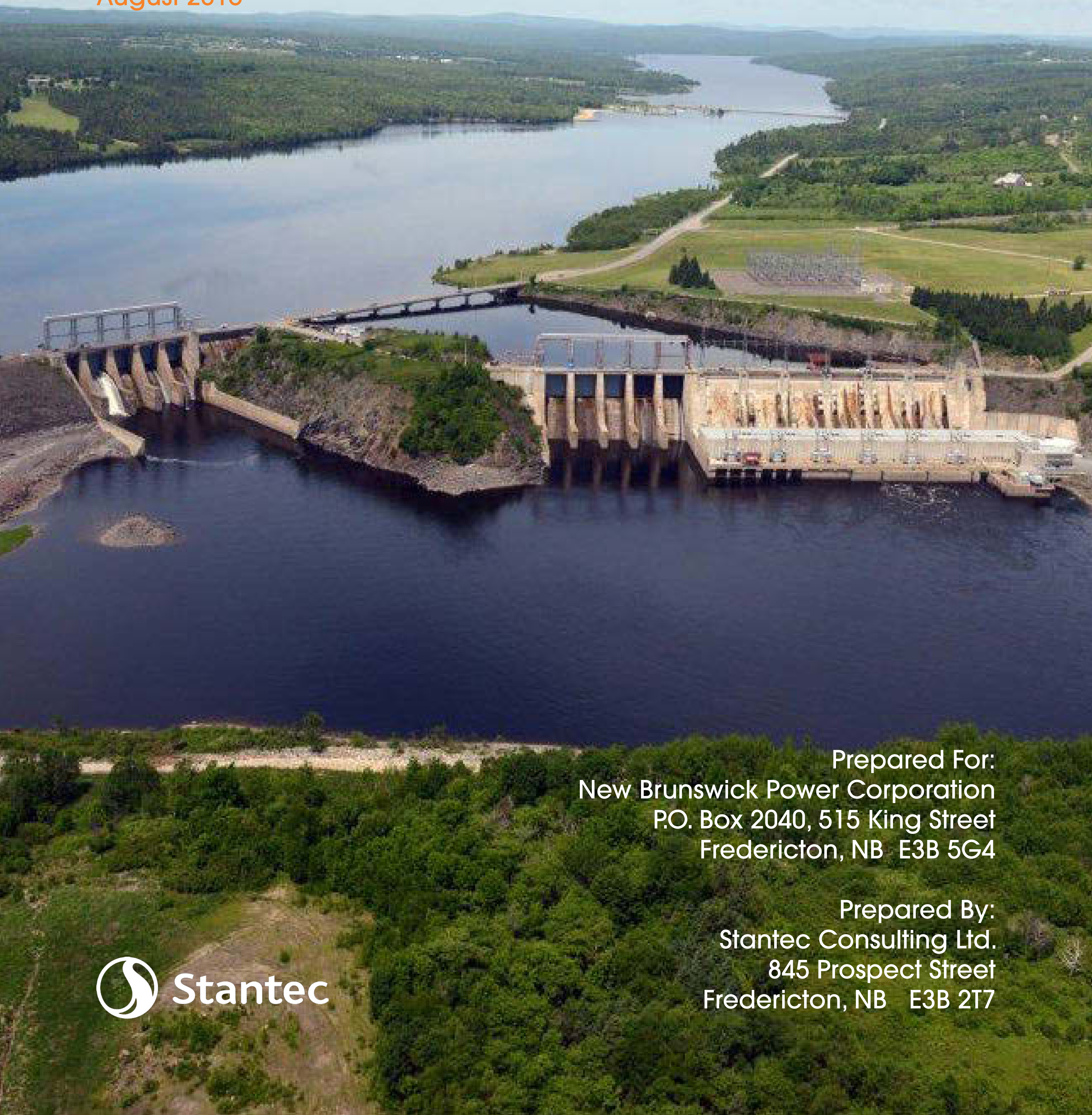
Mactaquac Project

Final Comparative Environmental Review (CER) Report - Summary Document

August 2016



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This document is a summary of the Final Comparative Environmental Review (CER) Report for the Mactaquac Project (the Project). It has been translated from its original English version by the firm BeTranslated (www.betranslated.com). The English version of this report constitutes the official version. In the event of conflict between the English and French versions, the English version shall prevail.

Introduction

This document is a summary of the final Comparative Environmental Review (CER) Report of potential Options to address the anticipated end of service life of the Mactaquac Generating Station (the Station) in Mactaquac, New Brunswick. The Station is owned and operated by the New Brunswick Power Corporation (NB Power). The location of the Mactaquac Generating Station is shown in Figure 1.

Current modelling indicates that the Station is experiencing a premature end of service life by 2030 as a result of an alkali-aggregate reaction (AAR) within the existing concrete structures at the Station. AAR is a chemical reaction that occurs between the cement and the aggregate rocks that are used to make concrete. As a result of the AAR reaction, the concrete used to construct these structures is expanding and must be removed and replaced. Studies to verify the 2030 end of service date have been conducted and are ongoing, and some of these studies may also identify other potential solutions (if any) that have not yet been considered.

The CER was proposed by NB Power as an innovative means to advance understanding of environmental and social issues potentially associated with each of the Options, and support Aboriginal, public and stakeholder engagement initiatives for the Project. The CER is a preliminary evaluation of these issues as well as identification of potential mitigation measures to reduce unwanted effects.

About the Comparative Environmental Review (CER) Process
The CER process is not part of a formal or legal environmental regulatory process. This process, developed by NB Power for the Mactaquac Project, is intended to contribute to NB Power's choice of a Preferred Option by offering a means of comparison between Project Options, based on how they might affect the environment and social conditions. The CER also informs and prepares for a focused, formal environmental assessment of the Preferred Option, once it is selected by NB Power

The information collected as part of the CER will be considered by NB Power, along with other information (*e.g.*, business case, engineering, other considerations), in its decision-making regarding the Station and the ultimate selection of a Preferred Option. The CER is not is not part of a formal environmental regulatory process.

Project Description

The Station, located on the Saint John River approximately 19 km west of the city of Fredericton, New Brunswick, is a hydroelectric generating station with a capacity of approximately 670 megawatts (MW) that provides renewable electricity and reliability services to New Brunswickers. The Station supplies approximately 12% of New Brunswick's power requirements (NB Power 2014c).

The Station was commissioned in 1968, and consists of an earthen dam constructed of rock-fill and sealed by clay; a concrete spillway; a concrete diversion sluiceway; a concrete intake structure; a concrete powerhouse that houses six hydroelectric turbines; and associated equipment, as shown in Figure 2. The dam also serves as part of an important highway link across the Saint John River, linking Routes 102 and 105 of the provincial highway system. Construction of the Station created an approximately 97-km long reservoir (headpond) on the Saint John River that extends from the Station to approximately 15 km upstream of the town of Woodstock. The headpond covers approximately 83 km^2.

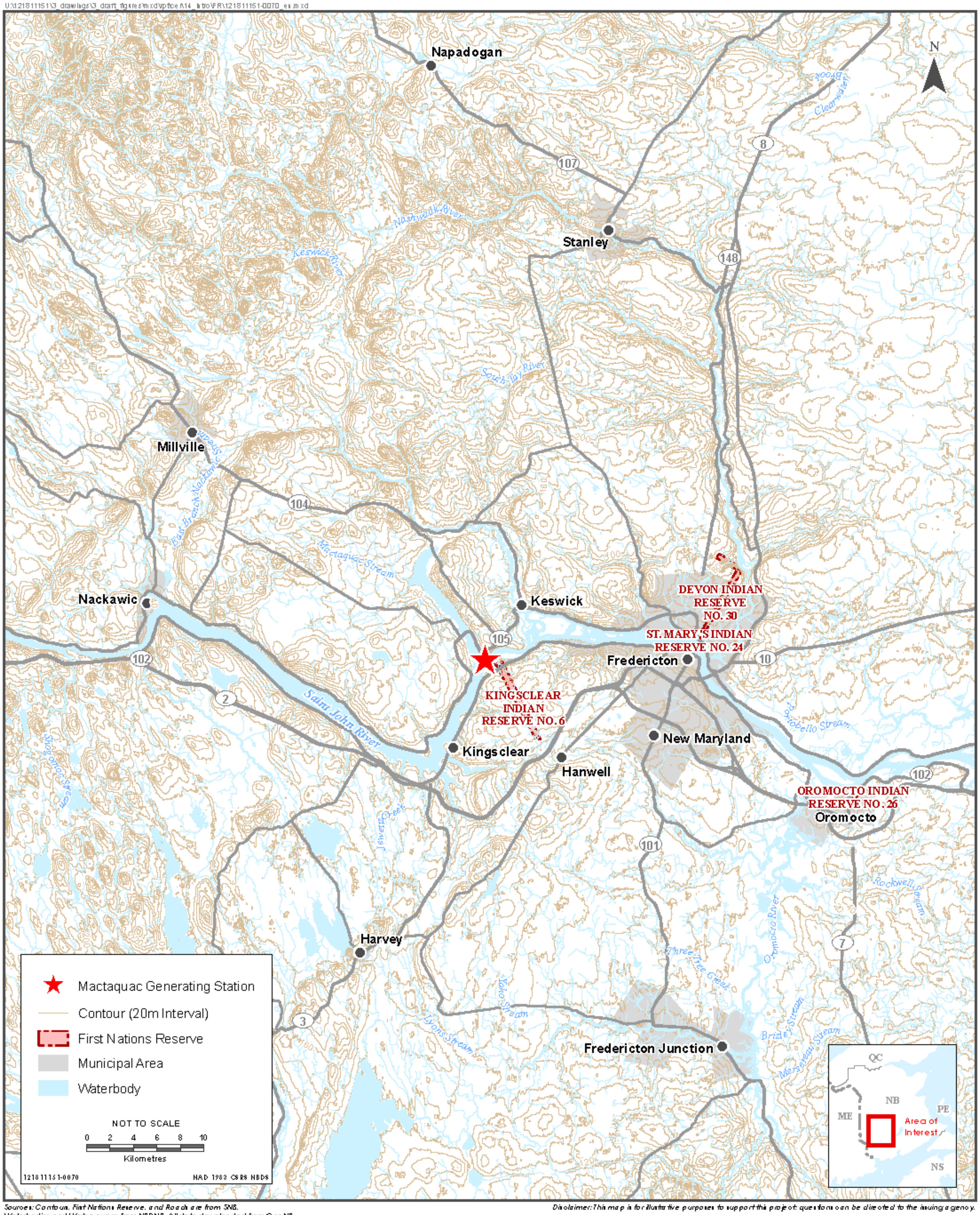
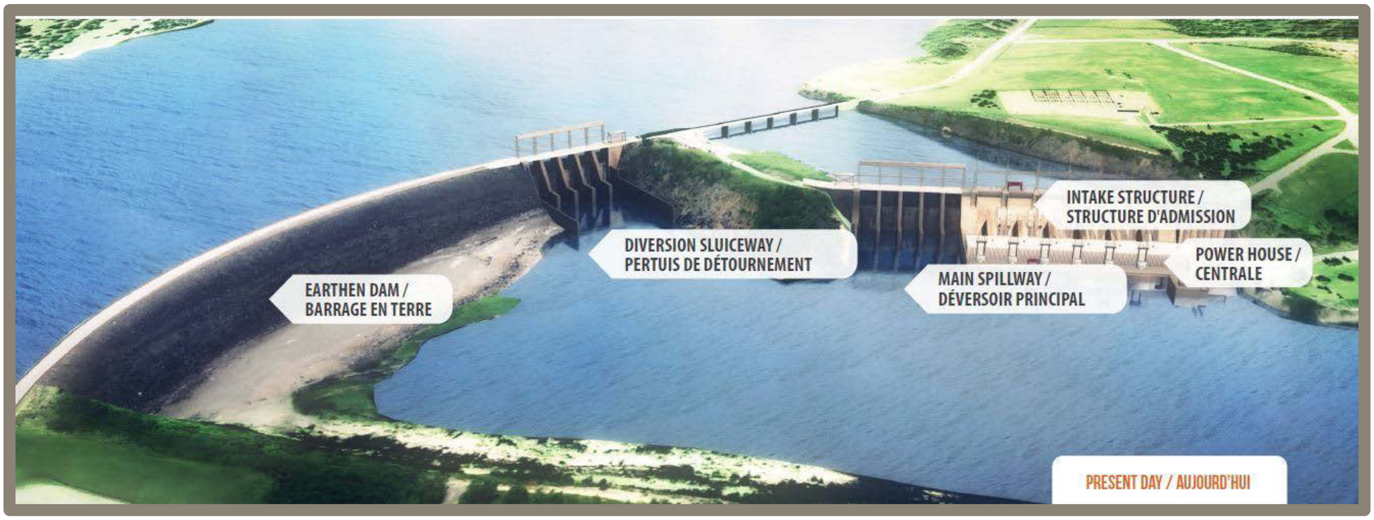


Figure 1 Project Location



Source: NB Power

Figure 2 Main Components of the Existing Mactaquac Generating Station

Project Options

NB Power is considering three end-of-life Options for the Station at the end of its service life in 2030. These options were chosen for the CER because they are considered to be technically achievable, and they can provide a long-term solution to problems facing the current Station.

The end-of-life Options are:

- Option 1, Repowering;
- Option 2, Retain the Headpond (No Power Generation); and
- Option 3, River Restoration.

Additionally, a fourth option, "Life Achievement", is described in Appendix A of the CER Report.

The three end-of-life Options are shown in Figures 3 to 5, and are briefly described below.

Did you know?

Hydroelectric power stations are often described by their generating capacity. Generating capacity is a measure of maximum power output (typically measured in megawatts [MW]) that could be created at the power station at any given time. This capacity is based on the output capacity of the installed turbines and generators. The actual electrical output of a power station depends on the amount of water flowing through these turbines, and the time where they are operating at the maximum output.

The current largest hydroelectric station in Canada is the Robert-Bourassa Generating Facility in northern Quebec. It has a generating capacity of 5,616 MW (Power Technology 2013).

Option 1, Repowering (Figure 3): Refurbish the Station by constructing a new powerhouse, spillway, and other components, followed by the removal of the existing concrete structures at the Station. (Source: NB Power)

Figure 3 Conceptual Rendering of Option 1, Repowering

Option 2, Retain the Headpond (No Power Generation) (Figure 4): Build a new concrete spillway and maintain the dam as a water control structure without power generation, followed by the removal of the existing concrete structures at the Station. (Source: NB Power)

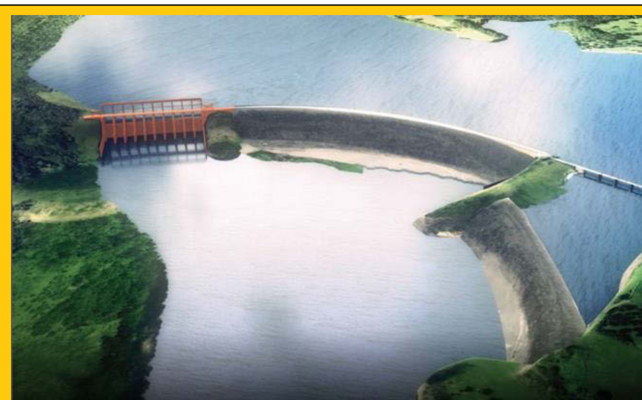


Figure 4 Conceptual Rendering of Option 2, Retain the Headpond (No Power Generation)

Option 3, River Restoration (Figure 5): Remove the Station and enable the river to return to a free-flowing state. (Source: NB Power)

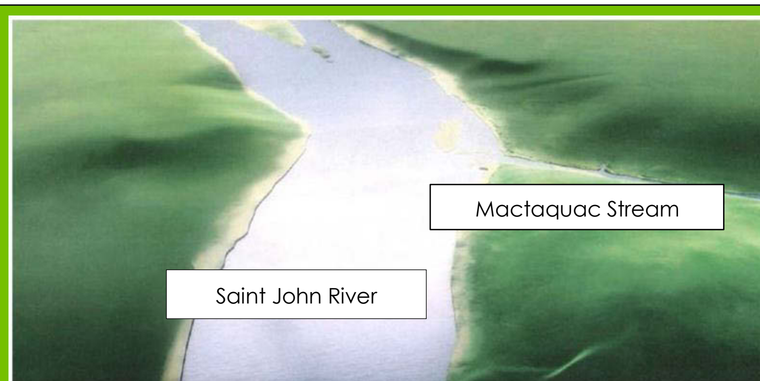


Figure 5 Conceptual Rendering of Option 3, River Restoration

**Note: These are artist's renderings and are intended to explain the basic concept of each option and foster discussion. Actual designs will include additional elements (*e.g.*, roadway, fish passage, powerhouse, and spillways) and are subject to updates as more studies are completed and feedback is received from First Nations, the public, and stakeholders.

NB Power is continuing to review the projected 2030 end of service life for the Station. That work includes exploring ways to continue operations within the current footprint beyond 2030. NB Power did not initially include these potential approaches for continuing operations within the current footprint, collectively referred to as the Life Achievement Option, in the CER process because they had not yet been determined to be technically or economically feasible. Since that time, recent modelling and engineering have shown that, despite an ongoing growth of the concrete due to AAR, known issues may be able to be mitigated with extensive ongoing maintenance, repair or refurbishment, and as such it may be possible to maintain or partially refurbish the existing Station components to extend their life beyond 2030. An Addendum to the CER Report was therefore developed to provide further information to NB Power on the possible environmental issues associated with the Life Achievement Option, and how it could be made acceptable, following a similar approach to that followed for the three end-of-life options in the CER Report. An Addendum discussing the Life Achievement Option is provided in Appendix A of the CER Report.

Key Studies

NB Power undertook various studies and analyses to identify the Preferred Option, some of which are ongoing. The planning process includes consideration of engineering, constructability, financial, Aboriginal, social, and environmental factors. These studies include, but are not limited to, the following:

- engineering design, cost estimates, and schedule;
- development of business case and analysis of financial considerations, including an evaluation of the cost of replacement power (including greenhouse gas (GHG) emissions) and reliability services under each of the Options;
- consideration of how each Option aligns with NB Power policies and obligations (for example, NB Power's obligation to meet the provincial Renewable Power Portfolio standard);
- the results of the Mactaquac Aquatic Ecosystem Study (MAES), a whole ecosystem study of the aquatic environment upstream and downstream of the Station;
- a comparative environmental review (CER) of the Options, including potential environmental interactions and mitigation measures;
- a social impact comparative review (SICR) of the Options;
- Aboriginal engagement; and
- public and stakeholder engagement.

What are reliability services?

The Mactaquac Generating Station provides much more than just a renewable power source to NB Power and its customers. It also serves many other important functions that ensure customers have a reliable source of power. These reliability services include things like balancing, reserves, and system black start.

Balancing means that the Station is able increase or decrease generation to respond to variations in consumption of energy by customers or variations in production of energy by other generating sources. Reserves are required in order to recover in minutes from the sudden unexpected loss of other generation. New Brunswick's system black start plan requires the Mactaquac Station to start generating electricity on its own and then start other generating facilities in the case of a province wide black-out.

These and other inputs will be considered by NB Power in the course of selecting its Preferred Option for the Project. Many of these studies have been completed or are nearing completion; however, some studies and programs (*e.g.*, MAES, engineering design, and Aboriginal, engagement) will continue up to and following the selection of a Preferred Option.

What will happen after the CER and Other Studies are complete?

NB Power has indicated that it will make a decision on which Option it will recommend as the Preferred Option at Mactaquac by the end of 2016, to allow sufficient time to complete the required approval processes, engineering design, and procurement processes to be able to implement the Preferred Option prior to the projected end of service life of the existing facilities in 2030.

Snapshot of the Area of Review

The general area considered in this CER is shown as an overall regional setting in Figure 6; this area forms the basis for identifying an "area of review" for evaluating each valued component (VC) as part of the CER.

The Station is located on the Saint John River, which is the largest river in Atlantic Canada. Located principally in New Brunswick, it flows 700 km from its origin at Little Saint John Lake in Maine to the Bay of Fundy at Saint John. The Mactaquac headpond is home to over 40 species of fish, some of which are considered species at risk or species of conservation concern, including Atlantic salmon. The entire river system is extensively used by migrating waterfowl, other avian species and terrestrial species including many sea ducks. Most of land in the Saint John River basin is forested including small patches of hardwood stands (MacDougall and Loo 1998; NBDNR 2007). The remainder of the area is made up of agricultural land and open wetlands, and developed areas.

The Station is located in central New Brunswick, approximately 19 km west of Fredericton, the provincial capital and closest city. There are three First Nations communities located within the area of review for the CER. The community of the Woodstock First Nation is located upstream of the Station, and the St. Mary's First Nation and Kingsclear First Nation are located downstream.

The Saint John River and the Mactaquac headpond are a tourism hub for central New Brunswick. The headpond is a popular area for both permanent residences as well as recreational properties. Many cottages are located in the vicinity of the headpond. The headpond and surrounding area are used for a variety of recreational activities, such as camping, boating, golfing and swimming. Mactaquac Provincial Park Campground, located on the headpond, is a popular destination for local residents and visitors offering approximately 300 serviced campsites. There are several other commercial campgrounds located along the shores of the headpond and downstream of the Station.

What is a Valued Component?

A Valued Component (VC) is a term that refers to aspects of the environment that have scientific, social, cultural, economic, historical, archaeological, or aesthetic values to society. This term is common in environmental assessment processes, and is used throughout this report to refer to the aspects of the environment receiving a more focused review.

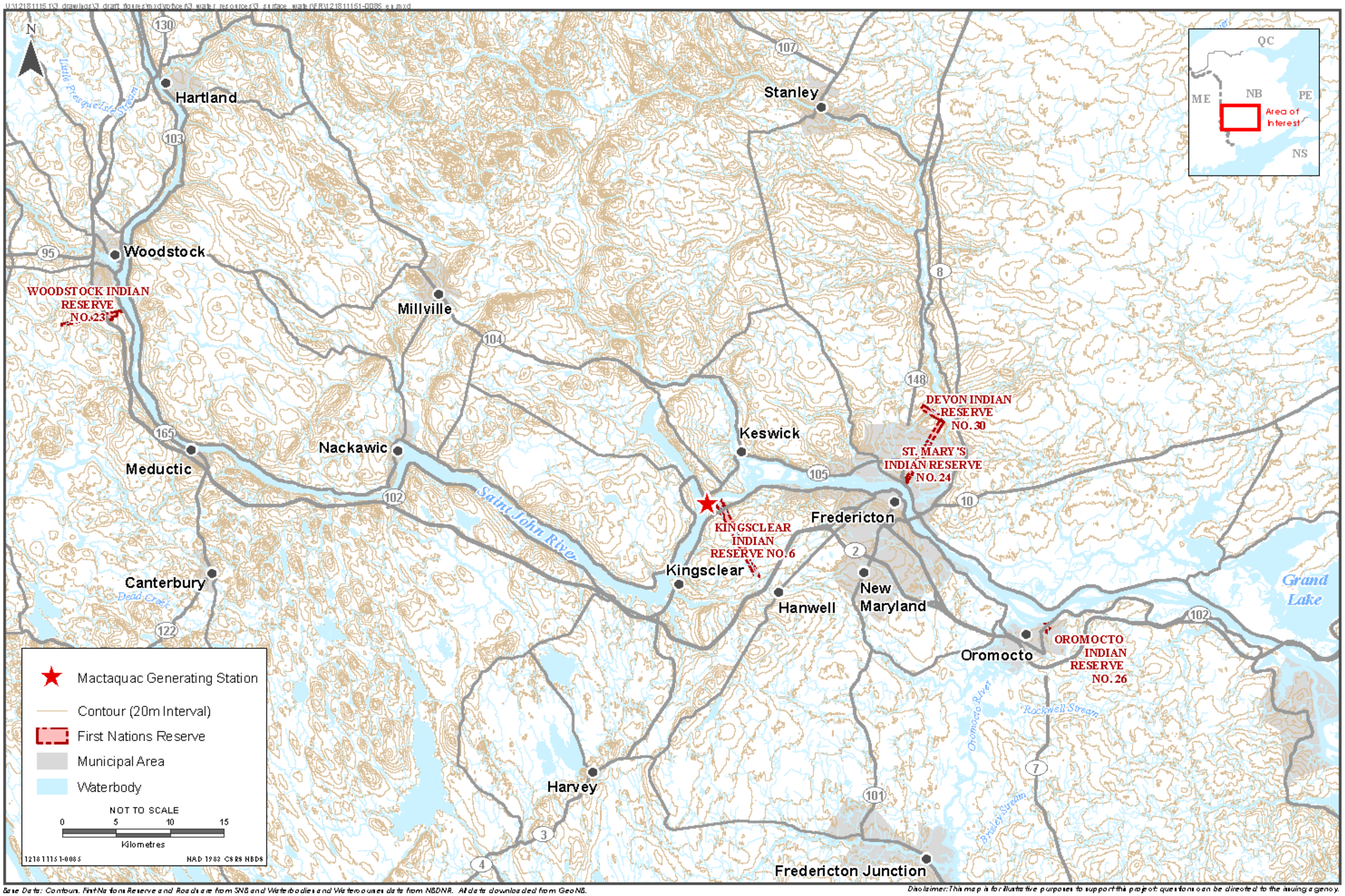


Figure 6 **Regional Setting**

Key Issues

The key environmental issues of concern (known as valued components, or VCs) that were examined in the CER were selected based on issues and concerns expressed through Aboriginal, public and stakeholder engagement; the ecological or socio-economic importance of the VC; and the potential of each VC to be affected by the Options, based on the CER study team's professional judgment and experience. The VCs for the CER are:

- Atmospheric environment;
- Acoustic environment;
- Surface water;
- Groundwater;
- Aquatic environment;
- Vegetation and wetlands;
- Wildlife and wildlife habitat;
- Economy and employment;
- Human occupancy and resource use;
- Infrastructure and services;
- Transportation;
- Heritage resources; and
- Current use of land and resources for traditional purposes by Aboriginal persons.

A summary of the key environmental issues identified through the CER for each VC is presented below.

<u>Atmospheric Environment (Section 4.0 of the CER Report)</u>

The area of review is rural and ambient air quality is expected to be good most of the time and similar to, or better than, that reported for the city of Fredericton.

Provincial greenhouse gas (GHG) emissions in 2011 were 18,500 kilotonnes of CO_2e, including industrial facilities, agriculture, vehicles, and natural sources (NBDELG 2015a). Canada's GHG emissions in 2011 were 701,000 kilotonnes CO_2e (Environment Canada 2015c).

The headpond is a small source of GHGs. Many factors influence the emissions of GHGs from flooded land including: age of the reservoir; land-use prior to inundation; climate; management practices; and pH, salinity, depth, altitude, and available carbon (IPCC 2006). GHG emissions from the existing operation of the Station are estimated to range from 70 to 86 kilotonnes CO_2e per year, which is approximately 0.5% of provincial GHG emissions.

Each of the Options has the potential to release emissions of dust or other air contaminants. With careful planning and implementation of good practices during construction and operation, none of the Options should result in a large change in air quality or change in GHG emissions compared to existing conditions.

Did you know?

The Earth's **atmosphere** makes water on Earth possible and allows life to flourish. The thin layer of gases, tiny water droplets and dust particles making up the earth's atmosphere provide us with oxygen to breathe, precipitation to nourish our ecosystems and an ozone shield to protect living things from harmful ultraviolet rays from the sun. The atmosphere also acts as an insulating blanket, reducing heat loss from earth to space, keeping temperatures on earth warm enough for life to exist. This natural phenomenon has been called the greenhouse effect (Environment Canada 2005). Additional warming beyond the natural energy balance provided by the atmosphere is called global warming and is caused in part by human activity (*e.g.,* release of CO_2 emissions).

Based on the preliminary estimates completed, releases of GHG emissions from combustion of fossil fuels during construction, demolition and decommissioning activities will not substantially contribute to existing provincial GHG emissions totals. The GHGs released as a result of biological processes are expected to be similar to existing conditions for Options 1 and 2 as there will be very little change to the headpond. For Option 3, an increase in GHGs released is expected as a result of biological processes from sediment and organic breakdown following the dewatering of the headpond, however these are expected to be offset by the re-vegetation of the headpond as vegetation matures.

Dust generation during construction and demolition under Options 1 and 2 has the potential to interact with ambient air quality. Once construction and demolition are completed, there will be little interaction with air quality, similar to existing operation of the Station. For Option 3 the dewatered headpond will create a large area of exposed sediment that could be a source of dust and odourous compounds. This area should begin to re-vegetate within one to two growing seasons as a vegetation cover establishes itself in the exposed soils, which will help reduce these emissions.

Option 3 may also result in small, localized changes in microclimate near the former headpond location due to physical changes in the landscape caused by the removal of the headpond. Overall, the changes to local temperature, precipitation, winds, fog and visibility are likely to be confined to a small distance from the headpond and be very small in size and generally indistinguishable from current conditions.

<u>Acoustic Environment (Section 5.0 of the CER Report)</u>

The Station is located in a relatively rural, agricultural area. The existing acoustic environment within the area is affected by traffic along the surrounding highways and roads, noise from human related activities including recreation, and natural sounds (*e.g.,* wind, birds, leaves rustling).

All of the construction and demolition activities associated with each of the Options (*e.g.,* blasting, equipment operation and vehicle movement) will emit sound, and have the potential to increase noise levels at nearby residences and other sensitive receptors. Because of the relatively long duration of construction, noise management is an important consideration to limit disturbance. Noise from blasting will be noticeable several kilometres from the blast site and may influence sound quality, but will be infrequent (up to twice daily during peak construction), and residents will be notified in advance of the blasting schedule.

Surface Water (Section 6.0 of the CER Report)

The Saint John River is the largest river in Atlantic Canada. It flows 700 km from its origin at Little Saint John Lake in Maine to the Bay of Fundy at Saint John. The tides in the Bay of Fundy cause the river level to fluctuate as far upstream as Fredericton (MacLaren Atlantic Limited 1979). In total, 11 hydroelectric dams are located on the Saint John River and tributaries (Lantz *et al.* 2011).

The Saint John River has solid ice cover in winter with the exception of downstream of Edmundston, where the water is warmed by paper mill effluents and immediately below the Station due to higher turbulence in the river flow. Ice jams are caused by the breakup and rapid accumulation of fragmented river ice. As the ice moves downstream it lodges on bars, islands, and at bridge piers. The headpond allows for the formation of a thick and extensive ice sheet. This ice sheet is held in the lower headpond, and melts in place prior to spilling over the dam. The Station prevents the migration of large amounts of ice downstream, thus preventing ice jams from occurring both in the lower headpond, and downstream. The upper headpond generally has ice break-up in the spring, which encounters the more intact ice sheet in the lower headpond, thus making the upper headpond more prone to ice jams.

Ice jams occurred more frequently downstream of the Station before it was installed. Since Station construction, ice jam flooding has occurred only once, in 1970, and was likely caused by the release of ice from the Nashwaak River.

Sediment movement in the Saint John River has changed as a result of changes in flow characteristics (*i.e.*, increased water elevations and reduced water velocities) since construction of the Station. The reduction in water velocities caused by the headpond has created higher sediment deposition rates, meaning larger sediment particles are found at the upstream sections of the headpond, while smaller sediment particles travel farther or even pass the dam structure. In MAES data to date, sediment in the headpond has consisted of a thin unconsolidated layer of material approximately 5-30 cm in depth.

The Saint John River and its tributaries supply water to several users within the area of review, for industrial, agricultural and municipal uses.

Did you know?

The surface water flow regime is characterized by the volume of water passing a given point over time. The components of flow regime include the magnitude, frequency, duration, timing (seasonality), and rate of change (flashiness) in flows. All play a direct or indirect role in maintaining the ecological integrity of the aquatic system.

Option 1 or 2 would not result in a substantive change to the existing flow regime of the Saint John River or to surface water and sediment quality.

Option 3 would result in the greatest long-term change in the surface water flow regime and river characteristics as the dewatered headpond moves from lake-like to river-like conditions. With Option 3, following dewatering of the headpond, the river would return to near-natural surface water flows similar to those existing prior to installation of the Station. A comparison of the Saint John River before and after the construction of the Station is shown in Figure 7. This change in flow regime will result in reduced water elevation throughout the headpond area, modified navigation opportunities, and may result in a reduced ability to achieve mixing from effluent discharges into the reduced waterway. Existing intakes and outfalls could become exposed and require modifications to remain operational. Submerged sediments would be flushed downstream during dewatering. A dewatering sequence would be developed based on sediment transport modelling to mitigate adverse downstream effects. After dewatering, the exposed and undrained soils and newly exposed river banks could become unstable and be prone to slope failure; engineered solutions would be put in place in areas of high potential for slumping and erosion. Following dewatering under Option 3, the upper headpond (*i.e.*, Meductic to Hartland) would be expected to be less susceptible to ice jam flooding; however, the lower portion of the headpond and downstream reaches of the Saint John River may become more susceptible. Flooding in the lower portion of the headpond should not become a problem as long as the flood plain remains undeveloped. The risk of downstream ice jam flooding can be reduced or controlled by various ice mitigation techniques.

<u>Groundwater (Section 7.0 of the CER Report)</u>

Groundwater levels near the headpond will vary depending on the water level in the headpond. As shallow wells tend to have less water in storage than deeper wells, shallow wells are generally more susceptible to decreases in water levels than deeper wells. Approximately 10% of the known wells in the area of review are shallow (*i.e.*, have well depths less than 30 m below ground surface). The remaining 90% of the wells in the area of review are deep.

The construction of new facilities for Option 1 or Option 2 has limited potential to cause a change in groundwater quantity and quality, as the current operating water level of the headpond is not expected to change in either of these Options. In Option 3, the removal of the Station would result in the lowering of the water level of the headpond, lowering the groundwater level adjacent to the headpond. This will likely result in lower well yields and changes to water quality in some wells by potentially altering the mixing of groundwater and surface water in the aquifer, particularly in shallow wells close to the headpond. In the event of decreased well yield, mitigation could include deepening of an existing well, replacement of a well, provision of water storage facilities, or a combination of these or other measures.

The water that lies beneath the ground surface is referred to as **groundwater**.

The **groundwater supply** that can be accessed by water wells or springs at the earth's surface is referred to as groundwater resources.

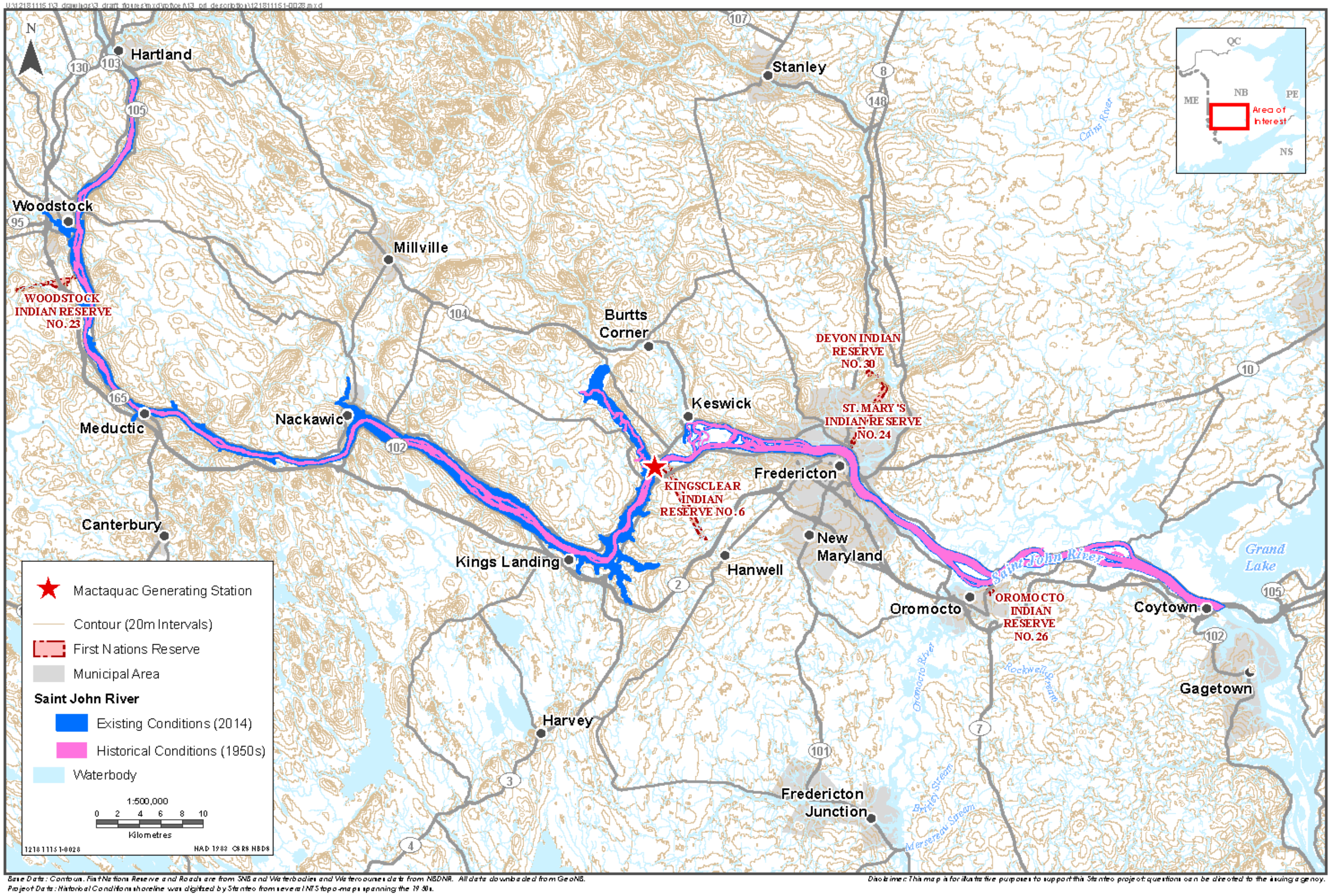


Figure 7 Comparison of the Saint John River Before and After Construction of the Mactaquac Generating Station

Aquatic Environment (Section 8.0 of the CER Report)

The Saint John River and Mactaquac headpond are the largest aquatic habitats in the vicinity of the Station. The creation of the headpond from a flowing river resulted in a wider main channel, increased depth and many flooded valleys that previously contained streams. While the headpond resembles a lake, many of its characteristics are river-like in nature, which is common in large dam headponds. The headpond is still a river, though now slower moving and deeper.

The downstream environment below the Station is a river, with shallow and fast-flowing waters that are influenced by water releases during periods of high electrical demand and/or high flow. The Station causes daily downstream water level fluctuations of up to 1 m that are mainly limited to short-term changes within the first 30 to 40 km below the Station (Luiker *et al.* 2013).

The headpond is home to over 40 species of fish, some of which are considered species at risk (*e.g.,* Atlantic salmon). Most of the fish in the headpond are permanent residents and have breeding populations both upstream and downstream of the station. Eleven species are diadromous, meaning they require both freshwater and marine environments to complete their life cycle.

Diadromy refers to a life history behaviour where fishes move between ocean and freshwater habitats for feeding and reproduction. Anadromous fishes begin life in freshwater and migrate to sea to feed before returning to breed. Catadromous fishes begin life in the ocean and migrate to freshwater to feed before returning to breed.

The Station obstructs the passage of fish species both upstream and downstream. In 1968, fish collection facilities were installed on the downstream side of the powerhouse to mitigate the complete obstruction to upstream passage (Ingram 1980). Fisheries and Oceans Canada (DFO) uses this facility to trap Atlantic salmon and gaspereau in support of management objectives. Trapped salmon and gaspereau are transported upstream of the Station by truck and released into the Headpond. Atlantic salmon are transported as far as upstream of the other existing dam structures (*i.e.,* Beechwood and Tobique Dams) on the Saint John River watershed. Gaspereau are transported directly to the headpond upstream of the Station. A number of other migratory species, including American shad, Atlantic sturgeon, shortnose sturgeon, striped bass, rainbow smelt, sea lamprey, and American eel are also obstructed from upstream habitat but are not actively transported or managed.

The Station does not have infrastructure designed specifically for fish passage that aids the downstream movement of fish from the headpond past the Station. Fish must move through the turbines, through the main spillway or over the diversion sluiceway; however, the main spillway and diversion sluiceway can be accessed only during periods of high water flow, such as during the spring.

Options 1 and 2 would interact in a similar way with the aquatic environment as the current operating water level of the headpond is not expected to change appreciably in either of these Options. However, Options 1 and 2 will provide improved fish passage at the Station through the design of improved upstream and downstream fish passage as part of Project facilities. Considerable dialogue among the design engineers, fish passage experts, stakeholders, and regulators will be required so that the designs are conducive to improved fish passage. Although these Options would include improved fish passage facilities, the continued presence of the dam would continue to present challenges to fish migrating upstream. The headpond would also remain in place and may continue to present challenges to some fish when navigating downstream.

Under Option 3, the removal of the Station will affect the current community of fishes in the headpond. There may be a decline in populations of resident fish species, but improved fish passage will benefit migratory and diadromous species like Atlantic salmon, providing favourable conditions for these species that might be beneficial to their populations. There will be an increase in river-like habitat between the Station and the Beechwood dam. Mitigation may be required to restore fish passage to tributary streams that no longer have unimpeded access from the restored river channel.

Preliminary results of the MAES indicate that by conducting an accelerated drawdown of the headpond in two stages that avoid key migration periods and coincide with seasonal periods of heavier precipitation and high downstream water flows, adverse interactions with fish populations can likely be avoided. If Option 3 is selected as the Preferred Option, additional study may be required and management measures will need to be carefully planned and conducted so that fish species are not adversely affected by dewatering. Discussions with regulatory authorities would inform the design and timing of the drawdown scenario to be carried out as well as the mitigation and management practices that could be implemented to reduce adverse outcomes to aquatic populations downstream during and following drawdown.

Regardless of the Option selected, the continued presence of other dams upstream of the Station would continue to influence flows through the area of the Station and also present challenges for fish passage upstream the headpond.

Vegetation and Wetlands (Section 9.0 of the CER Report)

In the Saint John River valley, including the upper portion in the area of review, there are hardwood stands known as the Saint John River Valley Hardwood Forest (SJRHF) (MacDougall and Loo 1998); they are also called the Appalachian Hardwood Forest (Betts 2000). Agricultural activities occupy about 32% of the total land area of the surrounding ecodistrict and occur mainly over soils formed from limestone (NBDNR 2007). Agricultural fields and roads have fragmented the landscape.

The Saint John River contains a chain of islands from just downstream of the Station, downriver to Coytown and beyond. These islands are a defining feature of the landscape in this district, and provide community pasture lands for cattle during the summer. This area contains the highest number of tree species and the greatest abundance of southerly species in the province. Many of the floodplain species, such as silver maple, butternut, and bur oak, depend on spring flooding. These species are scarce in New Brunswick outside of this region (NBDNR 2007).

There is a wide variety of wetland types in the area surrounding the headpond. Many wetlands are found in rich soils within riparian areas next to the Saint John River. Common wetland types include emergent marshes, peatland, deciduous treed and shrub swamps, and shallow, open-water wetlands. Upstream mapped wetlands represent 0.8% of the area of review; downstream wetlands represent 5.0% of the area of review. The gentler slopes and terraces normally associated with river valley bottoms were covered when the headpond was created.

Did you know?

Butternut is in the walnut family, and produces fruit that are relatively large nuts. It has yellowish-green leaves that are composed of many, smaller leaflets surrounding a hairy stalk. The nuts can be eaten, and the tree has been used for medicinal purposes.

Option 1 or 2 is expected to have limited interactions with vegetation and wetlands beyond those associated with the disturbance of undeveloped lands on the south bank of the Saint John River during construction and demolition.

Under Option 3, vegetation and wetlands upstream of the Station will change as a result of a drop in water level and a return to river-like conditions, increasing various types of wetland and riparian mineral habitats. These habitats are important for many plant species at risk and/or species of conservation concern, and would provide an opportunity for these species to colonize this section of the Saint John River. Some plant species that previously occurred in the headpond area may be able to recolonize new habitats that will be exposed. Downstream vegetation and wetlands could receive a large release of water and some sediments when the Station is removed. If Option 3 is selected as the Preferred Option, additional study may be required to further understand the best drawdown schedule to manage vegetation and habitat changes as a result of direct interactions with the force of water, sedimentation, and scouring.

Wildlife and Wildlife Habitat (Section 10.0 of the CER Report)

Wildlife habitat upstream of the Station is generally less diverse than downstream. The entire river system is extensively used by migrating waterfowl, other avian species and terrestrial species. Downstream, the largely natural flow regime supports a greater diversity of habitats compared with the headpond. Surface water features like the Saint John River contribute to the food chain for terrestrial species and birds, as well as for fish. Wetlands associated with waterbodies are often the most productive and diverse habitat features; they provide essential feeding, breeding and nursery habitat for a wide range of species.

The area surrounding the Station is an important feeding site for bald eagle and osprey; they feed opportunistically on injured or stunned fish that pass through the powerhouse turbines. Open water at the Station provides important winter habitat for a number of waterfowl species, such as American black duck, mallard, common goldeneye and common merganser (SJRBB 1973a; Burrows and Cormier 2010).

In New Brunswick, there are two **bald eagle** populations; one is a permanent resident and spends winters here, and one that annually migrates to and from the southern US (NBDNR website). Bald eagles have been endangered in New Brunswick since 1976. The species has slowly recovered and is making a comeback in New Brunswick through legislation to protect the eagle and its habitat as well as the banning of DDT and other pesticides in the 1970s (NBDNR 2008).

The headpond is used as a migration route by waterfowl, including seaducks, on their way to northern breeding areas. As many as 2,000 Canada geese and 200 snow geese migrate along the headpond in spring and fall (Burrows and Cormier 2010). A large wetland at the mouth of the Meduxnekeag River is used extensively as a stopover by migrating ducks during spring and fall (Burrows and Cormier 2010). A pair of harlequin ducks, which are endangered, was reported on the headpond in spring 2015 (Button, H., pers. comm., 2015). The Mactaquac Stream Basin (also known as the Mactaquac Arm) includes some of the larger wetland areas on the headpond and one of the few islands in the lower headpond. The downstream portion of the river has always been productive for waterfowl because it has vast expanses of floodplains, high spring and fall waters, and large wetland complexes. The headpond is also less productive for furbearing species than downstream habitats (SJRBB 1973a).

The downstream portion of the area of review is well known for its importance in providing many types of bird habitat. It is also one of the most important areas for breeding and migrating waterfowl in New Brunswick and perhaps the Maritimes (Carter 1952; Mendall 1958; SJRBB 1973b; Burrows and Cormier 2010). The two most productive areas of waterfowl habitat in the area of review are along the lower Oromocto River and Portobello Creek to the east. The open river is not productive for breeding waterfowl, it but serves as a stopover for migrating waterfowl. The interface between land, wetland and water provide important breeding and foraging habitats for a variety of species. Waterfowl that breed in the downstream environment include blue-winged teal, American black duck, green-winged teal, wood duck, ring-necked duck, and common goldeneye. The wetlands of the lower Saint John River are used extensively by migrating Canada geese, Atlantic brant, greater scaup, lesser scaup, goldeneye, and many sea ducks. The area is also highly productive for muskrat (Dilworth 1966; SJRBB 1973a). Species at risk and species of conservation concern that may interact with the Project include bald eagle, bank swallow, and two dragonfly species, skillet clubtail, and pygmy snaketail.

Option 1 or 2 is expected to have limited interactions with wildlife beyond those associated with the disturbance of undeveloped lands on the south bank of the Saint John River during construction and demolition.

The return to a river system in the headpond area as a result of Option 3 could cause a short-term stress for local wildlife habitat and communities; however, long-term improvements in, and enrichment of, the current headpond area would also result.

An increase in various types of wetland and riparian mineral habitat is expected as a result of dewatering associated with Option 3. These habitats are important for many species at risk or species of conservation concern. While wildlife and wildlife habitat may be sensitive to change, secure and non-secure wildlife populations will not change substantially on a local or regional basis. No Option is expected to affect any population of a wildlife species in a way that would threaten their survival in New Brunswick. Changes to wildlife and wildlife habitat will be mitigated by a variety of measures, such as implementing timing restrictions on clearing, and establishing buffers.

Economy and Employment (Section 11.0 of the CER Report)

The forestry sector is one of the main employers in central New Brunswick, particularly in the town of Nackawic, where a large pulp mill is located. There are also a number of farms along the banks of the Saint John River and headpond. The economy in York County, where the Station is located, is centered on the city of Fredericton; 57.8% of county residents live in the city and most businesses are located there.

Many businesses located immediately upstream of the Station use the headpond for recreational activity, rely on water uptake for water supply (*e.g.*, for irrigation, industrial water supply for pulp mill) or access aesthetic values and attractions (*e.g.*, those used by tourism businesses).

Similar to New Brunswick as a whole, the service-producing sector accounts for most of the labour force in York County. Public administration has the largest labour force, followed by retail trade, and educational services.

Each of the Options has potential to contribute both positively and negatively to economy and employment in Central New Brunswick. Option 1 would require a peak labour force of 1,750 workers; approximately 1,000 workers would be required at peak for Option 2; and Option 3 would require up to 300 workers. The duration of construction in Option 1 is 11 years; 10 years in Option 2; and 7 years in Option 3. All Options would contribute to job creation, the purchase and sale of goods, and the creation of economic activity in the region. Local companies are expected to benefit from construction-related business contracts. Business-related benefits would extend to the provincial economy, as specialized goods and services are likely to be sourced from companies outside the immediate area if they are not available locally. Government revenues would also increase, primarily through increased income taxes and sales taxes paid to the provincial and federal governments. Positive economic outcomes can be enhanced through initiatives to increase the potential for local businesses to participate in the Project.

Negative social and economic interactions could occur such as: transportation delays affecting the movement of goods and services; displacement of businesses such as tourism and recreation that depend on the headpond; population increase in the area from an influx of construction workers potentially affecting availability of local goods, services and infrastructure. These effects can be reduced by careful planning and management.

NB Power can optimize the local benefits of the Project by implementing local and Aboriginal employment and procurement policies. These could include measures related to education, training, hiring, and supplier development.

Human Occupancy and Resource Use (Section 12.0 of the CER Report)

Land in the vicinity of the Station is mainly woodland, agricultural land, or residential properties, with smaller areas of commercial, industrial, and recreational land use. The Mactaquac headpond is a popular area for both permanent residences as well as recreational properties. Approximately 12,400 residential properties are located within 500 m of the river and headpond, including many cottages.

Mactaquac Provincial Park, located upstream of the Station, has a campground, two beaches, a golf course, and hiking and cycling trails. Recreational boating within the Saint John River and headpond is a popular pastime for many residents and visitors, and is strongly linked to other activities, such as fishing, waterfowl hunting and tourism. Several public recreational access points are located within the area of review. Common routes travelled by boaters within the headpond include the area surrounding Mactaquac Provincial Park and coves located along the river.

All Options are expected to result in some nuisance-type interactions (*e.g.*, noise, vibration, and dust) during construction and demolition activities; but they will be carefully managed (*e.g.,* compliance with applicable regulations and standards and permit conditions) to reduce negative effects. Option 1 or Option 2 will change the land use at the location of the new structures from agricultural, commercial, and recreational land use to an industrial landscape, and will require redevelopment of the area on the south side (*i.e.,* right bank) of the Saint John River.

Under Option 1 or 2, navigation may be affected by increased vessel exclusion zones near the new facilities; but the headpond will continue to provide recreational opportunities, including several public access points and navigable waters.

With Option 3, dewatering will eliminate the headpond, and changes in the flow regime will create a new river-like environment. Some current navigational and recreational opportunities could be lost, but others might be created. Downstream flow regimes will change and potentially affect navigation during dry seasons; but with the dam no longer presenting a physical barrier to navigation on the river, navigational opportunities for downstream users would be expected to generally improve due to increased connectivity to upstream areas. Lower water levels may make some areas of the River or its tributaries impassable for some of the larger vessels that are currently used on the headpond, particularly during dry conditions.

Removal of the headpond, and the associated change in the aesthetics of the area, will likely negatively affect local residents' sense of community; however, it is expected that residents and users will adapt to the new conditions over time, and will find new ways to identify with the character and aesthetics of the area.

Infrastructure and Services (Section 13.0 of the CER Report)

The Saint John River and headpond have been a valued water resource for many years. Many municipalities bordering the river and headpond, including the town of Oromocto, city of Fredericton, town of Nackawic, Kingsclear First Nation and Woodstock First Nation, and town of Woodstock provide wastewater and storm water treatment for residents. Treated wastewater is subsequently released into the Saint John River and/or headpond. Water is also pumped from the river/headpond for fire response or for other purposes (*e.g.,* irrigation).

Did you know?

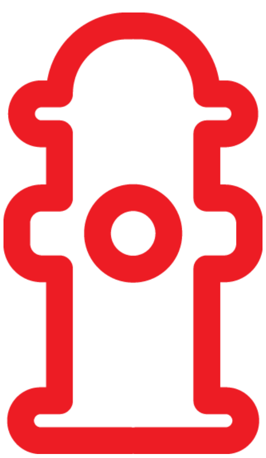
Wastewater is simply water that has been used. It may contain various contaminants, depending on what it was previously used for.

Effluent is liquid waste or sewage discharged into a body of water.

Option 3 could affect existing infrastructure as a result of receding water levels (especially upstream of the Station) or from downstream sediment deposition. Potentially affected infrastructure includes intakes, outfalls, municipal water supply and drainage, instream culverts, water wells, public boat launches/commercial docks and marinas, and bridges and piers. Interactions with infrastructure related to water, sewage along the banks of the river and headpond include erosion, sedimentation, and ice jams and related flood events.

Water level changes to the headpond under Option 3 have the potential to interact with existing infrastructure as a result of receding water levels or downstream sediment deposition. However, preliminary results of the MAES (study ongoing) indicate that the risk to downstream infrastructure from sediment is relatively low. Intakes and outfalls, erodible slopes, existing drainage infrastructure, and transportation infrastructure could be affected. Infrastructure could be left stranded with considerable distance between the structure and the river channel. Studies have been completed identifying regulated intakes and outfalls, and culverts in the area of review, which includes preliminary design information on potential modifications to these structures under Option 3. Geotechnical stability assessments of river banks and exposed slopes have also been conducted and potential mitigation has been recommended for areas with a high risk of erosion or slumping.

Downstream water elevations under Option 3 could be more variable with increased potential for flooding compared to current conditions, particularly as a result of ice jams, resulting in increased potential for damage to in-stream infrastructure (*e.g.*, bridges and piers). Increased water flows downstream of the Station, particularly during a shorter drawdown scenario, could result in river bed and bank scour, leading to shoreline erosion, and subsequent slope failure. Careful planning and management, including the identification of high risk areas and implementation of corrective measures, would be required to reduce the potential for damage to infrastructure.



Public services in York and Carleton Counties include two hospitals and four health clinics, emergency medical services (*i.e.* ambulance services), eight fire departments, several detachments of the Royal Canadian Mounted Police (RCMP), Fredericton Police Department, and Woodstock Police Department. Accommodations in the vicinity of the Station include hotels, motels, resorts, bed and breakfasts, inns and tourist homes. The occupancy rate in the Saint John River valley region (between Woodstock and Fredericton) was 50% in 2014.

Construction activities associated with all Options will likely require some workers with specialized skills who may come from outside the local area. This may place pressure on the existing rental market and local hotels and motels as well as other public services (*e.g.*, healthcare, emergency services, education). Overall, it is expected that locally available facilities and services will be sufficient to accommodate Project needs and the community would respond to fill any further needs for facilities and services beyond existing levels. Careful implementation, communication, and planning by NB Power and the community would be expected to meet those needs. Option 1 will require the largest workforce with activities expected to last longer than those for the other Options.

Transportation (Section 14.0 of the CER Report)

Mactaquac Road, which passes over the Station, provides an important transportation link between Routes 102 and 105 over the Saint John River. Routes 102 and 105 are both two-lane undivided highways. Route 102 was part of the TransCanada Highway system and is locally referred to as the "Old TransCanada Highway". It provides access from the south side of the Station, and is the primary route used by travelers between the south side of Fredericton and Mactaquac. Route 105 provides access from the north side of the Station, and is the primary route used by travelers between the north side of Fredericton and Mactaquac.

There are four river crossings from Fredericton to Nackawic. The Mactaquac Road over the Station had the third highest Annual average daily traffic (AADT) volumes. The AADT volume on this route decreases moving west of the Fredericton city limits, which is a reflection of the number of commuters that travel this route to and from Fredericton (exp Services Inc. 2015).

Each of the Options will result in a temporary or permanent disruption to traffic on Mactaquac Road as the existing concrete structures at the Station are demolished and either replaced or restored. With any Option, construction activities and increased passenger vehicles and heavy trucks transporting workers, materials, and equipment to and from the site will affect local traffic patterns in the transportation network leading to and from the Station and surrounding area.

Regardless of Option selected, a crossing linking Routes 102 and 105 will be maintained under any Option (either existing, modified, or new), thereby maintaining traffic flow and connectivity in the area. Several routes and locations for a potential new transportation link are being considered and these are shown in Figure 8. A permanent crossing would need to be put in place prior to the existing or temporary roads coming out of service. The timing of this would depend on the Preferred Option and transportation link alternative selected for the Project and crossing.

Changes in transportation patterns will depend on the new cross-river transportation link selected and the origin and destination of the vehicles. NB Power will work with NBDTI in selecting and implementing the alternative transportation link, and developing a plan to manage transportation issues associated with Project-related traffic including consideration of carpooling, bussing, park-and-ride lots, and staggering shifts, among others.

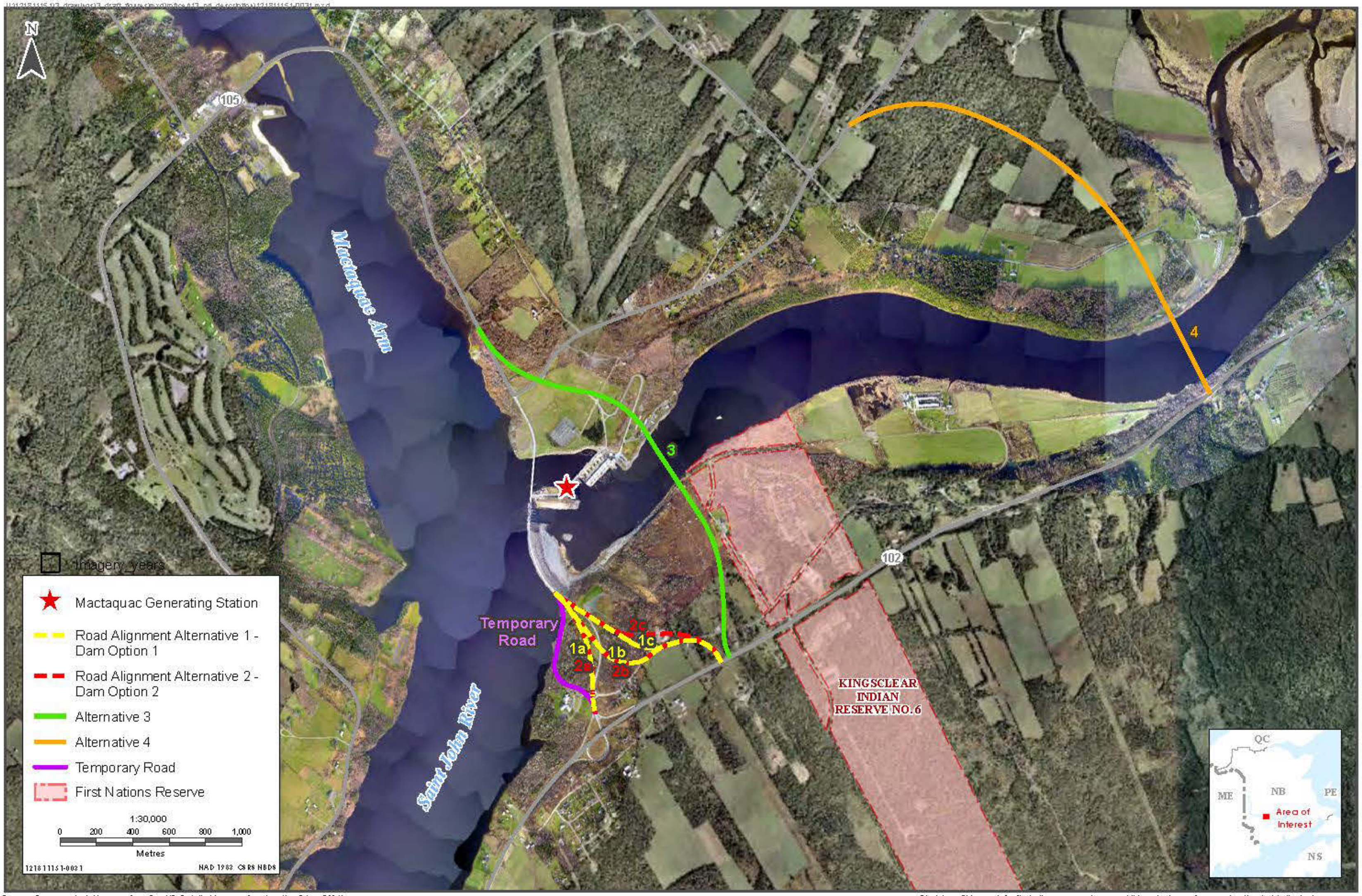


Figure 8 **Transportation Link Alternatives**

Heritage Resources (Section 15 of the CER Report)

The portion of the Saint John River in the area of review is considered to be very rich in archaeological deposits considering historical use by First Nations) spanning thousands of years. There is a deep connection of the Wolastoqiyik to the Saint John River as an integral part of their identity, culture and heritage. European settlers, following their arrival in the 18th Century, have also left significant substantial evidence of use of the lands currently occupied by the headpond.

Over 30 registered archaeological sites were identified in the Mactaquac headpond area that included Pre-Contact Period sites, Historic Period sites, and Multi-Component sites. Many of the older buildings and other heritage resources were moved from the Saint John River valley to the Kings Landing Historical Settlement prior to the commissioning of the Station. Numerous cemeteries, portage routes, and a suspected and known plane crash site have been registered within the vicinity of the headpond. Given the use and occupation of the Saint John River by Aboriginal persons for several centuries and historical settlement by Europeans, it is very likely that unknown heritage resources are present in or near the headpond.

All Options have the potential to adversely interact with heritage resources. Option 1 or Option 2 may uncover heritage resources in the areas where new structures would be built, if they are present. It is possible that maintaining the current water levels may expose or damage any archaeological sites located along shorelines or on land features under the headpond that may be eroding. With the continued presence of the headpond and associated water levels, examining submerged land features for archaeological resources that might have been present prior to flooding of the headpond would not be feasible.

With Option 3, all heritage resource types, particularly Pre-Contact artifacts and sites, that may be present under the headpond will be exposed after water levels are lowered, possibly subjecting some sites to continued or accelerated erosion. Mitigation for Option 3 may be extensive if it is determined that large areas with heritage resources under or near the current headpond have eroded or are at risk of eroding.

Current Use of Land and Resources for Traditional Purposes by Aboriginal Persons (Section 16 of the CER Report)

Aboriginal people have lived in the territory now known as New Brunswick for at least 8,000 years, with the Maliseet (Wolastoqiyik) concentrated along the Saint John River. General information was provided in the CER Report on potential existing conditions for traditional use, though specific information and use patterns by Aboriginal persons of the six Maliseet communities of New Brunswick will be documented through a Traditional Knowledge/Traditional Land Use study commissioned by those communities. However, it is widely known that the lands and resources of New Brunswick and particularly along or near the Saint John River have been used, and are being used, by Aboriginal persons for traditional hunting, fishing, trapping, gathering, subsistence, and related purposes. The extent to which the practice of traditional activities might be affected by the Options is not fully understood at this time; the Traditional Knowledge/Traditional Land Use study being conducted will further evaluate if and how traditional activities (and potentially Aboriginal and treaty rights) might be affected by the Options.

Conclusion

All three of the end-of-life Options have both positive and negative attributes from an environmental and social standpoint. It is clear, however, that any Option selected by NB Power will require careful planning, management, and execution to achieve acceptable environmental results and enhance positive attributes.

The CER Report is an integral part of the early planning process to assist NB Power in its decision making regarding the Station and to consider environmental, social and economic opportunities and constraints. It will be important for NB Power to continue this ongoing planning, consultation, issues management, and mitigation so that whatever Option is ultimately selected is carried out in a progressive, systematic, and environmentally responsible manner.

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