9.0 VEGETATION AND WETLANDS

9.1 SCOPE OF THE REVIEW

The combination of vegetation and wetlands is an important environmental component that is valued by the people of New Brunswick for environmental, recreational, aesthetic and socio-economic reasons. The integrity of vegetation and wetlands has an influence on wildlife and wildlife habitat (Section 10), as vegetation communities (including wetlands) provide habitat for wildlife species. Vegetation and wetlands are also connected to surface water resources (Section 6), as wetland functions can interact with surface water conditions.

9.1.1 Why Vegetation and Wetlands is a Valued Component

Under Option 1 or 2, vegetation will be directly affected by construction and demolition, and by downstream sediment transport associated with construction and demolition.

More interactions may occur under Option 3. For example, upstream wetlands and vegetation in the headpond area will experience water drawdown as that section of the Saint John River returns to normal river flow conditions. The return to normal flow will result in interactions with vegetation communities (including wetlands) and will change the environmental conditions for individual plant species.

9.1.2 Regulations and Policies Relevant to Vegetation and Wetlands

Vegetation and wetlands are protected under federal and provincial legislation, including:

- *Canadian Environmental Assessment Act, 2012* and associated regulations;
- federal *Species at Risk Act* (*SARA*);
- the federal policy on wetland conservation (Government of Canada 1991);
- New Brunswick *Species at Risk Act* (NB *SARA*);
- New Brunswick *Clean Water Act* and the associated *Watercourse and Wetland Alteration Regulation* (*WAWA Regulation*);
- New Brunswick *Clean Environment Act* and the associated *Environmental Impact Assessment Regulation* (*EIA Regulation*); and
- New Brunswick Wetlands Conservation Policy (NBDNRE 2002).

9.1.2.1 Species at Risk and Species of Conservation Concern

Species at Risk (SAR) are defined in this CER as species listed as Extirpated, Endangered, Threatened, or Special Concern under the NB *SARA* or the federal *SARA*, or by the Committee on the Status of Endangered Wildlife in Canada (COSEWIC). The purposes of the NB *SARA* and federal *SARA* are to prevent wildlife species (including plants) from becoming extinct (extirpated); to provide for the recovery of species that are Extirpated, Endangered, or Threatened; and to manage species of Special Concern to prevent them from becoming Endangered or Threatened. While only species listed as Extirpated, Endangered, or Threatened in Schedule 1 of the federal *SARA* and those species listed under Schedule A of the *Prohibitions Regulation* of NB *SARA* currently have regulatory protection, the definition above also includes those species on the NB *SARA List of Species at Risk Regulation* and those listed by COSEWIC that are candidates for further review and may become protected within the timeframe of this Project. The federal *SARA* is co-administered by Environment Canada, Parks Canada Agency, and Fisheries and Oceans Canada. NB *SARA* is administered by the New Brunswick Department of Natural Resources (NBDNR).

Species of Conservation Concern (SOCC) are not listed under federal or provincial legislation but are considered rare in New Brunswick and/or the long-term sustainability of their populations has been evaluated as tenuous. SOCC are typically included in the description of existing conditions (Section 9.2) as a precautionary measure, in order to reflect observations and trends in the provincial population status. For this CER, SOCC are defined as species that do not meet the above definition of SAR but have been ranked in the province by the Atlantic Canada Conservation Data Centre (AC CDC) as S1 or S2, or S3 with a Canadian Endangered Species Conservation Council (CESCC) general status rank of at risk, may be at risk, or sensitive.

Did you know?

The Atlantic Canada Conservation Data Centre is an important resource for ecological data and knowledge.

It is a registered charity and part of NatureServe and NatureServe Canada. The NatureServe Network provides similar service in all of the Canadian provinces and territories with the exception of Nunavut, in all 50 American states, as well as in a number of Latin American countries (http://www.accdc.com/en/about-us.html).

9.1.2.2 Wetlands

Wetlands are defined in federal and provincial policy as land permanently or temporarily submerged or saturated by water near the soil surface, for long enough that the area maintains aquatic processes. These aquatic processes are characterized by plants that are adapted to saturated soil conditions, wet or poorly drained soils, and other biotic conditions found in wet environments (Government of Canada 1991; NBDNRE and NBDELG 2002).

Wetlands in New Brunswick are managed by the New Brunswick Department of Environment and Local Government (NBDELG), and their management is guided by the New Brunswick Wetlands Conservation Policy (NBDNRE 2002). This policy aims to protect wetlands through securement, stewardship, education and awareness, and to maintain wetland function within New Brunswick. Legislation that supports the policy includes the New Brunswick *Clean Water Act* and associated *WAWA Regulation*, and the New Brunswick *Clean Environment Act* and associated *EIA Regulation*.

NBDELG maintains the official map of known wetlands in the province; it is available to the public on the GeoNB website (SNB 2011). As of November 2011, NBDELG considers the GeoNB map to represent the extent of "regulated" wetlands within the province. Any wetlands labelled as "Provincially Significant Wetlands" in this database are subject to a greater level of protection, as outlined in the New Brunswick Wetland Conservation Policy (NBDNRE and NBDELG 2002).

9.1.3 Area of Review

The area of review includes the Mactaquac headpond, which is defined by NB Power as extending from the Mactaquac Generating Station (the Station) to 97 km upstream of the Station, and extends 63 km downstream of the Station to approximately the Highway 2 overpass in Coytown, near the Village of Gagetown. Laterally, it also includes a 500 m buffer on either side of the Saint John River (Figure 9.1). This area of review is the same as that used in the discussion of interactions with wildlife and wildlife habitat (Section 10).

9.1.4 Key Issues

Construction of the Station and creation of the headpond in the late 1960s flooded many landscape features (*e.g.*, islands, wetlands and upland areas) upstream of the Station. Many of these features had provided habitat for SAR/SOCC and may have included wetlands that would today be considered Provincially Significant Wetlands (PSW). Although the headpond will be maintained under Options 1 and 2, interactions with vegetation communities and SAR/SOCC could occur as a result of construction and demolition. Option 3 will involve demolition of the Station and the return of the headpond to a near natural flow regime. Option 3 will interact with vegetation communities, SAR/SOCC, and wetlands.

The key issues of concern for this VC are listed in Table 9.1.

Table 9.1 Description of Key Issues for Vegetation and Wetlands

Key Issue	Description
Potential change in vegetation communities	• Direct and indirect disturbance or removal of habitat. • Changes in species richness and diversity.
Potential change in species at risk and/or species of conservation concern	• Changes in plant species and potential SAR/SOCC habitat.
Potential change in wetland area and/or function	• Direct loss of wetland area. • Change in, or loss of, wetland functions and values.

9.2 EXISTING CONDITIONS

9.2.1 Sources of Information

The following sources of information were used to characterize existing conditions:

- available data on vegetation communities, vegetation species records, habitat (including wetlands) and Environmentally Significant Areas (ESA) from AC CDC, NBDELG, NBDNR, and GeoNB;
- historical information on the Saint John River, including aerial photography;

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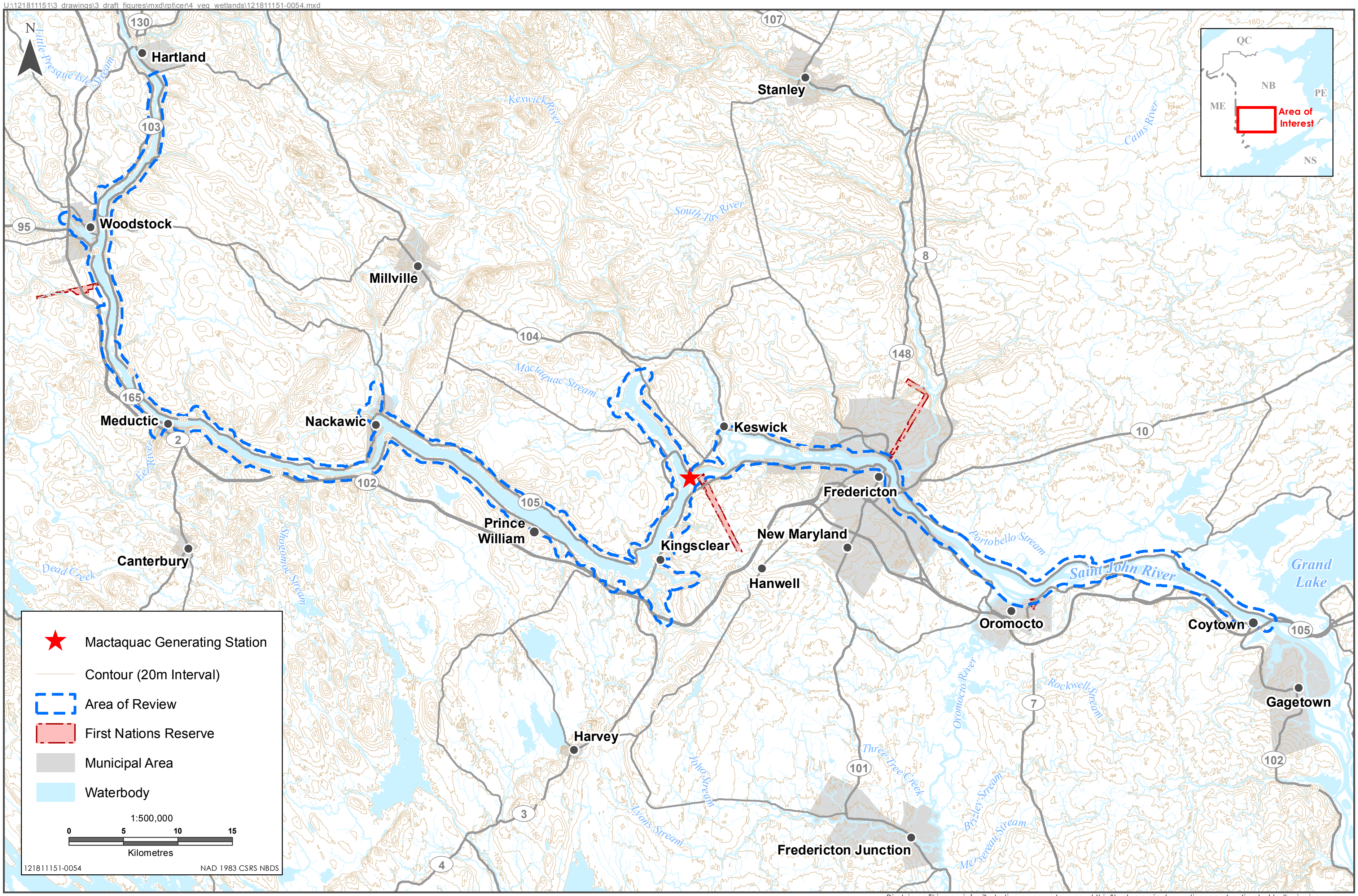

Base Data: Contours, First Nations Reserve and Roads are from SNB and Waterbodies and Watercourses data from NBDNR. All data downloaded from GeoNB.

Disclaimer: This map is for illustrative purposes to support this Stantec project; questions can be directed to the issuing agency.

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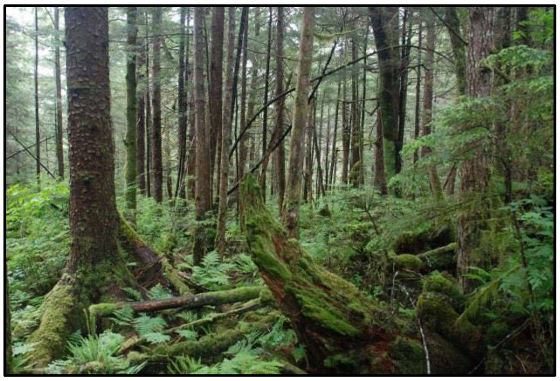
Area of Review for Vegetation and Wetlands

Figure 9.1

- information from past research, studies or assessments conducted in the region and elsewhere (literature review); and
- an interview with a local expert.

Forested areas, as defined in data acquired from NBDNR, are summarized by species composition into hardwood, mixedwood, softwood, and shrub-dominated categories. Within these categories, dominant species and age classes were reviewed, both upstream and downstream of the Station. The three age classes are regenerating (recent clearcuts) and sapling forests; young and immature forests; and mature and overmature forests. The interaction between the Options and vegetation communities (including forested areas and wetlands) is reviewed. Important habitat locations, such as ESAs and Protected Natural Areas (PNAs), and their potential interactions with the three Options are also reviewed.

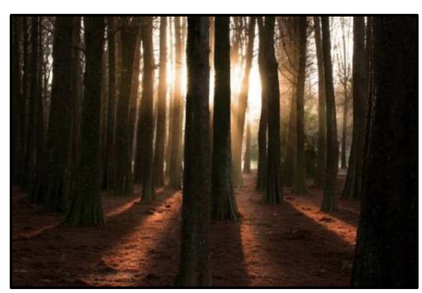


SAR/SOCC locations were obtained from AC CDC. Habitat requirements for each species were recorded from several data sources, including Flora of New Brunswick (Hinds 2000), Manual of Vascular Plants of Northeastern United States and Adjacent Canada (Gleason and Cronquist 1991), Flora Novae Angliae (Haines 2011) and Moss Flora of the Maritime Provinces (Ireland 1983). Locations and habitat requirements of species are used to review potential interactions between SAR/SOCC and the Options.

The location and extent of current wetlands was determined by combining available data from three sources: wetlands included in the NBDNR landbase data; GeoNB and PSW from Service New Brunswick (SNB); and NBHydroNetwork wetlands (the wetland layer currently maintained by NBDNR). This allows a more complete picture of wetlands to be developed because there are unique wetland areas within each of these data sets. The potential interactions between the Options and both wetland area and function were reviewed.

9.2.2 Description of Existing Conditions

The New Brunswick Ecological Land Classification (NBELC) is part of a national ELC system, which classifies ecological units at various spatial scales (NBDNR 2007). At the national scale, the area of review is in the Atlantic Maritime Ecozone, which encompasses the Maritime Provinces of Canada, the Gaspé Peninsula, and southeastern Québec (Marshal *et al.* 1999).



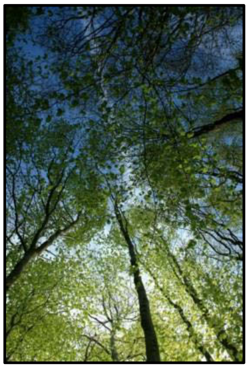
The NBELC divides the province into seven ecoregions, which are defined primarily by climate, but are also differentiated by other features, such as geology and soils, forest cover and vegetation, and wetlands. Each of these ecoregions is further divided into ecodistricts, which are delineated by features such as elevation or rock types.

The area of review spans the Meductic Ecodistrict (specifically in the southern portion of the Valley Lowlands Ecoregion) and the Aukpaque Ecodistrict (in the Grand Lake Lowlands Ecoregion). The division between the two ecodistricts is approximately 16 km upstream of the

Station. In the following discussion, two subareas are used to describe existing conditions: the area upstream of the Station and the area downstream of the Station.

9.2.2.1 Upstream of the Station

Most of the headpond is in the Valley Lowlands Ecoregion (Figure 9.2), which is the largest ecoregion in New Brunswick. Much of the ecoregion flanks the upper and middle Saint John River valley. This region is diverse and contains a large group of vegetation species generally associated with more southern areas. The Meductic Ecodistrict within the ecoregion is a rolling lowland area that encompasses the middle Saint John River valley between Kilburn and Prince William. The dominant geographic feature of this ecodistrict is the Saint John River. The elevation within the river valley and surrounding areas is rarely greater than 100 m (NBDNR 2007).



The forest cover of the area includes southern species such as basswood (*Tilia americana*), butternut (*Juglans cineria*), ironwood (*Ostrya virginiana*), silver maple (*Acer saccharinum*), green ash (*Fraxinus pennsylvanica*), and white ash (*Fraxinus americana*) (NBDNR 2007).

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). This forest type is associated with well-drained and calcareous upland and riparian areas where the soil layer has been deposited by a watercourse over time. Mature stands are usually dominated by tree species such as sugar maple (*Acer saccharum*), white ash, beech (*Fagus grandifolia*), yellow birch (*Beula alleghaniensis*), and ironwood but may also contain white elm (*Ulmus americana*), hemlock (*Tsuga canadensis*), basswood (*Tilia Americana*), and butternut (MacDougall and Loo 1998).

Understorey vegetation can include SOCC, such as:

- American lopseed (*Phryma leptostachya*) (S2/sensitive);
- Canada honewort (*Cryptotaenia canadensis*) (S1/may be at risk);
- Canada violet (*Viola canadensis*) (S1S2/may be at risk);
- clustered sanicle (*Sanicula odorata*) (S2/may be at risk);
- inflated narrow-leaved sedge (*Carex grisea*) (S1/may be at risk);
- longbeak sedge (*Carex sprengelii*) (S2/sensitive);
- showy orchid (*Galearis spectabilis*) (S2/may be at risk);
- thin-leaved sedge (*Carex cephaloidea)* (S1/may be at risk); and
- wild leek (*Allium tricoccum*) (S2/may be at risk) (MacDougall and Loo 1998).

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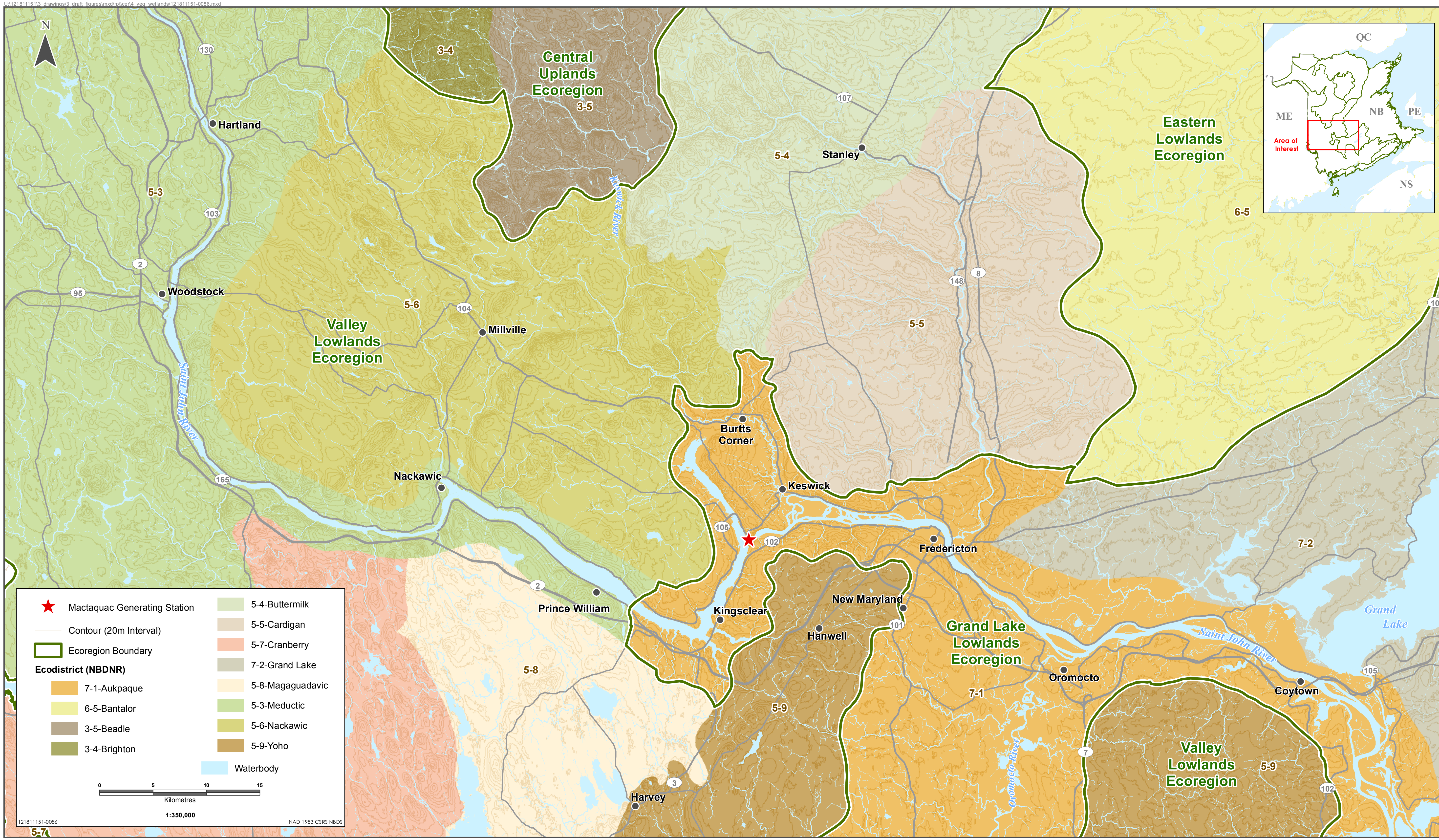

Base Data: Contours and Roads are from Service New Brunswick and Waterbodies and Watercourses data from New Brunswick Department of Natural Resources. All data downloaded from GeoNB.

Disclaimer: This map is for illustrative purposes to support this Stantec project; questions can be directed to the issuing agency.

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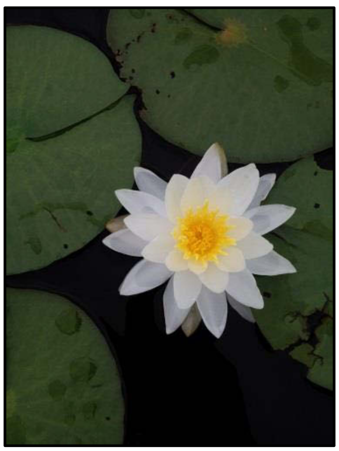
Ecoregions and Ecodistricts in the Area of Review

Figure 9.2

Red spruce (*Picea rubens*) and hemlock are generally confined to steep slopes. Hemlock also occurs with hardwood. The flooded bottomlands in the Eel River Valley contain butternut and basswood, whereas calcareous, poorly drained flatlands typically contain eastern white cedar (*Thuja occidentalis*) stands, sometimes punctuated by black ash (*Fraxinus nigra*), red maple (*Acer rubrum*), and white elm.

These forest stands, including the SJRHF, once dominated the landscape but have been disturbed by more than 200 years of dense settlement and forest harvesting. The SJRHF stands presently occur as small patches, isolated by widespread agricultural lands (MacDougall and Loo 1998; NBDNR 2007).

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. White spruce (*Picea glauca*) and tamarack (*Larix laricina*) are indicators of old field sites. Intolerant hardwood species are restricted to abandoned farmlands, and consist mainly of trembling aspen (*Populus tremuloides*) and large-tooth aspen (*Populus grandidentata*) with birch (*Betula* spp.) (Loo *et al.* 2010; NBDNR 2007).



Major river valleys, abundant lakes, varied climatic conditions and diverse bedrock lithology has produced a diversity of wetland types in the area surrounding the headpond. Many wetlands are situated 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 containing fragrant water lily (*Nymphaea odorata*) and narrow-leaf water plantain (*Alisma gramineum*) (NBDNR 2007).

Beginning in 1925, hydroelectric dams were constructed at various points along the Saint John River and its tributaries, beginning at Grand Falls (CRI 2011). Construction of the Mactaquac Generating Station in 1968-69 created the headpond, which is a lake-like environment. The water is deeper, and the Saint John River is wider and has a slower flow than the pre-dam conditions. Many habitats, such as islands, were submerged when the headpond was created (CRI 2011).

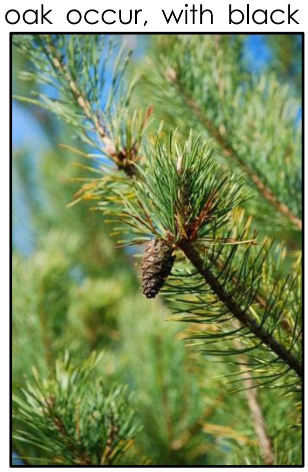
9.2.2.2 Downstream of the Station

This area is in the Grand Lake Lowlands Ecoregion, which encompasses the Grand Lake Basin, the Oromocto River watershed, and the lower Saint John River and its floodplains. The most distinguishing features of this region are its floodplains and the warmest climate of any ecoregion in New Brunswick. A unique assemblage of southern vegetation species grows in the moist, rich soils of this ecoregion, and the soils are dependent on regular flooding (NBDNR 2007).

The floodplains of the Saint John River and along portions of the Keswick River and Oromocto River contain thick beds of sand and gravel overlain by silt or fine sand. Spring floods carry accumulated melt water from the Saint John River watershed and a thin layer of fertile soil forms when the floodwaters recede in late May or early June. The diversity of the ecoregion is partly due to this annual replenishment of the rich soils, along with the natural fluctuation in water levels (NBDNR 2007).

In this area, 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 (*Quercus macrocarpa*), are dependent on spring flooding. These species are scarce elsewhere in New Brunswick, outside of this region (NBDNR 2007).

The area around the Saint John River downstream of the Station became one of the most heavily settled areas in the province by the mid-1800s. Over the last three centuries, many areas were cleared for agriculture (particularly in bottomland areas) and settlement. Early settlers' accounts describe a much different forest type from that today: larger trees and higher proportions of late-successional species made up the dominant forest type before the arrival of Europeans (Loo *et al.* 2010). Clear-cutting of the original forest has often been followed by tree plantation development, which has reduced the habitat for late-successional species (NBDNR 2007; Loo *et al.* 2010; CRI 2011). Now, the dominant forest in this area is a mixture of red spruce, balsam fir (*Abies balsamea*), sugar maple, and beech, with substantial amounts of white pine and hemlock. Rich understories are present, which include round-leaved hepatica (*Hepatica nobilis*) and several species of fern. On more highly drained soils, communities of sugar maple, red maple, ironwood, basswood, and red oak occur, with black cherry (NBDNR 2007). On raised, sandy beaches along the shores of Grand Lake and the Saint John River, white ash and red oak may be found. Upland areas around lakes and river valleys contain communities of red maple, red spruce, hemlock, beech, sugar maple and white ash. White pine may be found on well-drained glacial deposits in the region. Typical understorey species in this area are often associated with aquatic habitats and other wet conditions (and include swamp milkweed [*Asclepias incarnata*], riverbank grape [*Vitis riparia*], waterweed [*Elodea canadensis*], and water-plantain [*Alisma* spp.] [NBDNR 2007]).



Repeated flooding in bottomlands and floodplains, in conjunction with the warm climate, has produced vegetation communities that are generally associated with more southern areas. Species in these communities include white elm, silver maple, butternut, bur oak, green ash, yellow oxytropis (*Oxytropis campestris*), Brunet's milk-vetch (*Astragalus alpinus var. brunetianus*), and woodland pinedrops (*Pterospora andromedea*) (NBDNR 2007).

The downstream area contains a large variety of wetlands associated with Grand Lake, extensive floodplains along the Saint John and Oromocto Rivers, and fluctuating water levels during the growing season (NBDNR 2007). Wetland types range from non-peatlands (*i.e.*, swamp, marsh, shallow water wetlands) to floodplain peatlands that have extensive fen or minerotrophic vegetation. Large areas of marshlands occur in the Saint John River floodplain. Lakeshores have widespread vegetation cover which is often shrubby.

9.2.2.3 Environmentally Significant Areas

In the 1990s, the Nature Trust of New Brunswick, in partnership with the New Brunswick Department of Environment and the New Brunswick Department of Natural Resources and Energy, identified more than 900 ESAs throughout New Brunswick. Today, Nature NB is also involved with updating the ESA database

(NTNB 2012). Tims and Craig (1995) defined ESAs as "*places that are distinctive because (a) they contain rare species of animals or plants or a rich diversity of species representative of an ecological zone; (b) their disturbance would have serious ecological consequences, or; (c) they contain geological or other features of specific scientific interest.*" There are 28 ESAs in the area of review; they contain rare plants, birds, mammals, amphibians, reptiles, invertebrates, geological features, forest communities and important wetlands. They are summarized in Table 1 (attached under separate cover), along with other important areas, such as PNAs and managed areas. Although there is no legislation protecting ESAs within New Brunswick, NBDELG considers ESAs when reviewing EIAs and environmental permit applications within the province (NTNB 2012).

Several notable ESAs for vegetation communities and plants exist upstream of the Station:

- Upper Woodstock Hardwood Slope ESA;
- Woodstock-Meduxnekeag Bridge ESA; and
- Lower Queensbury ESA.

Other ESAs for wetlands, vegetation communities and plants exist downstream of the Station:

- Keswick Ridge Escarpment ESA;
- Crocks Point ESA;
- Shore Island Gravel Strand ESA;
- Currie Mountain Mixed Wood Stand ESA;
- Main Street Environmental Park ESA; and
- a number of wetland ESAs between Oromocto and Coytown, including the Grand Lake Meadows ESA.

These ESAs are discussed further within their habitat types in the following sections.

9.2.2.4 Vegetation Communities and Other Land Uses

Vegetation communities are assemblages of plants that share certain characteristics, such as dominant taxonomic groups or species. Vegetation communities considered in this chapter are hardwood forest, mixedwood forest, softwood forest, plantation, shrub, agriculture, riparian mineral shore, and wetlands. Other land forms and uses include watercourses, waterbodies and developed land.

Land use type (including vegetation communities) upstream, downstream and in the entire area of review is summarized in Table 9.2.

Table 9.2 Land Use Types within the Area of Review

Land Use Type	Upstream of the Generating Station (%)	Downstream of the Generating Station (%)	Total in the Area of Review (%)
Forested	36.2	19.5	30.3
Agriculture	10.3	22.8	14.8
Riparian mineral shore	0.3	0.8	0.5
Wetlands	0.8	5.0	2.3
Watercourses and waterbodies	37.7	35.2	36.8
Developed	14.6	16.7	15.4
TOTAL	**100**	**100**	**100**
Source: NBDNR (2013)			

Forested vegetation communities are summarized in Table 9.3.

Table 9.3 Forest Types within the Area of Review

Forest Type	Regenerating/Sapling (%)	Young/Immature (%)	Mature/Overmature (%)	Total in the Area of Review (%)
Hardwood	5.9	19.8	19.2	44.9
Mixedwood	0.5	8.3	11.5	20.3
Softwood	0.3	12.7	13.0	26.0
Plantations	0.2	–	–	0.2
Shrub	0.9	3.0	0.0	3.9
Unknown	4.7	0.0	0.0	4.7
TOTAL	**12.5**	**43.8**	**43.7**	**100.0**

9.2.2.4.1 Hardwood

Hardwood stands contain more than 70% broad-leaved trees in the tree canopy layer. These stands make up approximately 44.9% of the forested land, or 13.6% of the area of review.

Upstream, most hardwood stands are shade-intolerant hardwood stands, dominated by poplar (*Populus* spp.). Downstream, other hardwoods can include oaks (*Quercus* spp.), ash (*Fraxinus* spp.), white elm, basswood, butternut, or ironwood (*Ostrya virginiana*). Red maple and birch (white and gray [*Betula papyrifera* and *B. populifolia*]) are also common species in hardwood stands, both upstream and downstream. Most hardwood stands upstream are mature and overmature. Most downstream stands are young and immature.

Some of these hardwood stands are likely SJRHF stands, with some occurring near Hartland and Woodstock, but also extending as far downstream as Nackawic. Hardwood stands adjacent to the Saint John River or other river valleys that are dominated by red maple, particularly downstream where there is natural flooding, likely include silver maple. These stands were historically more abundant in this region but were cleared for agriculture and settlements, and were lost during creation of the headpond (Loo *et al.* 2010).

In the area of review, several ESAs contain hardwood forest vegetation communities. The Upper Woodstock Hardwood Slope ESA is a hardwood and hemlock forest on a slope on the right bank of the Saint John River, approximately 0.5 km upstream of Upper Woodstock. Pale jewelweed (*Impatiens pallida*) (S2/may be at risk) occurs within this ESA.

Lower Queensbury ESA is a rich hardwood stand on a slope on the left bank of the Saint John River opposite Kings Landing. Several large concentrations of the SOCC cut-leaved toothwort (*Cardamine concatenata*) (S2/may be at risk) occur in this ESA.

Keswick Ridge Escarpment ESA is approximately 1.5 km downstream of the Station, on the left bank of the Saint John River. A number of habitats occur within this ESA, including hardwood forest on a steep slope up the valley. This ESA supports what is thought to be one of the richest concentrations of uncommon plant species in the province.

The Main Street Environmental Park ESA includes mature, closed-canopy silver maple forest at the mouth of Nashwaaksis Stream within the city limits of Fredericton. This ESA supports two known plant SOCC:

- Nuttall's waterweed (*Elodea nuttallii*) (S1/may be at risk); and
- white cut grass (*Leersia virginica*) (S2/may be at risk) (Nature Trust of New Brunswick 1995).

9.2.2.4.2 Mixedwood

Mixedwood stands contain 30% to 70% hardwood and softwood species in the tree canopy layer and are not strongly dominated by either species group. These stands make up approximately 20.3% of the forested land, or 6.2% of the area of review. They are composed mainly of a mix of balsam fir, birch, poplar or red maple, and shade-tolerant stands dominated by poplar and eastern white cedar.

Upstream mixedwood stands are often dominated by poplar or birch; downstream mixedwood stands are typically dominated by birch, red maple or eastern hemlock. Stands dominated by eastern hemlock are also considered uncommon habitat types because this species (and eastern white cedar) has declined since European settlement (Lutz 1997; Zelazny and Veen 1997). Mixedwood stands are mostly mature and immature upstream, and generally mature downstream of the Station.

Two ESAs in the area of review contain mixedwood forest vegetation communities. The Keswick Ridge Escarpment ESA contains mixedwood forest on the steep slope. The Currie Mountain Mixed Wood Stand ESA is on the left bank of the Saint John River, approximately 10 km west of Fredericton. The mixedwood forest in this ESA is typical of the Saint John River valley: it contains sugar maple, white pine and red oak. The following species also occur in this ESA:

- butternut (S1/at risk), a *SARA* and NB *SARA* listed species;
- woodland pinedrops (*Pterospora andromedea*) (S1/at risk), an NB *SARA* listed species; and
- smooth hedge-nettle (*Stachys tenuifolia*) (S3/sensitive).

9.2.2.4.3 Softwood (Including Plantations)

Softwood stands contain more than 70% needle-leaved, cone-bearing trees in the tree canopy layer. These stands make up approximately 29.9% of the forested land, or 9.0% of the area of review.

Softwood stands are dominated primarily by white spruce, balsam fir and eastern white cedar. This overall trend is similar upstream. Downstream, softwood stands are dominated by white pine and white spruce, with lesser amounts of eastern white cedar and eastern hemlock. Many of the eastern white cedar stands have wet or poorly drained soils; they are likely forested wetlands. Softwood stands also include plantations, though this is a relatively small habitat class. Softwood stands are mostly mature and immature, both upstream and downstream.

9.2.2.4.4 Shrub

In the area of review, shrub communities are 4.7% of the forested habitat, or 1.4% of the total area.

Shrub stands are more common downstream, where they cover 3.0% of the area. Upstream, they are 0.6% of the area. Most shrub communities (90%) in the area of review are dominated by speckled alder (*Alnus incana*). More than half of these shrub stands are considered wet, and are likely unmapped wetlands. Other shrub habitats are dominated by other shrub or small tree species, such as various species of cherry (*Prunus* spp.) willow (*Salix* spp.), mountain or striped maple (*Acer spicatum* or *A. pensylvanicum*), or mountain ash (*Sorbus americana*).

9.2.2.4.5 Agriculture

Most agricultural land is croplands and fallow pasture. Less commonly, agricultural land is used for cultivated blueberries, horticultural products, orchards and Christmas tree farms. Agricultural land is 14.8% of the area of review. It is 10.3% of the upstream area of review and 22.8% of the downstream area of review.

9.2.2.4.6 Riparian Mineral Shore

Riparian mineral shore habitat includes areas along the margins of rivers or on islands that are periodically subjected to flooding and ice scour. This habitat type usually contains minimal to no woody vegetation (trees and shrubs), and typically is small. It is 0.5% of the area of review. Because the water level near the Station is allowed to fluctuate up to approximately 1 m, some narrow bands of this habitat occur within Mactaquac Arm and other areas of the lower headpond, up to the Prince William area. Some additional areas of this habitat occur in the upper headpond near the Meduxnekeag River where inputs from the Meduxnekeag River may have some influence on water levels and ice scouring. This habitat is more common downstream, where natural watercourse disturbances occur. It occurs on many downstream islands and other floodplain areas. It comprises 0.8% of downstream habitat and 0.3% of upstream habitat.

The Crocks Point ESA is a floodplain area that contains riparian mineral shore habitat, which is located downstream between the Keswick Ridge Escarpment ESA and the Shore Island ESA. This ESA contains several rare plants, such as:

- Canada garlic (*Allium canadense*) (S1/may be at risk);
- slender beakrush (*Rhynchospora capillacea*) (S1/may be at risk); and
- low flatsedge (*Cyperus diandrus*) (S1/may be at risk).

The Shore Island Gravel Strand ESA is located on the southwest corner of Shore Island, approximately 4 km downstream of the Station. This riparian mineral shore habitat contains many rare plants, including:

- smooth hedge nettle (S3/sensitive);
- rough dropseed (*Sporobulus compositus* var. *compositus*) (S1/may be at risk);
- sticky goldenrod (*Solidago simplex* var. *racemosa*) (S2/may be at risk);
- low flatsedge;
- Canada wild rye (*Elymus canadensis*) (S2/may be at risk);
- little bluestem (*Schizachyrium scoparium*) (S2/sensitive);
- white vervain (*Verbena urticifolia*) (S2/may be at risk);
- tall goldenrod (*Solidago altissima*) (S2/secure); and
- bayberry willow (*Salix myricoides*) (S2?/sensitive).

This habitat is also found further downstream on the upstream edge of several islands, including Gilberts Island ESA and Ox Island ESA, and on the Saint John River edge of the Grand Lake Meadows ESA.

9.2.2.4.7 Wetlands

Wetlands account for 790.6 ha, or 2.3%, of the total area within the area of review. They are discussed in detail in Section 9.2.2.6.

9.2.2.4.8 Watercourses and Waterbodies

Watercourses and waterbodies in the area of review include the Saint John River, its larger tributaries, and several small, unnamed waterbodies. Together, these watercourses and waterbodies comprise 36.8% of the total area within the area of review.

9.2.2.4.9 Developed Land

Developed land is typically unvegetated, aside from lawns and ornamental plants, and includes Department of National Defence land, industrial land, infrastructure, recreational areas and settled land. Developed land is 15.4% of the total area within the area of review, and the upstream and downstream areas have a similar amount.

9.2.2.5 Species at Risk and/or Species of Conservation Concern

AC CDC records of plant SAR/SOCC indicate that 118 plant species are known to occur within the area of review, including 107 vascular plant species and 11 bryophyte species (all mosses). Many of the bryophyte records are more than 70 years old and have very general locational information. More recent bryophyte records were not recorded in locations or are associated with habitats that are expected to change under any of the Options. Therefore, bryophytes are not carried further in this review. The records of vascular plants include 74 forb species, 22 graminoid (grass-like) species, one vine species, seven shrub or small tree species, and three tree species. These species are listed in Table 1 (attached under separate cover), and their locations are shown in the vegetation and wetland mapbook (attached under separate cover).

Plant SAR recorded within the area of review include:

- butternut;
- woodland pinedrops; and
- Anticosti aster (*Symphotrichum anticostense*).

9.2.2.5.1 Butternut

Butternut is a small to medium-sized deciduous tree species. It is listed as Endangered on Schedule 1 of *SARA*, on the *List of Species at Risk Regulation* for New Brunswick, and by COSEWIC. It is listed as S3 by AC CDC and is ranked as at risk by CESCC. Butternut is shade intolerant. It establishes best under little to no canopy, and typically occurs in forest stands with rich, moist, often riparian soils, but it can also be found on well-drained, gravelly, calcareous soils (COSEWIC 2003; Farrar 1995; Gleason and Cronquist 1991). In New Brunswick, it grows in the Saint John River valley and the upper Southwest Miramichi River valley (Hinds 2000). Since the late 1960s, butternut has been threatened by butternut canker, which is caused by a fungus (COSEWIC 2003). The fungus causes crown dieback and eventually stem girdling, which kills the tree. Butternut canker was first reported in New Brunswick in 1997, and continues to spread. Some butternut individuals appear to have a low level of natural genetic resistance to the canker (Loo 2009).

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.

Butternut has been recorded in a variety of habitats both upstream and downstream of the Station. Less than half of the records are in forests, typically hardwood or mixedwood, often wet, and mature or overmature stands. Many records are within developed areas, in rural and urban settings or along roadsides. Several records are associated with wetlands or are within the boundaries of watercourses and waterbodies (including several pre-dam records from the headpond area). Information on the health of the butternut trees was not reported in these records.

There are several records of butternut in the Meduxnekeag River Valley; they are associated with the Woodstock-Meduxnekeag Bridge ESA and downstream wetland. A concentration exists in the Eel River Valley; it is associated primarily with wetlands. Another concentration exists in the Sugar Island area, including in the Sugar Island ESA, on Shore Island, at the mouth of Keswick River, on Eqpahak Island, and on the north and south shores of the Saint John River, including in the Currie Mountain Mixedwood Stand ESA. There are several records within the Fredericton city limits, and near the mouth of Oromocto River. A concentration exists within the Grand Lake Meadows ESA and surrounding area. Additional records of butternut are scattered throughout the area of review. Many of these occurrences were recorded before the Station was constructed; some date as far back as the 1800s. They include some records from valleys and islands that were subsequently flooded. Because of the age of many of the records, it is unlikely that all individuals are still present at the noted locations. Survey work would be required to confirm their existence.

9.2.2.5.2 Woodland Pinedrops

Woodland pinedrops is a small, reddish, parasitic plant. Its eastern populations are rare and appear to be in decline. It is not listed under *SARA*, but is listed as Endangered under NB *SARA*, and is listed on the *Prohibitions Regulation* under NB *SARA*. Woodland pinedrops does not obtain its energy through photosynthesis, like most plants. Instead, its roots form an association with a few specific species of soil fungi, from which it derives nutrients. These fungal species also appear to be associated with pine trees (Schori 2002). In New Brunswick, woodland pinedrops is limited to mature white pine (*Pinus strobus*) and mature white pine-hemlock stands that are often on rich, calcareous soil on steep slopes (NBDNR 2015c). The rarity of eastern woodland pinedrops is likely related to the rarity of the fungus with which it is associated (Hazard *et al.* 2012; Schori 2002).

Within the area of review, woodland pinedrops is located both upstream (along the Eel River Valley) and in two locations downstream of the Station. Several observations have been recorded 1 to 1.5 km downstream of the Station, in or near the Keswick Ridge Escarpment ESA. Other observations have been recorded approximately 9 km downstream of the Station, in the Currie Mountain Mixed Wood Stand ESA.

9.2.2.5.3 Anticosti Aster

Anticosti aster is a difficult species to identify, even for experts. It grows in rich or calcareous areas on seasonally flooded gravelly banks of fast-flowing rivers (Gleason and Cronquist 1991; NBDNR 2015b). It is listed as Threatened on Schedule 1 of *SARA* and by COSEWIC. It is also listed as Endangered under NB *SARA* and on the *Prohibitions Regulation* under NB *SARA*. It is ranked as S1S3 by AC CDC and at risk by CESCC, but it closely resembles and hybridizes with other common asters (NBDNR 2015b).

There are only three records of Anticosti aster in the area of review, all of which are downstream of the Station. Recent genetic work indicates that these specimens were misidentified. They are not Anticosti aster, but rather some other thin-leaved aster (Blaney, S., pers. comm., 2015).

9.2.2.6 Wetlands

Provincially mapped wetlands do not fully reflect wetland conditions in New Brunswick. Mapped wetlands are a subset of all wetlands and are weighted toward wetlands that are easily interpreted from aerial photos (*e.g.*, marshes, bogs). Forested and shrub wetlands are typically underrepresented.

Within the area of review, 78.2% of the total GeoNB-mapped wetland area are located downstream of the Station; 21.8% are located upstream of the Station (Table 9.4). This is notable because the downstream area represents only 36% of the area of review. Upstream mapped wetlands represent 0.8% of the area of review; downstream wetlands represent 5.0% of the area of review. This indicates that within the area of review, GeoNB-mapped wetlands are more than six times more common downstream of the Station than upstream of the Station. The gentler slopes and terraces normally associated with river valley bottoms were covered when the headpond was created. Therefore, wetland area in this section of the Saint John River was reduced. Within the area of review, PSW only occur downstream of the Station. They account for 91.4% of all wetlands in this section of the river. This percentage is much higher than in other areas of New Brunswick. Overall, PSW account for approximately 35% of GeoNB-mapped wetlands in New Brunswick.

Table 9.4 Wetland Distribution by Area within the Area of Review

Wetland Parameter	Upstream of the Generating Station	Downstream of the Generating Station	Total in the Area of Review
Total area (ha)	22,167.5	12,329.2	34,496.7
Wetland (ha)	172.2	618.4	790.6
Wetland (% of wetland upstream vs. downstream)	21.8	78.2	100
Wetland (% of total area in the area of review)	0.8	5.0	2.3
Provincially Significant Wetlands (PSW) (ha)	0	565.1	565.1
PSW (% of wetlands that are PSW)	0	91.4	71.5

Mapped wetland types within the area of review are shown in Table 9.5.

Table 9.5 Wetland Types within the Area of Review

Wetland Type	Upstream of the Generating Station (%)	Downstream of the Generating Station (%)	Total in the Area of Review (%)
Aquatic bed	14.7	12.1	12.7
Freshwater marsh	8.2	65.0	52.6
Forested	1.2	2.3	2.0
Shrub	75.9	20.5	32.6
TOTAL	**100**	**100**	**100**

Most wetlands within the area of review are riparian. Riparian areas (specifically wetlands) are transitional between open water and upland habitats, and support a wide diversity of species, communities and functions (Naiman and Décamps 1997). The headpond area represents a lentic (lake-like) system with generally steep adjacent slopes. Therefore, it has minimal fluctuations in water flow and channel, which are necessary for maintaining riparian diversity (Naiman and Décamps 1997).

9.2.2.6.1 Aquatic Bed

Aquatic beds are permanently flooded wetlands with standing water up to 2 m deep. They contain aquatic plants that can grow on or below the water surface and may or may not be rooted. Open water makes up at least 75% of the wetland (NBDNR 2013; NWWG 1997). These wetlands often form in areas with lentic characteristics, but they can form in lotic (river-like) conditions (NWWG 1997).

Within the area of review, approximately 12.7% of mapped wetlands are aquatic beds (Table 9.5). Their distribution is similar upstream and downstream of the Station. By area, aquatic beds make up 0.1% of the upstream area, 0.6% of the downstream area, and 0.3% of the overall area of review.

9.2.2.6.2 Freshwater Marsh

Freshwater marshes are wetlands that are dominated by herbaceous plant species, often grasses and sedges (NBDNR 2013; NWWG 1997). They are associated with freshwater sources such as stream flow, surface runoff and groundwater discharge, and their water levels typically fluctuate, usually seasonally (NWWG 1997).

Freshwater marshes are the most common mapped wetland type within the area of review (52.6%) (Table 9.5). They account for 8.2% of mapped wetlands upstream of the Station but 65.0% downstream of the Station. By area, freshwater marshes comprise 0.06% of the upstream area, 3.3% of the downstream area, and 1.2% of the overall area of review. Freshwater marshes also represent 68.4% of PSWs.

9.2.2.6.3 Forested Wetland

Forested wetlands, also known as treed swamps, are dominated by trees. They can include coniferous, deciduous or mixedwood forest types, and usually have a water table at or below the soil surface (NWWG 1997). Forested wetlands are the least common mapped wetland type within the area of review (2.0% of all wetlands) (Table 9.5). Upstream, forested wetlands represent 1.2% of all wetlands and 0.01% of the overall area of review. Forested wetlands are more prevalent downstream of the Station, where they account for 2.3% of all wetlands and 0.1% of the overall area of review. This is likely because the portion of the Saint John River Valley downstream of the Station experiences periodic flooding.

Did you know?

At more than 5,000 ha, Grand Lake Meadows is New Brunswick's largest inland wetland complex (NTNB 2012; Papoulias *et al.* 2006). It contains many different types of wetlands, including some that are uncommon in other areas of the province, such as silver maple floodplain forests.

Some downstream forested wetlands include silver maple stands. Silver maple-dominated forested wetlands are particularly common in several areas between the Station and Fredericton, including the banks of Keswick River and the Main Street Environmental Park ESA. Other silver maple-dominated wetlands occur on islands and in floodplain areas downstream of Oromocto, including Oromocto Island, Middle Island, Ox Island ESA, Gilbert Island ESA and Grand Lake Meadows PNA and ESA. These stands are uncommon elsewhere in the province (NBDNR 2007).

9.2.2.6.4 Shrub Wetland

Shrub wetlands or shrub swamps are dominated by shrubs, such as speckled alder (*Alnus incana*). Shrub swamps often occur in mineral rich, high water table areas, and can grade into wetter freshwater marshes (NWWG 1997). Within the area of review, shrub wetlands make up approximately 32.6% of all wetlands (Table 9.5). This wetland type is much more common upstream of the Station, where it accounts for 75.9% of all wetlands and 0.6% of the total area, than downstream of the Station, where it comprises 20.5% of all wetlands and 1.0% of the total area.

One wetland accounts for a large proportion of shrub wetland habitat upstream of the Station. It is an extensive wetland complex in Woodstock near the mouth of the Meduxnekeag River where it joins the Saint John River. Mapped portions of this wetland total nearly 60 ha. Two-thirds of this area is mapped as shrub wetland; the remainder is mapped as aquatic bed. This wetland complex supports an abundant population of fiddleheads (*Matteuccia struthiopteris*) and many rare plants, including:

- butternut (S1/at risk), a *SARA* and NB *SARA* listed species;
- thin-leaved sedge (S1/may be at risk);
- inflated narrow-leaved sedge (S1/may be at risk);
- clustered sanicle (S2/may be at risk); and
- calypso (*Calypso bulbosa*) (S2/may be at risk).

9.2.2.6.5 Wetland Complexes

Many of the more notable wetlands within the area of review are complexes. Wetland complexes often have higher biodiversity than single-type wetlands of similar size because they provide a number of different types of habitat for plants and wildlife. The most noteworthy wetland complex within the area of review, and the province, is the Grand Lake Meadows (GLM).

Wetland portions of the GLM are usually flooded for at least six months of the year. Flooding happens when water levels in the Saint John River exceed certain levels. This typically occurs between April and June, and between October and December. Flooding results in the deposition of floodplain sediment from the Saint John River; historically, this sediment was transported from upstream areas of the river (Papoulias *et al.* 2006). Local farmers believe that construction of the Station interrupted this downstream sediment transport, which historically contributed to the enrichment and restoration of floodplain soils within Grand

Lake Meadows. The farmers believe that this has led to soil depletion and erosion in the area, and as a result, soils in floodplain areas are becoming wetter over time. However, there is currently no documented evidence to support these claims. It is also difficult to attribute any changes in wetlands in this area to construction of the Station because Ducks Unlimited has altered many of the wetlands in the lower Saint John River. However, dams do retain sediments and change associated nutrient availability and downstream vegetation community composition (Gregory *et al.* 2002). This has occurred in the lower Mississippi River. Modifications such as channelizing, dam construction and artificial bank stabilization have considerably reduced the suspended sediment load in that system, which has resulted in major wetland losses (Kesel 2003).

The multiple functions and values that GLM provides have been recognized by many government and conservation groups within the province. Crown land within the area has been designated as a PNA, and restrictions have been placed on allowable activities. There are a number of managed areas within the Grand Lake Meadows, such as several Ducks Unlimited sites and the proposed Portobello National Wildlife Area (AC CDC 2015). Grand Lake Meadows is also recognized as an ESA.

9.2.2.6.6 Wetland Function

Both the *Federal Policy on Wetland Conservation* (Government of Canada 1991; NBDNRE and NBDELG 2002) and the *New Brunswick Wetlands Conservation Policy* have goals of "no net loss of wetland function." The term wetland function refers to the valued processes and services provided by wetlands (Government of Canada 1991; Hanson *et al.* 2008). Although wetland area is commonly used as a surrogate for wetland function, the two are not equal, particularly when comparing well-established and newly created wetlands (Turner *et al.* 2001).

Wetlands perform a number of functions that enhance surrounding ecosystems and provide socio-economic and cultural benefits. These functions can include:

- maintaining base flow;
- mitigating peak flow;
- providing stormwater storage;
- attenuating flooding;
- discharging and recharging groundwater;
- acting as an oxygen and nutrient source;
- providing habitat for many species of plants, waterfowl, reptiles, amphibians, fish, and other wildlife;
- preserving biodiversity;
- storing carbon;
- providing ideal locations for hunting, fishing, trapping and other recreational activities such as canoeing and kayaking and gathering traditional foods;

- protecting shorelines; and/or
- allowing humans access to aesthetic and heritage areas.

Wetlands in the Saint John River valley, such as Grand Lake Meadows, are the most extensive inland freshwater wetlands in New Brunswick; many are considered to be PSW because they provide important spring freshet floodwater storage function. These wetlands are threatened by anthropogenic activities, such as development, industrial and agricultural runoff, and recreation (NBDNRE and NBDELG 2002).

Wetlands along the headpond portion of the area of review perform many of the functions listed above but to a lesser degree because:

- these wetlands are smaller, and there are fewer of them;
- their water levels are more stable; and
- the diversity of habitats in these wetlands is less than that in wetlands downstream of the Station because:
  - there is less low-lying topography in the headpond area, and therefore, less transitional habitat between aquatic and upland areas; and
  - the natural flow regime in wetlands downstream of the Station creates a more lotic (river-like) environment, which promotes greater habitat diversity.

9.3 SUMMARY OF STANDARD MITIGATION FOR VEGETATION AND WETLANDS

Standard mitigation and best management practices that are relevant to the vegetation and wetlands VC will be implemented during construction and operation of all Options. These measures are based on normal operating procedures and regulatory requirements (outlined in Section 2.6).

- Environmentally sensitive features (*e.g.*, watercourses, wetlands, locations of SAR/SOCC, areas of high archaeological potential) will be identified and clearly marked, where feasible.
- Natural vegetation will be preserved when possible.
- Engineered surface water drainage and diversion channels will be constructed to direct flow around the construction site and away from watercourses and wetlands.
- Erosion and sedimentation control structures will remain in place until the disturbed area is stabilized or natural revegetation occurs.
- All fuels and lubricants used during construction will be stored according to containment methods, in designated areas. Storage areas will be at least 30 m from watercourses, wetlands and water supply areas (including known private wells).

- Refueling of machinery will not occur within 30 m of watercourses and water supply areas (including private wells). Where stationary equipment is situated near a wetland, special precautions will be implemented to prevent spills during refueling (*e.g.*, absorbent pads will be placed below nozzles, and spill response kits will be located at the refueling location).
- Temporary storage of waste materials on-site will be located at least 30 m from watercourses, wetlands and water supply areas (including known private wells).

9.4 POTENTIAL INTERACTIONS BETWEEN VEGETATION AND WETLANDS AND THE OPTIONS

Table 9.6 provides an overview of how the Options will interact might vegetation and wetlands.

Table 9.6 Potential Interactions between Vegetation and Wetlands and the Options

Phase	Option 1			Option 2			Option 3		
	Potential Change in Vegetation Communities	Potential Change in Species at Risk and/or Species of Conservation Concern	Potential Change in Wetland Area and/or Function	Potential Change in Vegetation Communities	Potential Change in Species at Risk and/or Species of Conservation Concern	Potential Change in Wetland Area and/or Function	Potential Change in Vegetation Communities	Potential Change in Species at Risk and/or Species of Conservation Concern	Potential Change in Wetland Area and/or Function
Construction (New facilities, Option 1 and Option 2)	✓	✓	NI	✓	✓	NI			
Demolition (Existing structures, Option 1 or Option 2)	✓	✓	NI	✓	✓	NI			
Operation (Option 1 or Option 2)	NI	NI	NI	NI	NI	NI			
Decommissioning (Option 3)							✓	✓	✓

Notes:
✓ = Potential interactions.
NI = No interaction.
Shaded cells are not applicable to the particular Option and phase.

The operation of Options 1 and 2 will be similar to that of the existing Station, except that power generation will not occur under Option 2. The same maximum and minimum water levels will be maintained. The continual stabilization of the new portion of the river channel may result in sediment movement for some time following construction and demolition, but it is expected to be minimal. Thus, the operation phase of Option 1 or Option 2 is not expected to interact with vegetation communities or species at risk/species of conservation concern.

There are no mapped wetlands within or immediately upstream or downstream of the Option 1 or 2 areas of physical disturbance. A review of aerial photography indicated that unmapped wetland is unlikely to occur within or near the Option 1 or 2 area of physical disturbance. Sediment control measures will limit potential erosion and runoff sources of sediment.

Dams and associated headpond areas are known to reduce downstream sediment and nutrient transport (Gregory *et al.* 2002). Though sediment transport modelling has been conducted as part of MAES, it is not known to what degree sediment transport within the Saint John River system is currently affected by the Station, or whether a change in sediment transport resulting from the Station has interacted with downstream wetlands. Suspended sediments drop out of the water column in areas where the river widens and water velocity slows. However, since construction of the Station, water velocity in the Saint John River slows considerably in the upper reaches of the headpond. Sediment deposition downstream of the Station is presumably less than it was prior to construction of the Station. The Saint John River is also a source for sediments and nutrients that enter Grand Lake Meadows during flooding.

9.4.1 Potential Change in Vegetation Communities

9.4.1.1 Option 1 or 2

Vegetation communities in the area surrounding the Station are expected to interact with the construction and demolition phases of Option 1 or Option 2. This will occur directly through the excavation of vegetation communities along the right bank of the Saint John River, and indirectly through changes in sediment resulting from construction and demolition activities.

The Option 1 and Option 2 areas of physical disturbance include a mix of agriculture (fallow pasture), developed land (industrial and rural settlements) and young to immature-aged forests (dominated by poplar-hardwood, white spruce and non-commercial species). These habitats are within the area of the new spillway and expanded river channel that will be created under Option 1 or 2, and the area of the new powerhouse under Option 1 and are expected to be completely removed. Based on existing information, these habitats are not of high ecological value, and are not limited within the area of review. Therefore, the direct loss of vegetation communities under Option 1 or 2 is not expected to be notable within the area of review. Field surveys should be conducted prior to construction and demolition to confirm NBDNR forest mapping and determine if any vegetation communities were improperly mapped. If ecologically important habitats are found within the areas of physical disturbance, further site-specific mitigation may be necessary.

Following construction, the surface water flow regime will change as the flow of the Saint John River is redirected through the new powerhouse or spillway. This may cause changes in local water velocities, which may increase local erosion in some areas. The physical disturbance associated with site preparation and excavation activities will be an additional source of sediment, which may be released into the river.

Sediment control measures will help limit potential erosion and runoff sources of sediment. However, some sediment is expected to be released into the Saint John River, which could have an interaction with vegetation communities and ESAs downstream of the Station. Keswick Ridge Escarpment ESA is approximately 1.5 km downstream of the Station, on the left bank of the Saint John River. The ESA includes a number of habitats, such as a beach that experiences flooding, ice scour and erosion; calcareous ledges; and mature mixedwood and softwood forest on a steep slope up the valley. It also supports what is thought to be one of the richest concentrations of uncommon plant species in the province (Nature Trust of New Brunswick 1995). Further downstream, the Shore Island Gravel Strand ESA contains a gravel beach vegetation community that is similar to that in the Keswick Ridge Escarpment ESA. These gravel beach communities may interact negatively with fine sediments that could be released into the Saint John River during construction and demolition. If it appears that the level of sediment released during these phases will interact with plants in these ESAs, sedimentation protection measures will be established to protect these communities.

9.4.1.2 Option 3

Option 3 will cause many physical changes in the Saint John River, most notably, the loss of the headpond and the return of that section of the river to near natural flow conditions. The restoration of natural flow conditions is considered to be a major ecological benefit of dam removal (Gregory *et al.* 2002). Loss of the headpond will result in lower water levels, and increased water velocity. Suspended sediments will increase within the water column. These changes will be most prominent immediately upstream of the Station, and will decrease with increasing distance upstream of the Station. Loss of the headpond will have two main interactions with vegetation communities: it will lower the water table in vegetation communities adjacent to the headpond, and it will expose previously submerged substrates within the headpond, providing additional habitat for plant species. It will also provide a source of sediment (an important source of nutrients to terrestrial plant species) to downstream terrestrial and wetland communities.

Plant species have different levels of tolerance for environmental features such as soil condition, availability of sunlight, and moisture availability. In terms of moisture availability, both the level and frequency of soil saturation are important. Different moisture tolerances can lead to gradients in vegetation communities with increasing distance from water. For example, this gradient may begin with aquatic vegetation within the water. It may then transition to wetlands in low-lying areas, which have different vegetation in the lower part of the wetland than at the upper edge. The gradient may then transition to vegetation communities containing a moderate amount of moisture. The distance along which these shifts occur depends on slope: vegetation communities change over shorter distances from water in areas with steeper slopes. Soil type and drainage also play a role in community structure because some soil types retain water more than others.

Much of the headpond is surrounded by relatively steep terrain. In steep areas, moisture availability is often independent from nearby water sources. The vegetation communities in these steep areas are expected to experience little if any change under Option 3.

Data derived from LiDAR were used to identify and further characterize low-lying areas within the area of review that are likely influenced by water levels in the headpond. Approximately half the vegetation communities in these areas are forest, about one-third are mapped wetland, and the rest are a mix of non-forested land use. Mapped wetlands are primarily shrub wetlands, although some freshwater marsh and a small amount of aquatic bed wetland are also present. It is likely that a portion of the forested communities are actually forested wetlands, such as eastern white cedar-dominated stands. Non-forested land use includes non-vegetated riparian and agriculture areas, both of which account for about 7% of low-lying areas.

Many of these vegetation communities will likely experience mild to moderate change in species composition as the water level is lowered. These changes will be most notable in wetland communities. The shifts in species composition may be minor or major, depending on the position of the wetland in the headpond area (*i.e.*, greater changes in water levels will occur closer to the Station than in the upstream portions of the headpond). Minor shifts will result in transitions within the existing vegetation community from riparian to upland at the upper edge of the wetland. Minor shifts will also occur at the former water's edge. Species in this area will be most sensitive to changes in water levels, and may not be able to establish on newly exposed substrates. Major shifts could occur where entire wetlands are drained. In these areas, the vegetation will convert to an upland community (Hanson *et al.* 2008). Most of the low-lying areas along the headpond are located in the upper reaches, where the change in water level is expected be less than in the lower reaches.

Option 3 will cause a shift within the current headpond area from a lentic (lake-like) environment to a lotic (river-like) environment. This will result in flooding and ice scour, which will alter riparian habitats. Increased water velocity will also cause some sediment shifts throughout the former headpond area, and will increase the suspended sediment load, at least in the former headpond area. Sediment shifting could change vegetation communities on existing islands, both upstream and downstream of the Station. The islands that remain in the upper reaches of the headpond following construction of the Station are currently dynamic, shifting over time. As a result, the vegetation communities are also somewhat dynamic. It is difficult to say how sediment shifting will influence re-exposed islands and shoreline areas. Sediment sampling and modelling is ongoing as part of the MAES. Potential changes related to sediment shifting will be better understood following completion of sediment transport and deposition modelling.

Vegetation growth on exposed sediments can reduce downstream sediment transport (Shafroth *et al.* 2002); however, this will happen only after substantial revegetation has occurred. Until exposed sediments are vegetated, increased transport of fine sediment, either as a result of natural shifting or release associated with decommissioning of the Station, may interact negatively with riparian vegetation communities both upstream and downstream of the Station. The sediment released during decommissioning could bury downstream vegetation communities, and the force of the initial release of water could affect riparian vegetation (Acker *et al.* 2008). Keswick Ridge Escarpment ESA is approximately 1.5 km downstream of the Station, on the left bank of the Saint John River. It includes a number of habitats, such as a beach that experiences flooding, ice scour and erosion; calcareous ledges; and mature mixedwood and softwood forest on a steep slope up the valley. It also supports what is thought to be one of the richest concentrations of uncommon plant species in the province (Nature Trust of New Brunswick 1995). Further downstream, the Shore Island Gravel Strand ESA contains a similar gravel beach vegetation community. The gravel beach communities in these ESAs may be sensitive to, and interact negatively with, fine sediments that could be released into the Saint John River during construction and demolition (Table 1, attached under separate cover). The location, mobility, and amount of accumulated sediments will be described through ongoing studies. Preliminary results from the MAES have indicated that the mass redistribution of sediment from the headpond will not result in substantive deposition in the area of the Keswick Ridge Escarpment ESA or the Shore Island Gravel Strand ESA, located within a few kilometres downstream of the Station, due to expected high water velocities in these areas. In other areas located farther downstream, sediment deposition may occur due to lower velocities, but such deposition may be beneficial as a source of nutrients to the Grand Lake Meadows and some islands located farther downstream. Erosion and sediment control structures and other shoreline interventions (*e.g.,* slope stabilization, shoreline protection) will be used to reduce the amount of sedimentation caused by Project activities.

Under Option 3, submerged islands and submerged areas of existing islands within the headpond will become exposed. The channel of the Saint John River has changed since the Station and headpond were constructed. Work is currently being completed to better understand what a new channel would look like under Option 3. Because this information is not yet available, historical information was used to estimate how island and floodplain habitats may change under Option 3.

Topographic maps from the 1950s were used to estimate the area of island habitat in the headpond prior to the creation of the Station (Table 6.12). There were 4.2 km^2 of island habitat at that time; now there are 0.4 km^2. Therefore, approximately 3.8 km^2 of island habitat were submerged following construction of the Station. It is assumed that a similar area of island habitat will be exposed or created under Option 3. A review of current and historical photos indicates that many of these islands, both present and historical, have similar vegetation community structure. Most contain an area of bare substrate that would be periodically submerged by flooding on the upstream end of the island, wetland, and some shrub or forest in larger islands. Portions of these islands and other floodplain habitat will also be subjected to ice scour. This represents a change in habitat conditions; areas within the headpond do not currently flood or experience ice scour. The change in island and floodplain habitats from pre- and post-dam construction is illustrated in Photos 9.1 to 9.3.

Photo 9.1 Islands and floodplains in the Saint John River near Woodstock, circa 1951 (pre-dam, left) and 2010 (post-dam, right).

Photo 9.2 Islands and floodplain habitat in the Saint John River near Prince William, circa 1958 (pre-dam, top) and 2007–2008 (post-dam, bottom).

Photo 9.3 Islands in the Saint John River near Longs Creek, circa 1951 (pre-dam, left) and 2004 (post-dam, right).

Newly exposed substrates will likely be rapidly colonized by herbaceous plant species. Riversides and floodplains are fairly susceptible to invasive species colonization because they frequently experience disturbance. In some areas where dam removal has occurred, invasive species, such as reed canary grass (*Phalaris arundinacea*) have become established and dominant on recently exposed or disturbed sites (Orr and Stanley 2006a; Shafroth *et al.* 2002; Stanley and Doyle 2003). Both native and exotic varieties of this species already occur within the Saint John River system. This species has become more prevalent in riparian marshes in New Brunswick within the last few years, particularly in the Hartland area (personal observation, and Hill and Blaney 2009). It is reasonable to expect that reed canary grass will become established on newly created wetlands along the Saint John River. Wetland restoration techniques such as planting or hydroseeding native plant species and varieties can help reduce, but not eliminate, the potential influx of invasive species (Orr and Koenig 2006b).

Did you know?

The term invasive species refers to exotic species that originated elsewhere. These species can become established and influence the dynamics of natural communities, typically by outcompeting native species (Hill and Blaney 2009).

Some examples of commonly known invasive plant species are: purple loosestrife, garlic mustard, Norway maple.

Under Option 3, the amount and rate of change in vegetation communities will depend, in part, on the rate of headpond drawdown. Compared to a slow drawdown rate, an accelerated drawdown will cause larger immediate changes within the riparian zone, a larger drop in the water table in areas adjacent to the water, and a wider zone of newly exposed substrates. This will likely increase the potential for invasive species to become established because the existing riparian community will be farther from the new riparian zone and some species may die off before they can colonize newly exposed habitat. Implementing a slow or incremental drawdown would benefit native plant communities because they would more likely be able to adapt to new environmental conditions and colonize newly exposed areas. The current design and planning for Option 3 is based on an accelerated drawdown scenario. Should Option 3 be selected as the Preferred Option and implemented using an accelerated drawdown, vegetation interventions such as additional planting, hydroseeding and monitoring may be considered to manage the spread of invasive species.

9.4.2 Potential Change in Species at Risk and/or Species of Conservation Concern

9.4.2.1 Option 1 or 2

AC CDC records indicate that several SOCC may be within or near the Option 1 or Option 2 areas of physical disturbance:

- Drummond's rockcress (*Arabis drummondii*) (S2/sensitive);
- Canada wild rye (*Elymus canadensis*) (S2/may be at risk);
- early saxifrage (*Saxifraga virginiensis*) (S1S2/may be at risk);

- rough dropseed (*Sporobolus compositus*) (S1/may be at risk); and
- rock spikemoss (*Selaginella rupestris*) (S1S2/may be at risk).

The locations of these SOCC records are shown in the vegetation and wetland mapbook (attached under separate cover). Plant locations are shown by symbol and the first four letters of the genus and species names (*e.g.*, Drummond's rockress = ARABdrum).

In 1997, Drummond's rockcress was observed within the Option 1 area of physical disturbance, downstream of the Station, on the right bank of Saint John River. This species may still exist at this location. There is a second, pre-dam construction record (1963) immediately upstream of the Station. The species was recorded on a rocky cliff on Saint John River, near Mactaquac Bridge; however, this site was inundated. Therefore, this occurrence presumably no longer exists and will not interact with Option 1. There are four other records of Drummond's rockcress within the area of review: two in the Meduxnekeag River area and two downstream near the Keswick Ridge Escarpment ESA. It is not expected that the loss of individuals within the Option 1 area of physical disturbance will result in a measurable change in the overall population of Drummond's rockcress.

There are two AC CDC records of Canada wild rye on the earthen dam portion of the Station, but these locations are likely inaccurate. The records describe the location as "exposed dry roadside" "near Mactaquac Dam at TCH overpass" (presumably Route 102, which was part of the TransCanada Highway prior to construction of Route 2). These records are from 1978; however, this species may still be present at this location. These records are likely within the area of physical disturbance for Option 1 and possibly Option 2. There are other records of Canada wild rye within the area of review, including nine records downstream of the Station, in the Chapel Bar and Sugar Island areas. The loss of the individuals within the Option 1 or 2 area of physical disturbance is not expected to result in a measurable change in the overall population of Canada wild rye.

Several pre-dam construction records (1959) for early saxifrage are located immediately upstream of the Station. This species is listed as occurring on cliff faces on Saint John River, near Mactaquac Bridge, in an area that was inundated or removed during construction of the Station. This species presumably no longer exists at this location and will not interact with Option 1 or 2.

Rough dropseed was recorded several times prior to Station construction (1959) on the shore of Saint John River near the mouth of Mactaquac River. These observations were made in an area that was inundated or removed during the construction of the Station. This species presumably no longer exists at this location and will not interact with Option 1 or 2.

Several pre-dam construction records (1959) for rock spikemoss are located immediately upstream of the Station. This species is listed as occurring on a rock cliff at the mouth of Mactaquac River, overlooking Saint John River, and on cliff faces of the Saint John River, near Mactaquac Bridge. Both of these sites were inundated or removed during construction of the Station. This species presumably no longer exists at this location and will not interact with Option 1 or 2.

The proposed construction area has been surveyed for rare plant species at various times in the past. Given the nature of habitats within this area, it is unlikely that additional SAR/SOCC will be found there. Drummond's rockcress and early saxifrage could occur on cliffs on the north side of the river near the Station. Field surveys should be conducted prior to construction and demolition to confirm the location of Canada wild rye and Drummond's rockcress, and to determine if any additional plant SAR/SOCC exist within the area of physical disturbance. If additional SAR/SOCC are found, further mitigation may be necessary.

9.4.2.2 Option 3

Under Option 3, decommissioning activities could directly interact with SAR/SOCC. However, it is more likely that interactions will occur as a result of changes in habitat. Changes in vegetation communities will represent changes in habitat for SAR/SOCC that currently exist or could exist in areas where vegetation communities change. Wetlands and adjacent upland areas are most likely to undergo changes. Removal of the Station and the resulting lower water levels along what is now the headpond area will create new habitat such as wetlands, floodplains, islands and riparian mineral shore habitat.

Two plant SAR have been recorded in the area of review upstream of the Station: butternut and woodland pinedrops. Although the habitat of some butternut trees that exist near the edge of the headpond will change under Option 3, most trees are expected to survive the change in water level associated with the loss of the headpond. Lower water levels in the headpond area will provide additional habitat for butternut.

Given the habitat requirements of woodland pinedrops, and its known locations within the area of review (Section 9.2.2.5), it is unlikely that physical changes in habitat due to lowering of the headpond will result in the loss of any individuals of this species. No additional habitat will be created for this species.

New habitats created under Option 3 will be subjected to flooding and ice scour. These processes have not occurred in the headpond since the Station was constructed. These habitats will be ideal for some SAR/SOCC, including some SAR that existed on islands that are now submerged, or that exist upstream of the headpond, in the Hartland to Beechwood Dam area (*e.g.*, Anticosti aster).

There are seven additional records of Anticosti aster upstream of the area of review, between Hartland and Bath, New Brunswick (AC CDC 2015). These occurrences were found on calcareous shores, limestone outcrops and rocky shorelines, which are ideal habitats for this species. Under Option 3, similar habitats are expected to be created downstream of Hartland; Anticosti aster may colonize new habitats that are created between Hartland and the Station (AC CDC 2015; Blaney, S., pers. comm., 2015).

Furbish's lousewort (*Pedicularis furbishiae*) is an endangered plant species (under *SARA* and NB *SARA*). It grows best in sparsely vegetated riparian habitats that experience a high degree of ice scour. Ice scour prevents the establishment of tree and shrub species that could out-compete this species. Furbish's lousewort has been recorded at only three locations in New Brunswick. The closest to the area of review is approximately 65 km north of the area. Although Option 3 will create suitable habitat for this species, it is unlikely that Furbish's lousewort will establish in the headpond of the Saint John River, at least in the near future (Blaney, S., pers. comm., 2015).

Increased transport of fine sediment may result from natural shifting associated with changes in flow in the headpond area and could affect riparian vegetation. Modelling work in this area is ongoing, and will provide more information on sediment transport. Sediment transport within the Saint John River system is dynamic, and is likely to be a continuous process.

Large volumes of water and large amounts of sediment could be released during dewatering of the headpond prior to decommissioning. Sediment release could affect downstream vegetation communities, including trees (Acker *et al.* 2008). SAR/SOCC in the Keswick Ridge Escarpment ESA and Shore Island Gravel Strand ESA may be particularly vulnerable because of their location and community composition. To mitigate potential interactions between water and sediment release and downstream SAR/SOCC, a drawdown schedule should be selected that avoids shoreline erosion or the deposition of sediment in sensitive areas. Preliminary results from the MAES suggest that an accelerated drawdown will not result in substantial sediment deposition in the Keswick Ridge Escarpment ESA or Shore Island Gravel Strand ESA. Under the planned accelerated scenario, there would be a temporary period of increased water velocities; however, this would coincide with a period where vegetation is accustomed to similar conditions (*i.e.,* spring freshet or fall recharge period) and would quickly return to seasonal flows. Erosion and sediment control structures and other shoreline interventions (*e.g.,* slope stabilization, shoreline protection) will be used to reduce the amount of sedimentation caused by Project activities.

Many species may recolonize new habitats, such as wetlands and riparian mineral shore, which are expected to be created in the headpond area. The lowering of water levels in the headpond will also change habitat for species in the existing riparian zone. Some SAR/SOCC in this area may not be able to adapt to this change. The predicted responses of species within the area of review to all three Options are described in Table 1 (attached under separate cover).

9.4.3 Potential Change in Wetland Area and/or Function

9.4.3.1 Option 3

Under Option 3, the headpond will be lost and near natural flow conditions will be restored in that section of the Saint John River. Much of the headpond is surrounded by relatively steep terrain. The gentler slopes and terraces where wetlands typically form were covered when the headpond was created. Drainage of the headpond will lower the water level in wetlands in the headpond area, which will result in vegetation shifts. Water levels will decline more in the lower headpond closer to the Station than in the upper headpond near Hartland. Depending on how much the water level is lowered, existing mapped wetlands could either be reduced in area or completely converted to upland habitat. However, new substrates will be exposed, which will likely develop into wetlands.

The channel of the Saint John River has changed since the Station was constructed. Work is currently being conducted as part of the Mactaquac Aquatic Ecosystem Study (MAES) to gain a better understanding of what the morphology of the Saint John River will look like under Option 3, but this information was not available at the time that this report was prepared. Consequently, the pre-dam historical information (*e.g.*, aerial photos, topography maps), LiDAR and bathymetry data collected for the Project provide the best approximation of a post-dam scenario under Option 3. This information can help determine the direction and magnitude of change in wetlands within the area of review.

Wetland policy and legislation did not come into effect until well after the Station was constructed; therefore, wetlands were not protected before that time. Many agricultural areas adjacent to the Saint John River that are visible in historical aerial photos were likely wetlands that had been drained and converted to land for farming and grazing. If the river channel returns to a state that is similar to pre-dam conditions, there will likely be an overall increase in wetland area relative to that which existed prior to construction of the Station and headpond. General predictions about the amount of area associated with selected wetlands or watercourse confluences under Option 3 are provided in Table 9.7. Quantitative estimates of existing and Option 3 wetland areas were not completed as part of the CER.

Sediment deposition and transport modelling had not been completed at the time of writing; however, sediment deposition and transport is not expected to have a major influence on overall wetland area within the area of review.

Table 9.7 Predicted Change in Wetland Areas under Option 3

Wetland Location	Predicted Change in Wetland Area under Option 3
Meduxnekeag River	Decrease in area. The Meduxnekeag River was quite channelized prior to creation of the headpond (Photo 9.4).
Eel River	Increase in area. Historically, there was wetland in what is now the mouth of Eel River.
Greer Creek	Increase in area. The backwater from the headpond currently extends into the Protected Natural Area; this will largely become wetland.
Shogomoc Stream	Increase in area. The current mouth of Shogomoc Stream was historically wetland.
Pokiok Stream	Area will remain relatively unchanged.
Nackawic Stream	Increase in area. The Nackawic valley was flooded when the headpond was created; there currently is little wetland in this location (Photos 9.5 and 9.6).
Coac Stream	Increase in area. Historically, a floodplain area existed at the mouth of Coac Stream.
Longs Creek area	Increase in area. An at-times wide valley associated with Longs Creek was flooded when the headpond was created. There currently is little wetland in this location.
Kellys Creek	Increase in area. A valley associated with Kellys Creek was flooded when the headpond was created. There currently is little wetland in this location.
McNallys Cove	Increase in area. Some riparian wetland that was associated with this watercourse was flooded when the headpond was created.
Mactaquac Arm	Large increase in area. Mactaquac Stream was historically a meandering watercourse with associated wetland in several locations. The current Mactaquac Arm has little associated wetland (Photo 9.7).
OVERALL	**Based on the information reviewed, Option 3 will likely result in an increase in wetland area in the current headpond area.**

Photo 9.4 Wetland in the Meduxnekeag River near Woodstock circa 1951 (pre-dam, top) and 2010 (post-dam, bottom).

Photo 9.5 Wetland in the Nackawic Stream circa 1951 (pre-dam, top) and 2004 (post-dam, bottom).

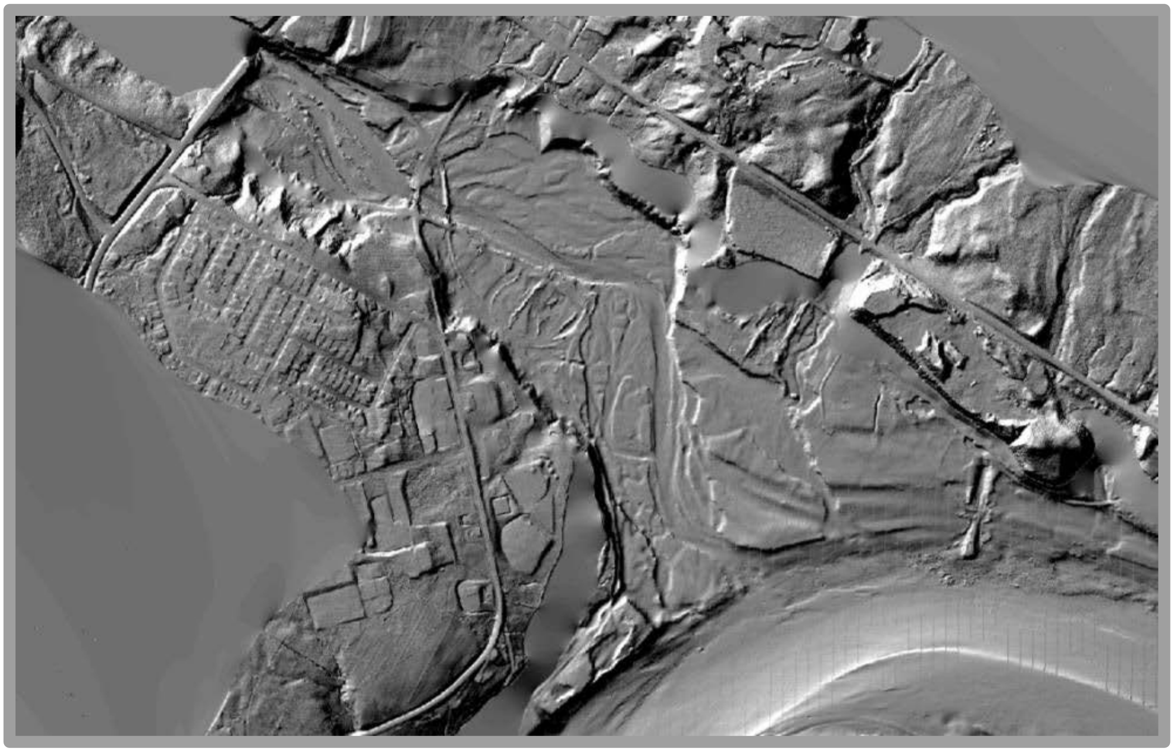


Photo 9.6 Bathymetry and LiDAR-derived Data for the Nackawic Stream, circa 2014.

Photo 9.7 Wetland in the Mactaquac Stream/ Mactaquac Arm circa 1951 (pre-dam, top) and 2007–2008 (post-dam, bottom).

Option 3 is expected to lead to a net increase in wetland area, but this will not result in an immediate net increase in wetland function. Existing wetlands in the headpond area will be partially drained and will likely experience an increase in invasive species, evapotranspiration, and inorganic chemical concentrations (Hanson *et al.* 2008). Newly created wetlands will likely take many years to develop and will not function similarly to well-established wetlands for some time. They will also likely be colonized by a number of invasive species (Hanson *et al.* 2008). It often takes years to decades for native riparian vegetation to establish and for community succession to occur in formerly impounded areas (Hart *et al.* 2002). Many wetland functions require mature vegetation for full functionality.

Wetlands downstream of the Station provide important flood protection to nearby areas; therefore, many are considered to be PSWs. Upstream, the Station currently mitigates water levels, and protects areas adjacent to the headpond against any potential flooding. Under Option 3, wetlands upstream of the Station will increase in flood protection function over time as they form and mature. This wetland function is not currently needed because the Station controls water levels.

The shift within the current headpond area from a lentic (lake-like) environment to a lotic (river-like) environment will alter riparian wetlands. Sediment shifting and increased suspended sediment loading will occur throughout the former headpond area and downstream. Sediment (and associated nutrient) shifting could change vegetation communities within existing wetlands, both upstream and downstream of the Station. This may affect wetland function, which often depends on the wetland vegetation that is present (*e.g.*, provision of wildlife habitat). Ongoing sediment transport and deposition modelling will provide more information about sediment movement, which may result in the need to give further consideration to Option 3 interactions with wetlands. Given the dynamic nature of the Saint John River system, sediment transport is likely to be a continuous process.

Large volumes of water and large amounts of sediment could be released when the Station is decommissioned. The force of the initial release of water could interact with wetlands immediately downstream of the Station by removing vegetation, if the drawdown occurs over a short period of time. Vegetation removal would have a number of negative interactions with wetland function, beyond the initial reduction in photosynthesis and potential loss of SAR/SOCC. Removal of vegetation would reduce habitat suitability, lead to increased erosion and establishment of invasive species, and change hydrological functions by increasing runoff velocity (Hanson *et al.* 2008). Increased turbidity can result in lowered photosynthesis, productivity and biological uptake by wetland vegetation, and can reduce habitat suitability for many species (Hanson *et al.* 2008). There is the potential for sediment to be released during decommissioning, both from Project activities, as well as the potential release of accumulated sediments in the headpond. The sediment released during decommissioning could bury herbaceous and shrub vegetation in the wetlands, and could also affect trees (Acker *et al.* 2008). The sequence and timing of the drawdown of the headpond should consider the potential for damage to downstream vegetation and avoid the deposition of large volumes of sediment in sensitive areas located immediately downstream of the Station. An accelerated drawdown is currently being considered for the planning and design for Option 3. Preliminary results of the MAES indicate that dewatering will result in the mass redistribution of sediments to slower moving areas of the river downstream and to large wetland complexes (*e.g.,* the Grand Lake Meadows), with most sediments flushed out to sea. While sediment deposition can be a negative interaction by “choking” terrestrial habitats or wetlands, it can also result in positive interactions by providing a useful source of nutrients to some wetlands and habitats. To reduce the negative interaction with the environment, the drawdown is planned to be completed in two stages, both of which coincide with seasonal periods of heavier precipitation where the river environment is accustomed to higher flows and increased sediment loads. Additional study is required to understand if increased sediment deposition is anticipated in areas where negative interactions with wetland function could occur.

Erosion and sediment control structures and other shoreline interventions (*e.g.,* slope stabilization, shoreline protection) will be used to reduce the amount of sedimentation caused by Project activities.

9.5 SUMMARY OF INTERACTIONS BETWEEN VEGETATION AND WETLANDS AND THE OPTIONS

The interactions between vegetation and wetlands and each Option are summarized below (Table 9.8).

Table 9.8 Summary of Interactions between Vegetation and Wetlands and the Options

Key Issues	Is the interaction negative or positive?	What is the amount of change?	What is the geographic extent?	How long does the interaction last?	How often does the interaction occur?	Has additional mitigation been recommended?
Potential Change in Vegetation Communities						
Option 1 : Construction, demolition and operation	Negative	Low	Site	Permanent	Single	No
Option 2: Construction, demolition and operation	Negative	Low	Site	Permanent	Single	No
Option 3: Decommissioning	Positive and Negative	High	Region	Long-Permanent	Continuous	Yes
Potential Change in Species at Risk and/or Species of Conservation Concern						
Option 1: Construction, demolition and operation	Negative	Low	Site	Permanent	Single	No
Option 2: Construction, demolition and operation	Negative	Low	Site	Permanent	Single	No
Option 3: Decommissioning	Positive and Negative	Medium	Region	Long-Permanent	Continuous	Yes
Potential Change in Wetland Area and/or Function						
Option 3: Decommissioning	Positive and Negative	High	Region	Long-Permanent	Continuous	Yes

KEY

Is the interaction negative or positive?
- Positive.
- Negative.

What is the amount of change?
- Low – a change that remains near existing conditions, or occurs within the natural variability for vegetation and wetlands.
- Medium – a change that occurs outside the natural variability for vegetation and wetlands but does not change the overall status of vegetation and wetlands.
- High – a change that occurs outside the natural range of change for vegetation and wetlands that will change the status of vegetation and wetlands locally or regionally.

How long does it last?
- Short – the interaction occurs for less than 3 months.
- Medium – the interaction occurs for 3 months – 1 year.
- Long – greater than a year.
- Permanent – there is no foreseeable end-date for the interaction.

How often does it occur?
- Single – the interaction occurs once.
- Multiple – the interaction occurs several times, either sporadically or at regular intervals.
- Continuous – the interaction occurs continuously.

Table 9.8 Summary of Interactions between Vegetation and Wetlands and the Options

Key Issues	Is the interaction negative or positive?	What is the amount of change?	What is the geographic extent?	How long does the interaction last?	How often does the interaction occur?	Has additional mitigation been recommended?
What is the geographic extent? • Site – the interaction is limited to the immediate area where Project-related activities occur. • Area – the interaction is limited to the general area surrounding the Station. • Region – the interaction occurs throughout the area of review and may extend to other regions. • Province – the interaction affects the entire province.			**Has additional mitigation been recommended?** • Yes. • No.			

9.5.1 Summary of Additional Potential Mitigation and Information Requirements

As described in Section 9.4, this review has identified the requirement for some additional potential mitigation and requirements for further study in some areas. These potential requirements are summarized in Table 9.9.

Table 9.9 Summary of Additional Potential Mitigation and Information Requirements

Option	Additional Potential Mitigation	Additional Information Requirements
Option 1: Construction, demolition and operation	• Field surveys should be completed within the area of physical disturbance to identify any important habitat that was not properly mapped or any wetland not included in provincial mapping sources. • Sedimentation protection measures should be established to protect vulnerable downstream communities such as the riparian mineral shore community at the Keswick Ridge Escarpment ESA, if modelling suggests that the level of sediment released during construction and demolition will interact with downstream communities.	• Field survey of the area of physical disturbance is required to confirm the absence of important habitat, including wetlands, and the location of SAR/SOCC. Locations of Canada wild rye and Drummond's rockcress within the area of physical disturbance will be confirmed.
Option 2: Construction, demolition and operation	• Field surveys should be completed within the area of physical disturbance to identify any important habitat that was not properly mapped or any wetland not included in provincial mapping sources. • Sedimentation protection measures should be established to protect vulnerable downstream communities such as the riparian mineral shore community in the Keswick Ridge Escarpment ESA, if modelling suggests that the level of sediment released during construction and demolition will interact with downstream communities.	• Field survey of the area of physical disturbance is required to confirm the absence of important habitat, including wetlands, and the location of SAR/SOCC. Locations of Canada wild rye and Drummond's rockcress within the area of physical disturbance will be confirmed.

Table 9.9 Summary of Additional Potential Mitigation and Information Requirements

Option	Additional Potential Mitigation	Additional Information Requirements
Option 3: Decommissioning	• Vegetation interventions such as planting and hydroseeding should be implemented to discourage the spread of invasive plant species and facilitate the establishment of a native riparian zone upstream of the Station.	• Further study is required to understand the anticipated sediment movement and sedimentation deposition patterns. • Quantitative estimates of existing and future wetland area would be required if Option 3 is selected; an overall net increase in wetland area is expected.

Field surveys should be conducted prior to construction and demolition, focused on the physical area of disturbance, to:

- confirm NBDNR forest mapping in the area of physical disturbance;
- identify any vegetation communities that were improperly mapped, including wetlands; and
- identify SAR/SOCC.

If ecologically important habitats or SAR/SOCC are found within the area of physical disturbance, further mitigation may be necessary.

During construction and demolition, the surface water flow regime will change as the flow of the Saint John River is redirected. This may result in changes in local water velocities, which may lead to increased erosion in some areas. In addition, erosion and runoff associated with site preparation and excavation activities will produce sediment, which may be released into the river.

Sediment control measures will help limit potential erosion and runoff sources of sediment. If modelling suggests that the level of sediment released during construction and demolition will interact with plants in downstream ESAs, sedimentation protection measures should be established to protect vulnerable plant communities, and the drawdown should be managed to reduce the potential for sediment movement.

9.5.1 Discussion

Vegetation and wetlands were included in this CER because of their environmental, recreational, aesthetic, and socio-economic value to the people of New Brunswick. Option 1 or 2 are expected to have limited interactions with vegetation and wetlands beyond those associated with construction and demolition. Option 3 will likely cause the greatest change in vegetation and wetlands.

Under Option 3, vegetation and wetlands upstream of the Station will experience change as a result of a drop in water level and a return to lotic (river-like) riparian conditions. This will likely result in an increase in various types of wetland and riparian mineral habitats. These habitats are important for many SAR/SOCC plants, and would provide an opportunity for SAR/SOCC species to colonize this section of the Saint John River. Some plant species that previously occurred in the headpond area were lost when the Station was built and the headpond was created. Under Option 3, these species may be able to recolonize new habitats that will be exposed. Downstream vegetation and wetlands could experience a large release of water and sediments when the Station is removed. Modelling results and field sampling for sediments will be important in understanding the best drawdown schedule to reduce vegetation loss and habitat changes (including changes to wetlands) as a result of direct interactions with the force of water, sedimentation, and scouring.

9.5.2 Assumptions and Limitations

Vegetation communities were derived from NBDNR landbase data. These data are several years old, and were collected with a forest harvesting bias. Complete coverage of landbase data (*i.e.*, forested, non-forested, and wetland data) was not available. It was assumed that landbase data for the areas with coverage were representative of areas without coverage.

Locations of individual plant SAR/SOCC were obtained from AC CDC records. The dates of these records ranged from 1838 to 2009. Because of the age of many of these records, it is unlikely that they all represent locations of current plant occurrences. Some plants that were recorded near or in the headpond area prior to construction of the Station were in areas that are now underwater (*e.g.*, submerged islands). These occurrences likely no longer exist. The precision of the data ranged from 10 m (*i.e.*, the plant was located within 10 m of the GIS point that represents it) to 10 km, and in a few extreme cases, to 100 km. The review of potential interactions with the Options was based on the locations given; however, less precise records may not actually be located within the area of review. Some records may also be from a location in which the plant would experience a different interaction than what was assumed based on the location given.

Wetland analysis was based on mapped wetland sources, which likely do not accurately reflect the actual extent of wetlands. The difference between the extent of mapped wetlands and the extent of actual wetlands may be larger in some areas than in others, depending on the wetland type, surrounding vegetation type and topography.

Sediment deposition and transport modelling for the three Options has not been completed; therefore, potential interactions between sediment and vegetation and wetlands have been discussed at only a high level.