Lake Winnipeg East System Improvement (LWESI) Transmission Project

Aquatic Environment Technical Report

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EXECUTIVE SUMMARY

The Aquatics Technical Report for the Lake Winnipeg East System Improvement (LWESI) Transmission Project (Project) was developed to assess the environmental effects of the project on aquatic resources. Information on the existing aquatic environment was obtained and compiled from published and grey literature, through field studies, and by conducting Aboriginal Traditional Knowledge workshops. One aquatic Valued Environmental Component (fish habitat) was selected for the aquatic environment, and project interactions with fish habitat were assessed. Fish habitat includes both the physical habitat (represented by water depth and velocity) and water quality (represented by pH, dissolved oxygen, total suspended solids and turbidity). Three Alternative Routes of the Pine Falls-Manigotagan 115 kV Transmission Line (Line PQ95) were initially evaluated, based on number criteria, and a single Preferred Route was identified. Subsequently, further public input received through the LWESI Public Engagement Program, resulted in a Final Preferred Route being identified and selected. The Project also includes the development of the Manigotagan Corner Station Site and additions to the Pine Falls Generating Station Switchyard (Switchyard).

The Final Preferred Route of the transmission line crosses a total of 19 watercourses, including 10 natural watercourses (creeks, rivers, beaver ponds) and nine man-made (anthropogenic) water features (highway drainage channels and water-filled borrow pits/quarries). Only four of the watercourse crossing locations contain important fish habitat and there are no known aquatic species at risk (invertebrates or fish) at or near the crossing locations. The construction and operation/maintenance of overhead transmission lines poses a low risk to fish habitat. When considering all Project activities associated with the transmission line, the effects assessment identified the loss of riparian vegetation (through initial right-of-way clearing and from subsequent vegetation management), as a Project effect, potentially leading to erosion and sedimentation at right-of-way water crossing locations. However, with application of proper mitigation measures, residual effects are expected to be negligible. Accidental release of deleterious substances (e.g., fuels, oils, hydraulic fluids) to watercourses, also a potential Project effect, will be mitigated through appropriate spill prevention techniques. No Project interactions with the aquatic environment are anticipated with the construction and operation of the Manigotagan Corner Station Site and the Switchyard.

Residual effects are expected to be negligible and the interaction of the Project with other existing or future projects will result in residual effects that are not measurable.

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^{o}C	degrees Celsius
%	percent
<	less than
>	greater than
µg/L	micrograms per litre
ASA	Aquatic Study Area
ATK	Aboriginal Traditional Knowledge
cm	centimetres
COSEWIC	Committee on the Status of Endangered Wildlife in Canada
DFO	Fisheries and Oceans Canada
DOC	dissolved organic carbon
EA	Environmental Assessment
GIS	Geographic Information System
GIS	Geographic Information System
GPS	Global Positioning System
HADD	Harmful Alteration, Disruption or Destruction
km	kilometre
km^2	square kilometre
kV	kiloVolt
Line PQ95	Pine Falls–Manigotagan 115 kV Transmission Line
LWESI	Lake Winnipeg East System Improvement
m	metre
m/s	metres per second
m^3/s	cubic metres per second
MBCDC	Manitoba Conservation Data Centre
MBESA	*The Endangered Species Act*
MCWS	Manitoba Conservation and Water Stewardship
mg/L	milligrams per litre
NTU	nephelometric turbidity units
PEP	Public Engagement Program
PR	Provincial Road
ROW	right-of-way
SARA	*Species at Risk Act*
SSEA	Site Selection and Environmental Assessment
Switchyard	Pine Falls Generating Station Switchyard
the Project	Lake Winnipeg East System Improvement Transmission Project

TSS	total suspended solids
VEC	Valued Environmental Component

1 INTRODUCTION

1.1 Project Overview

The Lake Winnipeg East System Improvement (LWESI) Transmission Project (the Project) is required to provide system upgrades in the region east of Lake Winnipeg. The Project will serve existing and new load growth, and provide firm transformation and adequate voltage support for the communities located in and around the region. It is expected that this new development will meet the electrical requirements for at least the next 20 years.

The Project includes the construction of a new 115 kiloVolt (kV) transmission line from Powerview-Pine Falls, Manitoba to Manigotagan (Pine Falls–Manigotagan 115 kV Transmission Line [Line PQ95]), approximately 75 kilometres (km) north of Powerview-Pine Falls. The Project will require the development of a new 115-66 kV transmission station (Manigotagan Corner Station) west of the intersection of Provincial Road (PR) #304 and the Rice River Road, near the community of Manigotagan. This station will serve as the terminal for the new Line PQ95 as well as the existing 66 kV sub-transmission lines in the Manigotagan area.

This technical report supports the Environmental Assessment (EA) Report to meet the licensing requirements of the *Manitoba Environment Act* for a Class II Licence for this project.

1.2 Report Purpose and Outline

This report provides a description of the existing aquatic environment in the Aquatic Study Area (ASA) and also at the locations of proposed water crossings of the Preferred Route of Line PQ95 for the Project. Information on the existing aquatic environment was compiled from a review of existing literature and data, field data collection and local and Aboriginal Traditional Knowledge (ATK). Fish habitat, defined in terms of physical habitat and water quality, was identified as a Valued Environmental Component (VEC). Three alternative transmission line routes were assessed for their potential effects on aquatic ecosystems (as well as other environmental, social and economic considerations by other Project discipline leads) and a single, Preferred Route was selected that strived to balance environmental, social, economic and technical considerations. Subsequently, minor alterations to the routing of the Preferred Route, based in part on input received through the Public Engagement Program (PEP) for the Project, resulted in the selection of a Final Preferred Route. As part of the EA, the effects of all Project components on the aquatic environment were identified and assessed for construction and operation phases of the project, and mitigation measures developed. Residual effects following the application of mitigation measures, as well as the interaction of the Project with other existing and planned projects in the region, were identified. Finally, aquatic monitoring during the construction and operation phases is outlined.

The Aquatics Technical Report is organized into nine Sections, as follows:

- **Section 1** provides an overview of the project and the purpose and outline of the Project.
- **Section 2** describes the ASA and watercourse crossings.
- **Section 3** provides a description of the methods for data collection and analyses, including desktop and field studies, identification of VECs and acquisition of ATK.
- **Section 4** provides a detailed description of the existing aquatic environment in the ASA and at the water crossing locations of the Preferred Route, as well as a description of the VEC.
- **Section 5** provides an evaluation of the alternative routes and infrastructures on aquatic ecosystems.
- **Section 6** identifies and assesses the effects of the Project, for both construction and operation phases, on aquatic ecosystems, and identifies mitigation measures to reduce or eliminate project effects. Residual effects are also identifies, as are interactions with other existing and proposed projects in the Project Study Area. Monitoring and follow up is also identified.
- **Section 7** provides conclusions.
- **Section 8** provides references, including literature cited and personal communications.
- **Section 9** provides a glossary of terms.

2 AQUATIC STUDY AREA AND WATERCOURSE CROSSINGS

Two spatial scales were used to compile information on the existing aquatic environment. The ASA included the major and minor watersheds in the region, while field data collection provided detailed information for selected water crossing locations of the Preferred transmission line route.

2.1 General Regional Area Description

The Project Study Area includes an area of approximately 2,112 square kilometres (km^2) and extends from south of the Community of Powerview-Pine Falls, north to the Community of Manigotagan, and from the eastern boundary of Lake Winnipeg, to approximately 10 km east of PR #304. The Project Study Area was chosen to be of sufficient size to assess any potential Project effects on biophysical and socio-economic components.

2.2 Aquatic Study Area

For the purposes of the aquatic assessment, the ASA was defined as the area from the Ontario border to the eastern shores of Lake Winnipeg, and from the Winnipeg River in the south to the Wanipigow River in the north. The ASA is located in the Boreal Shield Ecozone (Smith et al. 1998), the largest ecozone in Canada. Much of the land in the area is forested, with vegetation communities of softwood tree species (jack pine, black and white spruce, tamarack, balsam, fir), hardwood tree species (trembling aspen, balsam poplar, ash) and mixedwood forests. Only the southern part of the ASA includes agricultural land use. Incorporated communities within approximately 25 km of the Project infrastructure (e.g., transmission line, transmission stations) are Powerview-Pine Falls, St. Georges, Bisset, and the Métis communities of Manigotagan, Seymourville and Aghaming. First Nation communities include Sagkeeng, Black River and Hollow Water.

The ASA for the aquatics description includes six major river watersheds in eastern Manitoba. The major river systems (from south to north) include the Winnipeg, O'Hanly, Black, Sandy, Manigotagan and Wanipigow rivers. In addition, Pine Creek (a minor watershed of the Winnipeg River), and Duncan Creek (a minor watershed of the Manigotagan River) are also located in the ASA. The headwaters of the Winnipeg River, Manigotagan River and Wanipigow River watersheds originate in northwestern Ontario. The Winnipeg River watershed is the largest in the ASA, with an area of over 100,000 km^2. The headwaters of the remaining rivers and creeks originate west of the Ontario border. The watercourses generally flow in a westerly direction and all drain into Lake Winnipeg.

2.3 Watercourse Crossings of the Preferred Route

The Final Preferred Route crosses several types of waterbodies, including natural waterbodies (rivers and small creeks, and beaver floods), as well as anthropogenic water features (old borrow pits now filled with water and linear drainage channels developed as part of the construction of PR #304 in the 1950s).

3 METHODS

3.1 Data Collection and Analysis

3.1.1 Desktop Studies

Desktop studies included a review of available literature for the ASA as well as literature and reports evaluating the effects of other transmission line development projects on aquatic ecosystems. Published materials and grey literature (technical and study reports, graduate student theses, government documents) as well as unpublished data were reviewed for information on hydrology, water quality, lower trophic levels, fish and fish habitat, aquatic invasive species, aquatic species at risk (Special Concern, Threatened, Endangered species) and provincially and regionally rare fish species (S1 and S2 species as defined by the Manitoba Conservation Data Centre [MBCDC]).

Mapping was also undertaken to identify and evaluate water crossing sites for the 3 Alternative Routes and the Preferred Route. The National Hydro Network, which provides geospatial vector data for hydrographic features such as lakes, reservoirs, rivers, streams and linear drainage networks, was used as a base layer for identifying water crossing sites. In addition, information from the National Hydro Network was supplemented with digital imagery from ArcGIS Online and Google Earth. Watersheds in the project region were identified based on boundaries originally delineated by the Prairie Farm Rehabilitation Association, and further refined in 2006 by Tembec Inc. to define smaller, sub-watersheds for forest management planning purposes.

Riparian vegetation community composition at water crossing locations, as well as 100 metres (m) upstream and downstream of crossing locations of the Preferred Route was assessed. This was conducted for each bank (shore) of the watercourses through Geographic Information System (GIS)-based analysis for four of the water crossing locations for natural water features (e.g., creeks, beaver flood) for which field surveys were not conducted (due to inaccessibility of the sites) as well as nine other water crossings on man-made water features (seven highway drainage channels perpendicular to PR #304 and two water-filled borrow pits adjacent to PR #304). Stand type and species composition was determined for GIS polygons within 50 m of the water using ArcExplorer 2.3.2 and the 1997 Forest Resource Inventory. Additionally, a similar riparian vegetation community analysis was conducted for watercourses that were located within 50 m of the Final Preferred Route (but not crossed by the transmission line). This latter analysis was conducted to account for riparian vegetation that could potentially be affected within the 60 m transmission line right-of-way (ROW).

3.1.2 Field Studies

Field studies were conducted from September 17 to 19, 2012, at water crossings of the Preferred Route on six natural watercourses. This included a tributary of Pine Creek, O'Hanly

River, Black River, Sandy River, Duncan Creek and Manigotagan River. As mentioned in Section 3.1.1 of this report, field assessments were not conducted on crossing locations of four natural watercourses (small creeks and a beaver flood) due to inaccessibility of the sites. Aquatic field studies were not required at the proposed Manigotagan Corner Station Site, as this facility is located more than 1.8 km from the nearest waterbody (Wanipigow River). Aquatic field studies were also not conducted at the existing Pine Falls Generating Station Switchyard (Switchyard), as all proposed modifications would not extend beyond the current industrial site, and the site is completely surrounded by an earthen berm. However, the environmental effects assessment for aquatic resources does include all project infrastructure (transmission line and watercourse crossings, Manigotagan Corner Station Site and Switchyard), construction activities and operations.

3.1.2.1 Habitat Assessment

The habitat assessment included both in-stream fish habitat, as well as the riparian vegetation community at each site. Fish habitat is broadly comprised of two main components: physical habitat such as substrate, in-stream cover, water depth and flow, and the chemical environment (including pH, dissolved oxygen, total suspended solids [TSS], turbidity). The riparian vegetation assessment was conducted to provide site-specific information necessary for developing mitigation measures related to, among other activities, ROW vegetation clearing close to waterbodies. Characterization of the watercourses, including in-stream fish habitat attributes and riparian vegetation occurred at two spatial scales. General characteristics of the watercourse were recorded for the entire reach of the watercourse (i.e., from 100 m downstream to 100 m upstream of the crossing location) and detailed information was collected on each shore at the Preferred Route centre line crossing location as well as 100 m downstream and 100 m upstream of the crossing location. Field data collected included:

General Characterization of Water Course

- Water Course Type – lake, river, stream/creek, beaver pond, drainage channel, borrow pit.
- Flow Regime - the permanence of water flow/presence, classified as:
  - Perennial (PER): containing water/flow at all times of the year;
  - Intermittent (INT): containing water/flow for most of the year, but where flow may cease seasonally or occasionally; and
  - Ephemeral (EPH): flow or water level is highly dependent on precipitation events (snow melt or rainfall) and the channel can be dry periodically.
- Stage- water level in relation to bankfull level, classified as:
  - Low (less than [<]30 percent [%] of bankfull level);
  - Moderate (30 to 90% of bankfull level);
  - High (90 to 100% of bankfull level); and
  - Flood (greater than [>]100% of bankfull level).

Detailed Characterization at Water Crossing (Centre Line) Location

- GPS Location (decimal degrees, and accuracy [±m]), measured with a Garmin Global Positioning System (GPS) map 60Cx;
- Wetted Width (m) – distance from water's edge to water's edge, measured with a Bushnell Sport 803 Rangefinder;
- Bankfull Width (m) – wetted width at normal high water mark, measured with a tape measure;
- Floodplain Width (m) – width of a noticeable flood plain beyond normal high water mark, measured with a tape measure;
- Bank Slope (degrees) - bank slope angle, measured with a Sunto PM-5/360PC clinometer; and
- Bank Stability – visually assessed along a shoreline transect in 60 m ROW, classified as:
  - High: bank well vegetated, or comprised of bedrock or boulders. Erosion unlikely under unfrozen soil conditions;
  - Moderate: >50% of bank well vegetated or comprised of bedrock or boulders. Erosion risk low under unfrozen soil conditions;
  - Low: <50% of bank vegetated or comprised of bedrock or boulders. Erosion risk moderate under unfrozen soil conditions. Evidence of exposed soil or erosion; and
  - Unstable: evidence of bank slumping.
- Water Depth (m) - water depth at half of wetted width (i.e., mid-point) in the watercourse, measured with a weighted line;
- Water Temperature (degrees Celsius [^{o}C]) – taken at the surface of the water (upper 10 centimetres [cm] of water column) at the mid-point of the watercourse, measured with a Hanna Checktemp 1 digital thermometer. The meter was calibrated daily; and
- Dissolved Oxygen (milligrams per litre [mg/L]) – measured at the surface of the water (upper 10 centimetres [cm] of water column) at the mid-point of the watercourse, measured with a Milwaukee MW600 Portable Dissolved Oxygen Meter. The meter was calibrated daily. Measurements were subsequently corrected for water temperature and altitude.
- In-stream Habitat Cover – presence/absence of various habitat covers for the 60 m ROW at the crossing location, classified as:
  - Large Woody Debris (LWD): trees lying in the water;
  - Overhanging canopy (OC): trees and shrubs overhanging the water, providing shade. Identified to species;
  - Aquatic Macrophytes (AM): aquatic and emergent plants;
  - Boulders (BOULD);
  - Shallow Rapids (SR);
  - Undercut Banks (UB);

- Beaver House (BH);
- Beaver Dam (BD); and
- Other.

- Riparian Vegetation Assessment – A 20 m wide quadrat, perpendicular to the shore, and extending 50 m inland from the water's edge. Vegetation community type and% cover (defined below), as well as distance from water, was recorded for every major change in vegetation community type and/or change in% cover class from the water's edge to 50 m inland;
  - Vegetation Community Types: sedge/grass (S/G), shrub (SH), conifer forest (CF), hardwood forest (HF), mixedwood forest (MF), agriculture (AGR). Dominant species were identified for shrub, conifer, hardwood and mixedwood forests;
  - % Cover Class:% ground cover for sedge/grass,% canopy closure for shrub and forest community types. Classified as 0% to 25%, 25% to 50%, 50% to 75% and 75% to100%;
- Photos – photographs were taken (as well as GPS coordinates) for the following locations:
  - Centreline looking upstream;
  - Centreline looking downstream;
  - Downstream end of ROW, looking upstream; and
  - Upstream end of ROW, looking downstream.

Detailed Characterization at 100 m Downstream and 100 m Upstream of Centre Line Location

The following assessments were undertaken at locations 100 m downstream and 100 m upstream of the centre line crossing location on each shore, to provide additional information that may be needed to make minor adjustments to the transmission line crossing alignment.

- GPS location;
- wetted width;
- bankfull width;
- floodplain width;
- bank slope;
- bank stability;
- water depth;
- in-stream habitat cover;
- riparian vegetation assessment; and
- photos;

- At 100 m downstream of centreline crossing, looking upstream;
- At 100 m upstream of centreline crossing, looking downstream.

3.1.2.2 Water Quality Sample Collection and Laboratory Analysis

In order to better define water quality and fish habitat, a single water sample was collected in the middle of each watercourse at the crossing point of the Preferred Route. Water samples were collected from the surface (upper 10 centimetres [cm] of the water column) and stored in a cooler. Samples were delivered to ALS Environmental Group (Winnipeg) and analyzed for pH, TSS and turbidity.

3.1.2.3 Water Velocity and Discharge

Ideally, water velocity (expressed as metres per second [m/s]) would be measured and discharge (expressed as cubic meters per second [m^3/s]) calculated at the transmission line water crossing location. At all water crossing sites visited during the field work, water depth was too great to safely allow *in situ* measurements of water velocity (as the methodology involves a person wading across the water course to take measurements). However, water velocity measurements (and discharge calculations) were made for some of the watercourses (O'Hanly River, O'Hanly Mid-tributary, Kapukwaywetewunk Creek, Black River and Duncan Creek) at the point where these watercourses cross PR #304. Although the water velocities measured at these locations would be expected to be higher than at the crossing sites (due to restriction in the channel width at the culverts or under bridges at PR #304), the resulting discharge calculations would not be expected to differ substantially from that calculated from the water crossing locations of the preliminary proposed route due to 1) the relatively short distance (less than 1 km) of all water crossings of the Preferred Route to PR #304, and 2) the lack of additional water courses entering the river or creek under consideration between the proposed water crossings and PR #304. Water velocity and discharge could not be measured in the Sandy and Manigotagan rivers, even at PR #304, due to the excessive water depth.

For those watercourses noted above where water velocity could be safely measured, the following methods were used. Water depth was measured every 2 m across the wetted width in the O'Hanly and Black rivers (every 0.50 m in the other, small water courses), as was water velocity at 60% of the water depth at each location across the transect. Water velocity was measured using an AquaSensa RC-2 water velocity meter, equipped with an electromagnetic RV4 mini probe. Water discharge was calculated between each measurement location (segment) from the water depth and velocity measurements, and summed across the watercourse to give a total discharge value.

3.2 Valued Environmental Component Selection

The EA was focused on VECs, which are aspects of the natural and socio-economic environment that are particularly notable or valued because of their ecological, scientific, resource, socio-economic, cultural, health, aesthetic, or spiritual importance. To be considered as a VEC, a component must have the potential to be adversely affected by project development or have the potential to have an effect on the Project.

A workshop was held with discipline experts to select VECs for the Project, which met one or more of the following criteria:

- identified regulatory requirements;
- consultation with regulatory authorities;
- information derived from published and unpublished date sources;
- information and comment received during the engagement of local communities;
- feedback through the PEP; and
- biophysical and heritage assessment field surveys.

A preliminary list of VECs was proposed, and revised throughout the EA process, which balanced biophysical and socio-economic components, and represented both potential positive and negative effects of the Project.

One VEC was selected for the aquatic environment: fish habitat. Fish habitat is comprised of both physical habitat, as well as the chemical (i.e., water quality) environment. Physical habitat for fish can be defined by a number of biophysical parameters, including hydrology (depth, velocity and discharge), substrate, in-stream cover and parts of the aquatic food web, such as benthic macroinvertebrates. Water quality parameters important to fish habitat include water temperature, dissolved oxygen, pH, suspended solids and turbidity. Legislation, in particular, the federal *Fisheries Act* was an important determinant in the selection of fish habitat as a VEC. The *Fisheries Act* (section 35.1) prohibits the Harmful Alteration, Disruption or Destruction (HADD) of fish habitat. Additionally, provincial guidelines exist for surface water quality as it relates to the protection of aquatic life (Manitoba Water Stewardship 2011).

For the Project, measurable parameters that were used to determine potential project effects on fish habitat were:

- Physical habitat;
  - Water depth (m); and
  - Water velocity (metres per second [m/s]).
- Water Quality;
  - pH (pH units);
  - dissolved oxygen (mg/L and% saturation);

- TSS (mg/L); and
- turbidity (nephelometric turbidity units – NTU).

3.3 Aboriginal Traditional Knowledge

An ATK study was undertaken to provide relevant information on local knowledge and land use that were absent from the Project Study Area data record. Data on ATK was gathered during five workshops that were held in the communities of Hollow Water, Manigotagan, Black River, and Seymourville. Workshops were guided by a series of questions provided by discipline leads. Information was summarized in a series of map biographies on traditional and current land use practices, and interview summaries, and land use maps. Relevant information was integrated into the technical reports which support the EA Report.

With respect to the aquatic environment assessment, the following questions were provided to the workshop facilitators:

- Are there fish spawning areas at or near the proposed water crossing locations for the Alternative Routes?
- Where do you fish? What species of fish do you catch?
- Can you identify place names of waterbodies (rivers, lakes) in Ojibway?

Based on the ATK workshops, spatial information on fish stocking locations, spawning locations and species of fish caught by local First Nations was collected. This information provided site-specific data, which was used to describe the existing aquatic environment (Section 4) and in the effects assessment (Section 6) in this report.

4 EXISTING ENVIRONMENT

The description of the existing aquatic environment is based on information obtained from published and unpublished literature and reports, existing raw data sets, field and GIS-based study, as well as ATK. The existing environment is described at two spatial scales:

- ASA – the area from the Winnipeg River in the south to the Wanipigow River in the north, and from the eastern shore of Lake Winnipeg in the west to the Ontario border in the east.
- Water crossing locations – from 100 m downstream of the alternative and Preferred Route crossings to 100 m upstream, as well as where some of the watercourses cross at PR #304.

The existing environment is described in terms of watersheds and watercourses (rivers, creeks), hydrology (velocity and discharge), surface water quality, lower trophic levels in the aquatic food web, fish species and distribution, aquatic species at risk, fish habitat, aquatic invasive species and VECs. Aboriginal Traditional Knowledge, obtained through ATK workshops, is included in the various descriptions of the existing environment.

A modification to the routing of the Preferred Route, as part of the final stages of selecting the Final Preferred Route, resulted in the avoidance of one watercourse crossing (on a tributary of Pine Creek), immediately north of Powerview-Pine Falls. For completeness, a description of this crossing is included in this report, as the crossing was assessed prior to the selection of the Final Preferred Route.

4.1 Desktop Studies and Literature Review

4.1.1 General Description of Aquatic Study Area

The ASA is approximately 18,000 km^2 in size, and is located in the Boreal Shield Ecozone, the largest ecozone in Canada (Smith et al. 1998). The ecozone covers much of the eastern part of the province, and is characterized by gently rolling uplands and lowlands. The surface geology consists of granite outcrops, moraines, and glaciofluvial deposits. The ecozone has a continental climate, with warm, relatively short summers, and cold, snowy winters. The ecozone in the ASA can also be further divided into the Lac Suel Upland Ecoregion (which covers most of the area north of the Winnipeg River) and the Lake of the Woods Ecoregion (covering only a small portion of the Study Area along the north shore of the Winnipeg River and the land area extending south from the Winnipeg River to the United States border in the southeast corner of the province) (Smith et al. 1998).

The ASA is largely forested, consisting mainly of Crown Land. Uplands are dominated by coniferous and deciduous forests of jack pine, black and white spruce, balsam fir, and poplar (trembling aspen, balsam poplar), while lowlands are dominated by species such as black spruce and tamarack, and occasionally green and black ash and American elm. Agriculture is only present in the extreme southern part of the ASA, along the north shore of the Winnipeg River. Other land uses in the ASA include mining, forestry (currently not operating), hydroelectric generating stations and transmission and distribution lines, all weather roads, commercial fishing, trapping, traditional resource use, recreation and tourism. Incorporated communities within approximately 25 km of the project infrastructure include Powerview-Pine Falls, St. Georges, Bisset and Métis communities of Manigotagan, Aghaming and Seymourville. First Nation communities include Sagkeeng, Black River and Hollow Water.

4.1.1.1 Watersheds and Water Courses

The ASA includes portions of two major watersheds (basins): the Winnipeg River and Lake Winnipeg watersheds. At a smaller watershed scale, the ASA includes portions of 6 main river watersheds (Map 1). These are, from south to north, the Winnipeg River, O’Hanly River, Black River, Sandy River, Manigotagan River and Wanipigow River. The watersheds flow in a generally westward direction, emptying into Lake Winnipeg. In addition, two smaller watercourses, Duncan Creek and an un-named tributary of Pine Creek, are also located in the ASA, and would be crossed by the Alternative Routes and the Preferred Route. Duncan Creek flows into the Manigotagan River and the un-named tributary of Pine Creek flows into the Winnipeg River (via Pine Creek). Finally, O’Hanly Mid-tributary and Kapukwaywetewunk Creek, located between the O’Hanly and Black rivers, would be crossed by Alternative Routes A and C and the Preferred Route. The six main river watersheds range in size from 335 km^2 (O’Hanly River) to over 100,000 km^2 (Winnipeg River) (Table 4-1).

Table 4-1 Watershed size in the Aquatic Study Area

Watershed	Area (km^2)[a]
Wanipigow River	1,929
Manigotagan River	1,102
Sandy River	346
Black River	740
O’Hanly River	345
Winnipeg River	126,400

a) watershed area in Manitoba only, except Winnipeg River
Source: Kotak, unpublished data, North/South Consultants Inc. 2006.

4.1.1.2 Hydrology

Discharge in the rivers and creeks of the ASA is highly variable between months and between years, depending on factors such as frequency and intensity of individual precipitation events (hence, weather) and longer-term climatic trends. Differences in discharge patterns also exist between the watercourses in the ASA depending on whether the river is regulated (such as the Winnipeg River, which has six hydroelectric generating stations in Manitoba) or non-regulated. For the natural watercourses, the ability to store water (partially a function of the amount and type of peatlands found in the watershed) also influences seasonal flow patterns. In non-regulated rivers and creeks, peak flows usually occur in spring, typically in May, and decreases significantly throughout the summer (except after intense rain events). Low flow periods generally occur during the winter, from December to March. In the Winnipeg River, peak flows are more protracted, lasting from spring to several months later in the summer.

Continuous discharge monitoring of watercourses in the ASA is generally lacking, with the exception of the Winnipeg River (1911 to present), Manigotagan River (1913 to 1996) and the Black River (1960 to 1992). Manitoba Hydro monitors the Winnipeg River, and Water Survey of Canada monitored the latter two rivers. Monitoring of the latter two stations has been discontinued. The Manitoba Model Forest conducted a water quality and hydrology monitoring program on a few of the rivers and creeks in the Study Area from 2004 to 2009, although discharge on the larger rivers (Wanipigow, Manigotagan and Sandy) was not measured (Kotak et al. 2005; Kotak and Selinger 2006; Miette Environmental Consulting Inc. 2008).

Discharge varies considerably between watercourses in the ASA, depending on the size of the watercourse (e.g., rivers versus creeks) and the size of its associated watershed. To facilitate comparison between watercourses, Table 4-2 provides minimum, maximum and mean discharge data for a standardized period of May to September. The Winnipeg River has the largest discharge, followed by the Manigotagan and Black rivers (Table 4-2), with mean summer discharges of 1207, 13.86 and 5.24 m^3/s, respectively (based on Water Survey of Canada data). Discharge of the Sandy River, for which no data is available, would likely fall between the values for the Manigotagan and Black Rivers. In small creeks such as the O'Hanly Mid-tributary and Kapukwaywetewunk Creek, discharge is typically less than 0.25 m^3/s, and occasionally these watercourses have no flow (although they still contain water). Water flow in these creeks can be highly influenced by beaver activity (Kotak and Selinger 2006). In dry years, flow in the O'Hanly River can cease, creating dry reaches of the river at locations of rapids (Kotak, personal observation).

Table 4-2 Discharge for Selected Watercourses in the Aquatic Study Area (May to September)

Water Course	Year	Min (m^3/s)	Max (m^3/s)	Mean (m^3/s)
Manigotagan River[b]	1913 to 1996	1.35	44.28	13.86
Duncan Creek[a]	2004	0.21	0.54	0.31
	2006	0.003	0.25	0.17
Black River[a, b]	1960 to 1992	0.26	17.46	5.24
	2004	1.21	5.14	3.18
Kapukwaywetewunk Creek[a]	2004	0.05	0.25	0.15
	2006	0.001	0.21	0.07
O'Hanly Mid-tributary[a]	2004	0.06	0.22	0.15
	2006	0.001	0.08	0.03
O'Hanly River[a]	2004	0.22	3.99	2.23
	2006	0.002	2.03	0.57
	2007	0.12	1.29	0.71
	2008	1.62	3.14	2.12
	2009	1.97	13.17	5.40
Winnipeg River (at Pine Falls Generating Station)[b]	2010	658	1540	1207

Source

a) Kotak et al. 2005, Miette Environmental Consulting Inc. 2008, Kotak, unpublished data.

b) Environment Canada 2012

Min = minimum; Max = maximum; m^3/s = cubic metres per second

Lakes are also a common water feature in the ASA, but only in the eastern two-thirds of the area. Lakes are absent from the area west of PR #304 to the shore of Lake Winnipeg. Popular lakes for recreation, and which generally form part of river systems, include Wanipigow, Quesnel, Manigotagan, Happy, Long, Wallace, Beresford, Garner, Gem, Tooth, Flintstone, Black, Shoe and Bird lakes, among others. Water level data for these lakes is generally lacking. An inventory of lakes for the Manitoba Model Forest area (larger than the ASA) can be found in Ramsey and Kruszynski (1993).

4.1.1.3 Surface Water Quality

Recent surface water quality data is available for the main rivers (O'Hanly, Black, Sandy, Manigotagan and Wanipigow) in the ASA, and also for sampling sites close to crossing locations of the Alternative Routes and Preferred Route. In addition, recent surface water quality data is available for two of the creeks (O'Hanly Mid-tributary and Kapukwaywetewunk Creek) from sampling sites located close to the proposed watercourse crossings of the Alternative and Preferred Routes. This data was collected as part of a regional water quality study on rivers and creeks by the Manitoba Model Forest from 2004 to 2009.

Surface water quality is variable between the rivers and creeks, and is highly influenced by watershed features (soil and forest types, extent of peatlands), disturbance history (forest fires, timber harvest) and beaver activity (on small rivers and creeks)(Kotak et al., 2005). Water quality can be described by several parameters, with some having direct applicability to fish habitat. Water quality is discussed in general terms in this section, and more specifically as it relates to fish habitat, in Section 4.1.1.7 of this report. Some of the more common water quality parameters are found in Table 4-3 for rivers and creeks in proximity to the Alternative and Preferred Routes during open water periods (May to September). Information on water quality in winter is also available for some of the watercourses, and is discussed later.

The pH (degree of acidity) of the water in the watercourses ranges from slightly acidic to slightly basic (Table 4-3). The level of acidity is largely dictated by soil type and the proportion of peatlands and organic soils in these watersheds (Kotak et al. 2005). Watercourses such as the O'Hanly River, O'Hanly Mid-tributary and Kapukwaywetewunk Creek are slightly acidic due to a high proportion of organic soils and peatlands in their watersheds. Water is slightly basic in Sandy River, Duncan Creek, Manigotagan River and Wanipigow River due to a higher proportion of mineral soils and fewer peatlands in their watersheds.

Phosphorus is a key nutrient that is essential for the growth of algae and macrophytes (higher plants) in aquatic ecosystems. It is commonly the most limiting plant nutrient in Canadian lakes and rivers (Schindler 1971). As is the case for pH, total phosphorus concentration is a reflection of soil type in these watersheds (Kotak et al. 2005). In addition, phosphorus concentration is also related to the disturbance history in the watersheds. Duncan Creek, Sandy River, Kapukwaywetewunk Creek, O'Hanly Mid-tributary and the O'Hanly River have total phosphorus concentrations between 80 and 250 micrograms per litre (µg/L) (Table 4-3), while total phosphorus concentrations in the Black, Manigotagan and Wanipigow rivers is much lower. Higher total phosphorus concentrations in the former watercourses are likely due to significant fire and timber harvesting disturbance histories in their watersheds over the last 60 years (Kotak et al. 2005). In addition, beaver activity in the smaller watersheds (e.g., Duncan Creek, O'Hanly Mid-tributary and Kapukwaywetewunk Creek) naturally elevates phosphorus concentrations through back flooding of soils, stagnation of water flow and a resulting leaching of nutrients such as phosphorus into the water column from riparian soils.

Table 4-3 Water Quality in Selected Watercourses in the Aquatic Study Area (May to September)

Water Course And Year	pH	Conductivity (µS/cm)	Total Phosphorus (µg/L)	Dissolved Organic Carbon (mg/L)	Turbidity (NTU)	Dissolved Oxygen (mg/L)	Dissolved Oxygen (% Saturation)
Wanipigow River							
2004 to 2009	7.65	76.6	44.9	23.9	11.1	9.51	100.8
Manigotagan River							
2004 to 2009	7.50	67.8	32.6	18.1	5.9	9.14	95.4
Duncan Creek							
2004 to 2006	7.45	178.8	95.3	40.9	5.4	4.92	48.1
Sandy River							
2004 to 2005	7.33	113.1	86.2	42.4	15.2	6.33	67.5
Black River							
2004 to 2009	6.97	48.3	48.4	35.7	11.4	8.19	82.2
Kapukwaywetewunk Creek							
2004, 2006	6.91	77.4	81.9	60.9	17.9	5.99	61.1
O'Hanly Mid-tributary							
2004, 2006	6.49	96.4	250.7	72.2	7.5	5.24	51.9
O'Hanly River							
2004 to 2009	6.82	51.0	108.6	46.6	44.7	7.66	78.7

Source: Kotak et al., 2005, Miette Environmental Consulting Inc, 2008, Kotak, unpublished data.
µS/cm = microSiemens per centimeter; µg//L = micrograms per litre; mg/L = milligrams per litre; % = percent

Dissolved organic carbon (DOC) is a measure of water colour and waterbodies located in the Canadian Shield tend to have some degree of brown color. The Manigotagan River has the least color (average of 18.1 mg/L of DOC – Table 4-3), while waters in Kapukwaywetewunk Creek and the O'Hanly Mid-tributary are stained dark brown (DOC of 60.9 and 72.2 mg/L, respectively – Table 4-3). Water colour in rivers and creeks in the Canadian Shield can be attributed to humic and fulvic acids, originating from peatlands (bogs and fens). Dissolved organic carbon concentrations in rivers and creeks are a result of a complex interaction of soil type, disturbance history (fire, timber harvest) and beaver activities in watersheds in the region (Kotak et al. 2005; Kotak and Selinger 2006).

Turbidity, measured in NTU, is a measure of water clarity. Most of the watercourses in the ASA can be considered as having relatively clear water (turbidity of less than 10 NTU – Table 4-3). One exception to this is the O'Hanly River. The higher water turbidity (44.7 NTU – Table 4-3) of the O'Hanly River is likely due to significant beaver activity upstream of PR #304, particularly along the banks of the river in areas with mineral (clay-based) soils. This was studied by Kotak and Selinger (2006), who assessed factors affecting the spatial variation in water quality along the length of the O'Hanly, Black and Manigotagan rivers from the Ontario border to Lake Winnipeg.

Dissolved oxygen can have a significant influence on the types and abundance of aquatic organisms (e.g., macroinvertebrates, fish) inhabiting a waterbody, as well as controlling the dynamics of several other water quality variables. Dissolved oxygen can be produced within a waterbody through the process of photosynthesis by plants (algae, aquatic macrophytes) and by turbulent aeration (rapids in flowing water, wave action in lakes). The larger river systems (e.g., Wanipigow, Manigotagan) generally contain dissolved oxygen concentrations at, or near saturation (Table 4-3). Smaller water courses, such as Duncan Creek, O'Hanly Mid-tributary and Kapukwaywetewunk Creek, can have oxygen concentrations that are significantly below saturation (Table 4-3) during the May to September period. These low oxygen concentrations are likely due to low flow (stagnant water caused by beaver dams), lack of shallow rapids, and decomposition of organic bottom sediments (Kotak et al. 2005). Dissolved oxygen concentrations in Duncan Creek and the O'Hanly Mid-tributary can drop below 25% saturation (approximately 2.0 to 2.5 mg/L) during the summer months (Kotak, unpublished data).

For larger watercourses (e.g., Wanipigow, Manigotagan and Black River), water quality characteristics such as dissolved oxygen and total phosphorus concentrations in winter are similar to the summer (Tables 4-4, 4-3). However, under ice concentrations of oxygen tend to be lower in smaller rivers such as the Sandy and O'Hanly, and significantly lower in creeks, such as Duncan Creek (Table 4-4). Lack of flow in winter and decomposition of organic matter likely resulted in very low dissolved oxygen concentrations and saturation levels (e.g., 2.09 mg/L and 15%, respectively - Table 4-4) in Duncan Creek by the end of winter (before ice break up). Smaller creeks such as the O'Hanly Mid-tributary and Kapukwaywetewunk Creek are frozen to the bottom (Kotak, unpublished data). Kotak et al. (2005) found that even deeper (>4m) beaver ponds can almost become anoxic (i.e., lack dissolved oxygen) by the end of the winter.

Significant declines in dissolved oxygen can also have a substantial influence on other water parameters, including phosphorus (Wetzel 1983). This is evident in under ice phosphorus concentrations in smaller rivers (e.g. Sandy) and especially in smaller creeks (Duncan Creek) (Table 4-4). In the case of Duncan Creek, total phosphorus concentrations increased from an average of 89 µg/L from May to September of 2004, to an average of 312 µg/L during the following winter, a 3.5 fold increase. Thus, water quality in the winter can be substantially different than in open water periods, particularly for small watercourses in the ASA.

Table 4-4 Water Quality in Selected Watercourses in the Aquatic Study Area (January to March)

Water Course And Year	Total Phosphorus (µg/L)	Dissolved Oxygen (mg/L)	Dissolved Oxygen (% saturation)
Wanipigow River			
2004	46.5	ND	ND
2005	38.5	13.31	103.5
Manigotagan River			
2004	31.0	ND	ND
2005	30.5	13.48	101.0
Duncan Creek			
2005	311.5	2.09	15.0
Sandy River			
2004	165.5	ND	ND
2005	116.5	9.50	66.5
Black River			
2004	45.0	ND	ND
2005	47.5	13.16	91.5
O'Hanly River			
2004	82.0	ND	ND
2005	79.5	10.53	74.5

Source: Kotak et al., 2005

ND = No Data; µg/L = micrograms per litre; mg/L = milligrams per litre;% = percent.

The most extensive recent study of water quality in lakes was conducted in 2004 and 2005 (Jacobs 2006). This study, a companion to the study examining the influence of watershed features and disturbance history on water quality in rivers, streams and creeks by Kotak et al. (2005), focused on 100 lakes in the Aquatic Study Area and further north. The majority of the lakes were remote, and visited by floatplane. Surface (0 to 2 m) water samples were collected and water quality analyses included major ions and nutrients, chlorophyll a, as well as metals. Light transmission, Secchi depth, and water temperature and dissolved oxygen profiles were also recorded. Samples for selected biological characteristics (phytoplankton species composition, algal toxins – microcystin LR) were also taken.

4.1.1.4 Lower Trophic Levels

Lower trophic levels in aquatic ecosystems form the base of the aquatic food web. The lower trophic levels include bacteria, primary producers such as phytoplankton, periphyton (attached algae) and large rooted plants (aquatic macrophytes) as well as aquatic insects (zooplankton, benthic macroinvertebrates). Studies on lower trophic levels in aquatic ecosystems in the ASA and in watercourses for which the Alternative and Preferred Route crosses, is lacking.

Algal communities represent are key primary producers in aquatic ecosystems. However, few studies have been conducted in the ASA on algal communities. While phytoplankton samples were collected by Jacobs (2006) in his survey of 100 lakes in eastern Manitoba, the samples were not analyzed and were archived for future phytoplankton identification and enumeration. Seasonal changes in periphytic algal primary production was studied in a dystrophic pond north of Powerview-Pine Falls (Goldsborough and Brown 1991). Additionally, Goldsborough and Brown (1988) also examined the potential effects of glyphosate (Roundup®) on periphyton productivity in several ponds north of Powerview-Pine Falls.

Aquatic invertebrates play an important ecological role in aquatic ecosystems. They are a food source for higher trophic levels (including for other aquatic invertebrates and for fish), and provide a pathway for recycling organic matter and nutrients in the aquatic environment. Aquatic invertebrates can be categorized into two broad groups: macroinvertebrates (such as zooplankon, and which are difficult to see with the naked eye) and macroinvertebrates (containing a diverse array of organisms such as water mites and spiders, crayfish, leaches, mayflies, dragonflies and damselflies, bivalves and various worms, among others). Aquatic invertebrates inhabit both lotic (flowing water) and lentic (still water) environments. Aquatic invertebrates, and in particular, benthic (bottom dwelling) macroinvertebrates, are taxonomically diverse and are widespread in waterbodies across Canada. For this reason, and are used as bio-indicators of aquatic ecosystem health (Environment Canada 2012). Despite their importance in aquatic ecosystems, no recent studies have been conducted in the ASA.

4.1.1.5 Fish Species and Distribution

There has not been a systematic inventory of fish species and distribution conducted by the provincial government in the western portion of the ASA in at least the last decade (Kansas 2012, personal communication). Most of the recent fish inventory work conducted by Manitoba Conservation and Water Stewardship (MCWS) has focused on lakes, particularly those used for recreational fishing in the eastern half of the ASA. Closer to the Alternative and Preferred Routes, a fisheries survey was conducted on the Black and O'Hanly rivers, between the community of Black River First Nation and PR #304 (Kotak 2006). Species caught during spring spawning events and in the fall included walleye, white bass, shorthead redhorse, white sucker, channel catfish, sauger, northern pike, goldeye, mooneye, brown bullhead, black bullhead, yellow perch, carp and rock bass.

Information obtained from ATK workshops with First Nation communities as part of the public engagement process for The Project provided additional information on fish species. Participants of an ATK workshop at Black River First Nation identified the Black and O'Hanly rivers, particularly near their community, as important for harvesting of walleye, jackfish (northern pike) and suckers (Map 2). Participants of ATK workshops at Hollow Water First Nation and the Community of Manigotagan identified the Manigotagan River, below Wood Falls (also known locally as First Falls) as important fishing areas for walleye and perch. One workshop participant identified a locally important lake, Goldeye Lake, which is adjacent and connected to the Wanipigow River, approximately 3 km from the community of Hollow Water

First Nation (Map 2). Participants at the ATK workshop in Manigotagan indicated that the Manigotagan River, below Wood Falls, was dredged in the past to create a deep-water habitat for sturgeon. At one time, sturgeon was so plentiful in the Manigotagan River that they were used as fuel for steamboats. Sturgeon is no longer plentiful in the river.

Formal fisheries surveys have also been conducted on rivers and creeks slightly north of the ASA (AEC 1999) and this inventory information provides a good estimate of the fish species present in rivers of the ASA. However, there are likely more fish species than this in the rivers and creeks of the ASA, particularly in the lower reaches of the rivers that empty into Lake Winnipeg. Lake Winnipeg has a diverse fish community, and several species from the lake likely inhabit, on a year round or seasonal basis, the lower reaches of rivers, up to the first natural barrier (e.g., waterfalls) to fish migration.

The area contains at least 41 species of fish, representing 14 families. These are identified in Table 4-5. The O’Hanly Pond, located approximately 5 km south of the O’Hanly River on PR #304 has been stocked with rainbow trout since at least 2005, and most recently in 2012 (MCWS 2012a). Lake trout is found only in Garner Lake, located in the extreme east portion of the Aquatic Study Area. Shoe, Tooth, Happy, Manigotagan and Quesnel lakes are managed as High Quality Management lakes for fisheries (MCWS 2012b), having special limits for various fish species. A walleye slot size limit is also in place for all waterbodies south of the Gammon/Bloodvein rivers (north of the ASA) to the Winnipeg River (excluding downstream of the Pine Falls Generating Station).

Table 4-5 Fish Species Known to, or Likely to Inhabit the Aquatic Study Area

Family	Common Name	Scientific Name
Acipenseridae	Lake Sturgeon	*Acipenser fulvescens*
Cyprinidae	Lake Chub	*Couesius plumbeus*
	Common Carp	*Cyprinus carpio*
	Pearl Dace	*Margariscus marginata*
	Golden Shiner	*Notemigonus crysoleucas*
	Emerald Shiner	*Notropis athernoides*
	Blacknose Shiner	*Notropis heterolepis*
	Spottail Shiner	*Notropis hudsonius*
	Northern Redbelly Dace	*Phoxinus eos*
	Mimic Shiner	*Notropis volucellus*
	Finescale Dace	*Phoxinus neogaeus*
	Fathead Minnow	*Pimephales promelas*
	Longnose Dace	*Rhinichthys cataractae*
Catostomidae	White Sucker	*Catostomus commersoni*
	Longnose Sucker	*Catostomus catostomos*
	Silver Redhorse	*Moxostoma anisurum*
	Shorthead Redhorse	*Moxostoma macrolepidotum*
Ictaluridae	Black Bullhead	*Ameiurus melas*
	Brown Bullhead	*Ameiurus bebulosus*
	Channel Catfish	*Ictalurus punctatus*
	Tadpole Madtom	*Norturus gyrinus*
Esocidae	Northern Pike	*Esox lucius*
Salmonidae	Cisco	*Coregonus artedi*
	Lake Whitefish	*Coregonus clupeaformis*
	Rainbow Trout	*Oncorhynchus mykiss*
	Lake Trout	*Salvelinus namaycush*
Percopsidae	Trout Perch	*Percopsis omisscomaycuus*
Gadidae	Burbot	*Lota lota*
Gasterosteidae	Ninespine Stickleback	*Pungitius pungitius*
Cottidae	Mottled Sculpin	*Cottus bairdi*
	Slimy Sculpin	*Cottus cognatus*
Centrarchidae	Rock Bass	*Ambloplites rupestris*
	Black Crappie	*Pomoxis nigromaculatus*
Percidae	Johnny Darter	*Etheostoma nigrum*
	Yellow Perch	*Perca flavescens*
	River Darter	*Percina shumardi*
	Suager	*Sander Canadensis*
	Walleye	*Sander vitreus*
Sciaenidae	Freshwater Drum	*Aplodinotus grunniens*
Hiodontidae	Goldeye	*Hiodon alosoideds*
	Mooneye	*Hiodon tergisus*

Source: AEC 1999; Kotak 2006.

4.1.1.6 Aquatic Species at Risk

Species at risk are those that are listed under the federal *Species at Risk Act* (SARA), designated by the Committee on the Status of Endangered Wildlife in Canada (COSEWIC) or listed in the *The Endangered Species Act* (MBESA). Species can be listed as extirpated, endangered, threatened or special concern. However, only those species listed on Schedule 1 of SARA or listed under MBESA receive protection. In addition to species at risk, the MBCDC also ranks species according to their degree of rarity either at the provincial scale (S1 species) or regionally (S2 species). The S1 and S2 are not necessarily listed under SARA or MBESA. Table 4-6 provides a list of aquatic species designated under SARA and listed by COSEWIC, as well as their MBCDC Rankings and their known distributions in and surrounding the ASA. There are no aquatic species listed under MBESA in the ASA.

There are two fish species listed under SARA known to inhabit waters in or surrounding the ASA. The carmine shiner (*Notropis pertcobromus*), listed as Threatened, has been observed in Peterson Creek and the Bird River, in the extreme eastern portion of the ASA (Doug Leroux 2004, personal communication), but is not located in proximity to the LWESI Alternative or Preferred Routes. The silver chub (*Macrhybopsis sotreiana*), listed as Special Concern, has been observed (rarely) in Lake Winnipeg (Stewart and Watkinson 2004). The chestnut lamprey (*Ichthyomyzon castaneus*), designated as Special Concern by COSEWIC, has been observed (rarely) in the Winnipeg River (EBM 2002) and the shortjaw cisco (*Coregonus zenithicus*), designated as Threatened by COSEWIC, has been recorded in the Winnipeg River (EBM 2002). Lake sturgeon, found in the Winnipeg River and northern brook lamprey, found in the Whitemouth River, are designated as endangered and special concern, respectively, by COSEWIC. The banded killifish (S1) and deepwater sculpin (S2/S3) are not listed under SARA or MBESA, but have restricted distributions in Manitoba, being found only in Crowduck Lake (banded killifish) and West Hawk and George lakes (deepwater sculpin), all outside of the ASA.

Table 4-6 Fish Species at Risk in Watersheds of, and Surrounding the Aquatic Study Area

Species	SARA (Schedule 1)	COSEWIC	CDC Rank	Watershed Distribution
Carmine Shiner (*Notropis percobromus*)	Threatened	Threatened	S2	Whitemouth River, Tie Creek[(a)], Pinawa Channel[(a)], Peterson Creek[(a)], Bird River[(a)]
Silver Chub (*Macrhybopsis sotreiana*)	Special Concern	Special Concern	S3	Red and lower Assiniboine rivers, Lake Winnipeg (rarely observed)
Chestnut Lamprey (*Ichthyomyzon castaneus*)	Not Listed	Special Concern	S3/S4	Red River, Winnipeg River[(b)] (rarely observed)
Shortjaw Cisco (*Coregonus zenithicus*)	Not Listed	Threatened	S3	Lake Winnipeg, Winnipeg River[(b)], George Lake[(c)]
Lake Sturgeon (*Acipenser fulvescens*)	Not Listed	Endangered	S2/S3	Lake Winnipeg, Winnipeg River
Northern Brook Lamprey (*Ichthyomyzon fossor*)	Not Listed	Special Concern	S2	Whitemouth River

Table 4-6 Fish species at risk in watersheds of, and surrounding the Aquatic Study Area (continued)

Species	SARA (Schedule 1)	COSEWIC	CDC Rank	Watershed Distribution
Banded Killifish (*Fundulus diaphanous*)	Not Listed	Not Listed	S1	Crowduck Lake
Deepwater Sculpin (*Myoxocephalus thompsoni*)	Not Listed	Not Listed	S2/S3	George Lake, West Hawk Lake

Note: Refer to Species at Risk website 2012 for listing criteria and classifications under SARA.

Source:

a) Doug Leroux personal communication, 2004.

b) EBM Science Team Report 2002.

c) Todd 2003; Kotak et al. (2009); Stewart and Watkinson (2004).

4.1.1.7 Fish Habitat

Fish habitat is found in an extremely wide variety of waterbodies. These include flowing and still water environments such as rivers, streams and creeks, as well as lakes, reservoirs, marshes, ponds and swamps. As defined under Section 34(1) of the *Fisheries Act*, fish habitat can be any place that a fish relies on for food, shelter, reproduction, growth or migration. It is a very broad definition that also takes into account various life cycle (e.g., spawning, larval habitat, adult) stages and seasonal requirements (e.g., overwintering habitat). As mentioned previously, fish habitat includes both physical habitat (flow or water velocity and discharge, physical structural attributes), as well as the chemical environment (e.g., water quality attributes). These will be discussed separately.

Fish habitat can be described in terms of the types of watercourses and the relative degree to which they either hold water or have water flow throughout the year, and the physical, structural habitat they provide to fish.

Ephemeral watercourses, which are numerous in the ASA and all of which are unnamed, only hold water for brief periods of the year. These watercourses are wholly dependent on precipitation events or snowmelt for water. They remain dry for a large portion of the year, and thus do not provide fish habitat. In-stream habitat such as rapids, boulders and large woody debris is generally absent. An example of an ephemeral watercourse is the small tributary of Pine Creek, which the Alternative and Preferred Routes would cross.

Intermittent watercourses may hold water for most or all of the year, but water flow may cease during dry periods. These watercourses usually drain low-lying areas such as wetlands (e.g., bogs, fens, marshes). In the ASA, they also tend to have beaver activity, which contributes to increased water levels upstream of beaver dams, and either lower water levels downstream, or little to no water flow. These watercourses usually have a well-defined channel and water depths of less than 1 m. Discharge is often below 0.5 m^3/s. Fish habitat may available seasonally, for example, during spawning periods, and provide nursery areas for larger bodied species such northern pike and sucker. Smaller forage fish including species of minnows and stickleback are likely to be found year-round in intermittent watercourses if other variables (e.g., dissolved oxygen, not frozen to the bottom) permit. Examples of intermittent watercourses include the O'Hanly Mid-tributary and Kapukwaywetewunk Creek, which Alternative Routes A and C and the Preferred Route would cross. Intermittent waterbodies generally only provide marginal fish habitat. Perennial watercourses include creeks, rivers, lakes and reservoirs. In the case of flowing watercourses, they have well-defined channels and water flow is continuous throughout most years. Severe or prolonged drought may cause flow to cease in some years or result in reaches of the watercourse that lack water. This generally only occurs in smaller perennial watercourses that have smaller watersheds.

Perennial watercourses provide year-round and diverse habitat for fish. In rivers, there are usually a diversity of flow habitats, including riffle/pool/run sequences, waterfalls and rapids. In-stream habitat is also diverse, with a variety of substrates (clay, silt, sand, cobble, boulders) and fish cover (macrophytes, undercut banks, large woody debris). Flood plains and distinct banks may be present. Examples of perennial watercourses in proximity to the proposed crossings of the Alternative and Preferred Routes include Duncan Creek, and the O'Hanly, Black, Sandy and Manigotagan River. With increasing size (bankfull width, volume, watershed size), the ability for a watercourse to provide more diversified and year-round fish habitat increases, for both small-bodied and large-bodied fish species, including northern pike, suckers and walleye. In contrast, smaller perennial water courses (such as Duncan Creek), due to lower (or no) water flow in late summer or winter, lower water depth and lack of in-stream habitat diversity, likely limits the abundance or presence of larger fish. Mid-size rivers such as the Manigotagan River can have mean annual discharges up to 15 m^3/s (Environment Canada 2012). Large rivers, such as the Winnipeg River, generally do not have a variety of water flow habitats (e.g., distinct riffles, pools and runs). However, habitat diversity is high, due to more complex channel characteristics, presence of bays and incoming tributaries, among other factors. Large rivers are able to support populations of large fish species such as sturgeon. Mean annual discharge in the Winnipeg River can be 500 to 1,500 m^3/s (Environment Canada 2012).

ATK workshop participants identified fish spawning sites on some of the main rivers close to their communities (Map 2). Black River First Nation, in 2003, worked with the provincial and federal governments to enhance (expand) a walleye spawning area on the Black River, in their community. Additional spawning reaches for walleye, sucker and northern pike on the Black River and O'Hanly River, close to the community, were also identified at the ATK workshop. ATK participants in Hollow Water First Nation and the Community of Manigotagan identified a spawning site (for walleye, perch, northern pike, catfish and whitefish) at the base of a waterfall on the Sandy River, between PR #304 and Lake Winnipeg (Map 2). The same participants also identified walleye and perch spawning sites on the Manigotagan River at Wood Falls and Poplar (Second) Falls (upstream of PR #304). Similarly, spawning sites of walleye, perch, northern pike, catfish and whitefish were identified on the Wanipigow River (Map 2).

As mentioned previously, lakes generally only occur in the eastern half of the ASA. Many lakes are connected to the main rivers in the ASA, either directly as being part of the river system (e.g., Quesnel, Manigotagan and Long lakes being part of the Manigotagan River) or via small creeks flowing out of the lakes and into the river systems. As with larger rivers, the larger lakes provide a higher degree of habitat diversity for fish compared to smaller lakes (or ponds), and thus, support a larger diversity of fish species. Common large-bodied fish species in lakes in the eastern part of the ASA include northern pike, walleye, white sucker, smallmouth bass, yellow perch and lake whitefish, among others. There are no lakes in the ASA west of PR #304.

The chemical environment that fish live in (water quality) is also considered as fish habitat. Parameters such as pH (level of acidity), dissolved oxygen, TSS and turbidity can be used to describe and evaluate watercourses in terms of providing for fish habitat. As these parameters are also considered as VECs in this assessment, they are described in Section 4.3.

4.1.1.8 Aquatic Invasive Species

Aquatic invasive species is a growing concern in Manitoba and worldwide. Such species are introduced to new waterbodies or regions either through intentional means (e.g., disposal of non-native baitfish by fishermen) or unintentionally (e.g., zebra mussels in boat ballast water discharge). Regardless of the mechanism of introduction, invasive species can proliferate quickly, displacing native species. Once established, invasive species are very difficult to eradicate.

There are several aquatic invasive species that are found in Manitoba, and several that occur in the Winnipeg River watershed in Ontario, that will likely move into Manitoba within the next decade. Three fish species (rainbow smelt – *Osmerus mordax*, common carp – *Cyprinus carpio* and white bass – *Morone crysops*) occur in Lake Winnipeg (Invasive Species Council of Manitoba 2012; Environment Canada and Manitoba Water Stewardship 2011). Two species of aquatic invasive invertebrates are known to be present in the Winnipeg River. They are the cladoceran *Eubosmina coregoni* (Suchy and Hann 2007) and the spiny water flea (*Bythotrephes longimanus* (Environment Canada and Manitoba Water Stewardship 2011). In addition, *E. coregoni* is already well established in the north basin of Lake Winnipeg, and it is likely that the spiny water flea is already present in the lake (Environment Canada and Manitoba Water Stewardship 2011). The rusty crayfish (*Orconectes rusticus*) has been reported in Lake of the Woods since 2007 (Ontario Ministry of Natural Resources 2012), and has recently been observed in the Winnipeg River, just east of the Manitoba border. The rusty crayfish is now present in Falcon Lake, in southeastern Manitoba (Invasive Species Council of Manitoba 2012). The zebra mussel (*Dreissena polymorpha*) is located in the Red River watershed, in Minnesota (MCWS 2012c). Four aquatic/riparian invasive macrophytes that are already established in southern Manitoba are purple loosestrife (*Lythrum salicaria*), with highest abundance along the Red River and southern shore of Lake Winnipeg, flowering rush (*Butomus umbellatus*), invasive phragmites (*Phragmites autralis spp. australis*) and Himalayan balsam (*Impatiens glandulfera*) (Invasive Species Council of Manitoba 2012).

4.1.2 Riparian Vegetation Communities and Watercourse Characteristics at Crossing Locations of the Preferred Route

The Preferred Route crosses 20 waterbodies in total with 11 being natural waterbodies (creeks, beaver ponds, rivers) and nine being anthropogenic waterbodies (highway drainage channels, water-filled borrow pits/quarries) (Map 3). Of the 20, seven are named watercourses (from south to north; O'Hanly River, O'Hanly Mid-tributary, Kapukwaywetewunk Creek, Black River, Sandy River, Duncan Creek and Manigotagan River). In addition, the Preferred Route crosses an unnamed tributary of Pine Creek, 7 highway drainage channels, 2 water-filled borrow pits/quarries, two additional unnamed creeks and a beaver flood (pond). Ten of the watercourses are considered perennial, 6 are intermittent and 4 are ephemeral at the crossing location of the Preferred Route. Riparian vegetation community characteristics and watercourse characteristics that were collected from field studies are provided for each crossing location (as well as 100 m upstream and 100 m downstream), in Appendix A. In addition, riparian vegetation community characteristics (obtained through GIS analysis) are also provided in Appendix A for those crossing sites that were not visited in the field. As mentioned previously, modifications were made to the routing of the Preferred Route in the area immediately north of Powerview-Pine Falls, based primarily on private landowner input. This led to the selection of the Final Preferred Route, which avoided one watercourse crossing (an un-named tributary of Pine Creek). For completeness, however, the field-based data for this watercourse is included in this report.

The watercourse crossing locations of the Preferred Route spanned a wide diversity of wetted width, stage, bank stability, bank slope, in-stream cover and riparian vegetation community composition (Appendix A). In addition, characteristics on one bank (shore) were not always similar on the opposite bank. Wetted width ranged from 1.7 m (tributary of Pine Creek) to 38m (Manigotagan River) in watercourses assessed in the field. Additionally, the stage (water level) of most watercourses was moderate, but considerably lower than peak stage in the spring. For example, the Black River was approximately 0.75 m lower at the time of the field assessments (September) than during the spring of 2012 (Brian Kotak, personal observation). One exception to this was Duncan Creek, which is often at flood stage due to beaver activity and the general characteristics of its watershed. Bank stability was generally moderate to high, with the exception of the Black River, where a combination of beaver activity and clay-based riparian soils create low bank stability. Bank slopes were generally below 15%, with many below 5%. In-stream cover frequently included large woody debris, aquatic macrophytes and occasionally overhanging canopy (tree species such as ash and willow). Boulders and beaver houses in proximity to the crossing locations were rare.

Riparian vegetation, based on field assessments or GIS-based analysis of the forest resource inventory (for those crossing sites for which field assessments were not conducted), was diverse. Riparian areas immediately next to the water usually consisted of sedges/grasses or shrubs (willow, alder, hazel), but also included sites with forest (mature or regenerating after the

1999 wildfire that burned north of the O'Hanly River) to the water's edge. One watercourse (tributary of Pine Creek), had only a very narrow width of riparian forest adjacent to the south bank, with the remainder of the 50 m width being agriculture (soybeans). This is the only watercourse with agriculture adjacent to it.

The information gathered during the field surveys and through the GIS analysis of riparian vegetation was used in developing mitigation measures for, as an example, clearing ROW vegetation in proximity to the watercourses.

4.1.3 Riparian Vegetation Communities Along Watercourses Within 50 m of the Final Preferred Route

In addition to assessing riparian vegetation at watercourse crossings of the Preferred Route, a GIS analysis was also undertaken to determine riparian vegetation in areas in which the Final Preferred Route comes within 50 m of a watercourse (but does not cross it). As the ROW on each side of the transmission line is approximately 30 m, this analysis accounts for ROW clearing in proximity to these watercourses. The Final Preferred Route (rather than the Preferred Route) was used in this analysis, as the minor adjustments made in the route alignment of the Preferred Route near the Winnipeg River and Pine Creek (discussed below) resulted in the Final Preferred Route being slightly closer to the two watercourses.

There are only three general areas where the Final Preferred Route comes within 50 m of a watercourse (Appendix B). The Final Preferred Route comes within 10 to 20 m of the north shore of the Winnipeg River at several locations along the route, east of the Pine Falls Generating Station, as well as within approximately 15 to 20 m of Pine Creek at several locations. Part of the area along the Winnipeg River is not forested, having been cleared for previous development, while other areas contain 20 to 45 year old stands of aspen-dominated forest. Along Pine Creek, the Final Preferred Route crosses a small area of 45-year old aspen-dominated forest, but mainly crosses grass and sedge meadow. Further north of the area, the Final Preferred Route also comes within 8 m of a small creek, which has a riparian area dominated by aquatic macrophytes (the riparian area is classified by the forest resource inventory as a beaver flood). Finally, the Final Preferred Route comes within 33 m of a highway drainage channel, which has a riparian area consisting of 45-year old black spruce.

4.2 Valued Environmental Components

Fish habitat was selected as a VEC for the aquatic environment. Measurable parameters for fish habitat included physical habitat (water depth, velocity) and water quality (pH, dissolved oxygen, TSS and turbidity).

Water depth is an important characteristic of waterbodies, as a lack of water, or low water levels may restrict movement of fish (e.g., spawning migration), affect flow and affect the concentration of important water quality constituents (e.g., dissolved oxygen). In addition, low water levels (either seasonally or as a permanent feature of a waterbody) may severely restrict habitat use by fish in the winter, as shallow watercourses may freeze to the bottom. Ephemeral and intermittent watercourses may not have water of sufficient depth to support fish for part or all of the year. In addition, smaller perennial watercourses may also lack water depth to prevent freezing to the bottom in winter. Of the watercourses for which field data was collected, rivers (within 100 m of the crossing location of the Preferred Route) had maximum water depths of 1.6 (Sandy River) to 4.4 m (Manigotagan River). The tributary of Pine Creek for which the Preferred Route (but not the Final Preferred Route) crosses, had a maximum depth of 1.5m (100 m downstream of the transmission crossing), but was completely dry 100 m upstream of the crossing (despite there being a stream channel). This tributary is classified as an ephemeral watercourse, as it does not contain water all year and relies on precipitation events or snowmelt for water to be present in the channel. Water depth in the O'Hanly Mid-tributary and Kapukwaywetewunk Creek was measured at PR #304 (approximately 500 to 700 m downstream of the crossing locations). Maximum water depth in these intermittent creeks was 0.3 and 0.7 m, respectively. It is likely that these watercourses freeze to the bottom in the winter, at least in certain reaches. This would make fish habitat only available seasonally, and generally only for small forage fish species. Water depth was not measured in any of the anthropogenic (man-made) watercourses such as highway drainage channels and water-filled borrow pits/quarries.

Water velocity is important in lotic (flowing water) aquatic environments, as it provides structurally diverse habitats (e.g., through channel scouring and by replenishing dissolved oxygen, among others benefits) but can also restrict use of aquatic habitats by fish if velocity is too great (e.g., after major precipitation events or during significant spring runoff events). Due to water depths that were too great to safely measure water velocity in the rivers at the crossing locations, water velocity could only be measured at structures such as bridges and culverts along PR #304, and only in selected watercourses. The velocities measured would likely be higher than what would be measured at the crossing locations, as the installations of bridges and culverts usually exist at natural constrictions of a watercourse, or the structures themselves cause a narrowing. This increases water velocity at the location. Shallower water at culverts and bridges also increases water velocity. Maximum water velocity in the O'Hanly River at PR #304 was 0.59 m/s. Maximum water velocity in the O'Hanly Mid-tributary, Kapukwaywetewunk Creek and Duncan Creek was considerably lower, at 0.325, 0.388 and 0.090 m/sc, respectively. The Black River (at PR #304) had a maximum water velocity of 1.03 m/s. It is important to note that the measurements of water velocity took place in late September of 2012, when water levels and flow were quite low relative to earlier in the summer and compared to other years (Kotak et al. 2005; Miette Environmental Consulting 2008). The water velocities measured in the field assessments for The Project are navigable for most fish species found in these waterbodies, and fish living in the larger rivers likely experience much higher water velocities during the spring freshet (spring snow melt) or after major precipitation events.

Water pH is a measure of the level of acidity. Water that is too acidic or too basic (the opposite of acidic) can restrict the use of habitat by fish. Water pH measured in previous studies (summarized in Table 4-3) ranges from slightly acidic (6.50 to 6.97) to slightly basic (7.33 to 7.65). Interestingly, watercourses located between the O'Hanly and Black rivers contain slightly acidic water, while those located north of the Black River (e.g., Sandy River, Duncan Creek, Manigotagan River and Wanipigow River) contain water that is slightly basic. This is due to the predominance of peatlands in the more southern watersheds (i.e., O'Hanly to Black rivers) and less peatland and more mineral soil in the watersheds north of the Black River (Kotak et al. 2005). Water pH measured during the field assessments for the Project (Table 4-7) was comparable to those reported in other published studies (summarized in Table 4-3).

Table 4-7 Water Quality Parameters Measured During Field Assessments of the Project

Water Course	Date	pH	Dissolved Oxygen (mg/L)	Dissolved Oxygen (% saturation)	TSS (mg/L)	Turbidity (NTU)
Manigotagan River	Sept 18, 2012	7.64	9.10	86	6.0	4.8
Duncan Creek	Sept 17, 2012	7.36	5.20	45	5.0	1.5
Sandy River	Sept 17, 2012	7.54	6.20	62	24.0	58.0
Black River	Sept 17, 2012	7.18	7.80	74	14.0	16.5
O'Hanly River	Sept 19, 2012	7.05	9.40	85	15.0	41.7
Pine Creek Tributary	Sept 18, 2012	7.47	7.20	64	12.0	7.0

mg/L = milligrams per litre;% = percent; TSS = total suspended sediments; NTU = nephelometric turbidity units.

Low dissolved oxygen levels can restrict the use of specific reaches of a watercourse or restrict use during certain periods of the year (e.g., in winter under ice cover). The concentration (amount) of dissolved oxygen in water is a function of water temperature, salinity and altitude (Wetzel 1983). Commonly, dissolved oxygen is reported as a concentration (mg/L) and also as% saturation (which accounts for water temperature). Dissolved oxygen during open water periods and in winter is high enough to support fish communities in the main rivers (Table 4-3). Dissolved oxygen in small creeks (e.g., O'Hanly Mid-tributary, Kapukwaywetewunk Creek, Duncan Creek) can be significantly less than saturated during the open water season (Table 4-3) and could limit distribution of fish species, particularly at night when the process of photosynthesis by aquatic plants stops and the process of respiration by aquatic plants removes dissolved oxygen from the water (as well consumption of oxygen through decomposition processes). In small water courses (e.g., creeks) that do not freeze to the bottom in winter, dissolved oxygen concentrations in the water can be very low, potentially limiting the use of such small watercourses during winter by fish. For example, dissolved oxygen concentrations in Duncan Creek can be naturally very low in the winter (Table 4-4). Kotak et al. (2005) suggest than many of the small creeks in the region, and even beaver ponds, may be anoxic by the end of winter, prior to ice off. Dissolved oxygen concentrations and% saturation measured during the field assessments for the Project in September of 2012 are shown in Table 4-7 and were sufficient for fish species likely to inhabit the water courses at that time of the year.

Manitoba Water Stewardship (2011) has established water quality guidelines for the protection of freshwater aquatic life, which includes guidelines for pH and dissolved oxygen. The rivers and creeks assessed for the LWESI project generally have pH values (Tables 4-3 and 4-7) within the guidelines established for aquatic life (pH between 6.5 and 9.0). However, pH of some of the small creeks (e.g., O'Hanly Mid-tributary) can be as low as 5.83 on individual sampling dates (Kotak, unpublished data). This may limit the distribution of some species of fish. Many small creeks in the region contain naturally acidic water due to the predominance of acidic peatlands (bogs) in their watershed. Dissolved oxygen concentrations in small creeks such at the O'Hanly Mid-tributary can be below water quality guidelines for the protection of aquatic life on occasion in winter for some cool water fish species. It is likely that many small creeks in the ASA freeze to the bottom in winter, and for those creeks that do not freeze to the bottom, dissolved oxygen concentrations in winter may too low for many fish species. Dissolved oxygen concentrations in the larger watercourses, including the main rivers, in the ASA would not limit fish distribution, even in winter.

Total suspended solids and turbidity are related, and are measures of the amount of suspended material in the water and of water clarity. Generally, high concentrations of TSS and high levels of turbidity can affect fish by limiting their success of foraging (especially for predatory fish such as trout species which rely heavily on keen eye sight for feeding), and under extreme conditions, by clogging gills. TSS concentrations and turbidity in the watercourses studied by Kotak et al. (2005) (Table 4-3) and those measured during the aquatic field assessments (Table 4-7) are typical of the region would not be considered as a limiting habitat factor to fish species in the region. Water clarity is very good, particularly in the Manigotagan and Wanipigow rivers.

5 EVALUATION OF ALTERNATIVE ROUTES AND INFRASTRUCTURE

The overall route selection process for Line PQ95 component is described in Chapter 3.0 of the main EA Report. Evaluation of the Alternative Routes focused on a predetermined set of evaluation criteria. The evaluation criteria reflected the importance of known factors that are identified from various perspectives including socio-economic, biophysical, cost and technical aspects. These criteria, as well as valuable feedback obtained from the PEP, became the basis from which to compare and evaluate the Alternative Routes.

The Manigotagan Corner Station Site was selected based on engineering and technical criteria. The preferred station site was integrated into the PEP and received favorable feedback from local community representatives.

The section below describes the inputs for the Line PQ95 alternative routes and the Manigotagan Corner Station Site from the aquatic resource perspective. Based on the evaluation of the three Alternative Routes, Route C was favoured over the other two routes.

5.1 Description and Evaluation of Alternative and Proposed Route and Infrastructure

5.1.1 Alternative Route Comparison

The aquatic evaluation of the three Alternative Routes (A, B, C) consisted of a number of criteria. This included the number of watercourses crossed, whether watercourses are natural (e.g., creeks, rivers, lakes) or anthropogenic (man-made, such as highway drainage channels, borrow pits and quarries), the angle at which the proposed route would cross the watercourse and the potential type of fish habitat present at the crossing site. With respect to crossing angle, transmission line crossings that are perpendicular (or as close to perpendicular as possible) to watercourses are preferred from an aquatics perspective, as perpendicular crossings minimize the extent of effects on riparian vegetation. Transmission line crossings not at a perpendicular angle could potentially result in more riparian vegetation being cleared. A qualitative assessment of potential fish habitat was based largely on analysis of orthophoto images, as well as knowledge of the watercourses by the author. Fish habitat was categorized as Important, Marginal or None. Important fish habitat is perennial watercourses that contain water and flow year-round, and likely have sufficient depth for overwintering of fish. Marginal fish habitat is represented by intermittent water courses, where water or water flow may not be present year-round, and where water depth is likely shallow enough to enable freezing to the bottom in winter. Intermittent watercourses only provide fish habitat for a portion of the year. Watercourses containing No fish habitat are those that lack water for most of the year. For the assessment of the three alternative routes, only the highway drainage channels that appeared to lack water on the orthophotos were classified as No Fish Habitat. All rivers (O'Hanly, Black, Sandy, Manigotagan) were classified as Important Fish Habitat.

Alternative Route C had the fewest total number of water crossings, as well as the fewest number of crossings of natural watercourses (Table 5-1; Map 4). Routes A & B had up to twice as many crossings, mainly because both routes cross meanders of Duncan Creek five times. Alternative Route C only crosses Duncan Creek once. While all three routes had four crossings of watercourses with Important Fish Habitat (i.e., the rivers), Alternative Route C had less than half the number of crossings of Marginal Fish Habitat (Table 5-1). Finally, Alternative Route C, with fewer crossings, also had a higher percentage of crossings that are perpendicular (or nearly so) to the watercourses. Based on the assessment of the three alternative transmission line routes, Alternative Route C was favoured from an aquatics perspective.

The assessment of Alternative Routes included analyses from other project disciplines (e.g., wildlife, forestry, heritage resources, socio-economics) as well as technical and cost considerations and input received from the public involvement process. Based on these, a Preferred Route (Map 3) was selected that attempted to balance environmental, social and cost factors. The Preferred Route combined segments of all three Alternative Routes.

Subsequent to the selection of a preferred route (Map 3), further input was received from private landowners immediately north of Powerview-Pine Falls, as part of the Public Engagement Process. This resulted in a minor alteration of the routing of Line PQ95 in this area, and the avoidance of one watercourse crossing (crossing #1 – tributary of Pine Creek; Appendix A, Map 3), and the selection of the Final Preferred Route. Map 5 shows the routing of the Preferred Route (including the location of crossing #1) and the routing of the Final Preferred Route, in the area immediately north of Powerview-Pine Falls. There were no modifications to the Line PQ95 route north of this area (i.e., the Preferred Route and Final Preferred Route are identical, north of the private land area near Powerview-Pine Falls).

Table 5-1 Comparison of 3 Alternative Routes of the Transmission Line

Assessment Criteria	Route A	Route B	Route C
Number of Water Crossings			
Natural Water Course	15	14	9
Man-Made Water Courses	5	9	2
Total Water Crossings	**20**	**23**	**11**
Fish Habitat			
Number of Crossings with Important Fish Habitat	4	4	4
Number of Crossings with Marginal Fish Habitat	14	15	7
Number of Crossings with No Fish Habitat	2	4	0
Angle of Transmission Crossing			
Number of Crossings at Right Angles	13	13	8
Number of Crossings at Oblique Angles	7	10	3

5.1.2 Manigotagan Corner Station Site

The Manigotagan Corner Station Site is located along PR #304, near the junction of PR #304 with the Rice River Road. The station would be located in the Wanipigow River watershed, and the closest natural waterbody to the station is the Wanipigow River, approximately 1.8 km away. There are no creeks that connect the station site to the river. There is one water-filled borrow pit on either side of the station site, next to PR #304. Therefore, the Manigotagan Corner Station Site, or activities to construct the station, will have not effect on water resources.

6 EFFECTS AND MITIGATION

6.1 Overview

The effects assessment followed the methods outlined in Chapter 7.0 of the EA Report. Table 6-1 provides a summary of the effects assessment for aquatics resources.

Based on the site selection process outlined in Chapter 6.0 of the main EA Report, a Preferred Route was selected based on route comparison using several criteria, including Aquatic Resources. The Preferred Route is a combination of Routes A and B (Maps 3 and 4). The Manigotagan Corner Station Site was selected based on engineering and technical criteria. Minor revisions made to the routing of the Preferred Route in the private land area immediately north of Powerview-Pine Falls resulted in a Final Preferred Route. The following effects assessment Section was completed on the Final Preferred Route and the location of the Manigotagan Corner Station.

6.2 Effects Assessment

The following section provides an assessment of the potential effects of the Project on the Aquatic Resources. Project components assessed include the proposed Line PQ95 (i.e., Final Preferred Route) and the proposed station.

The identification and assessment of effects for the aquatic environment focused on fish habitat, as no effects are predicted on aquatic species at risk, due to the lack of spatial overlap of the species with the project components and activities, and mitigation measures. Fish habitat includes physical habitat (water depth, water velocity) and surface water quality parameters with relevance to fish habitat (pH, dissolved oxygen, TSS and turbidity). Environmental effects for the aquatic environment were identified based on the interaction of activities and components of the project (Final Preferred Route of Line PQ95, Manigotagan Corner Station Site, Switchyard) with the aquatic environment, and considered existing available literature as well as field data from the habitat assessments. The identification and assessment of effects was structured around two phases: construction, and operations and maintenance, including accidents and malfunctions. It should be noted that many of the potential environmental effects were already mitigated through the initial stages of the Site Selection and Environmental Assessment (SSEA) process for the selection of the Final Preferred Route.

6.2.1 Construction Phase

6.2.1.1 Transmission Line

The loss of riparian vegetation, potentially leading to erosion and sedimentation, creation of water crossings at the ROW and access trials or roads, as well as the introduction of deleterious substances (e.g., fuels, lubricants) to water courses, among others represents the great potential effect on fish habitat. This is described in more detail below.

Increase Water Yield to Receiving Watercourses Due to Right-of-Way Clearing

The construction of the transmission line involves clearing of vegetation (trees, shrubs) within a 60 m ROW over a distance of approximately 75 km. Removal of vegetation (trees in particular) will result in a reduction in evapotranspiration (the movement of water from soils through vegetation and back to the atmosphere through leaves and needles) (Hetherington 1987), an increase in soil water (moisture) and increased water yield from the land to receiving streams (creeks, rivers). The increase in water yield is related to the proportion of watershed area for which trees are removed (Keenan and Kimmins 1993). In a forestry context, water yield increases of 27% have been reported when approximately 50% of watershed area was harvested in Alberta (Swanson and Hillman 1977).

Water yield increase caused by removal of vegetation in the ROW for The Project would not be measurable. Even if the ROW was fully forested along its length in each watershed that it crossed (which is not the case, as there are significant areas of small plant communities such as sedges and shrubs), removal of all vegetation would affect a maximum of 0.4% of the gross watershed area in the O'Hanly River watershed (the smallest watershed of the rivers) and much less than this percentage in the other river watersheds. Even without any form of mitigation, the increase in water yield would be imperceptible and not measurable, and therefore effects on fish habitat (water depth and water velocity) would not be measurable.

Loss of Riparian Vegetation at Water Crossings Due to Improper Construction Practices

Riparian vegetation plays an important ecological role in protecting fish habitat. Overhanging tree and shrub canopy can provide shade in smaller watercourses, thereby partially regulating water temperature. The removal of large portions of riparian vegetation along such watercourses could increase water temperature and light availability, leading to increased aquatic plant growth. Larger watercourses benefit much less from overhanging canopy in terms of shade, due to the watercourse's larger width. However, overhanging canopy in riparian areas also provide for long-term input of large woody debris (e.g., fallen trees) in the water, creating more complex in-stream fish habitat. The removal of significant portions of riparian vegetation along watercourses could affect fish habitat by eliminating the long-term input of large woody debris into the water. Field assessments at the crossing locations of the Preferred Route for watercourses with important fish habitat (i.e., the O'Hanly, Black, Sandy and Manigotagan rivers) found that only three of the 12 riverbanks had overhanging canopy. At two of the locations (north shores of the O'Hanly and Sandy rivers), overhanging canopy was sparse (Appendix A). Only one location (south shore of the Sandy River) contained a significant amount of overhanging canopy. The remainder of the riparian areas adjacent to the water of the rivers containing important fish habitat consisted of sedge/grass, shrub or forest communities lacking overhanging canopy.

The transmission line will also be located within 10 to 20 m of, but not crossing, the Winnipeg River (Appendix B), as well as within 15 to 20 m of Pine Creek. This occurs just north and east of the Pine Falls generating station. Clearing of riparian vegetation will not be required at some of these locations, as the sites are either not forested (being previously cleared for other purposes along the Winnipeg River) or contain only grass and sedge plant communities (along Pine Creek). However, there are some riparian areas along both the Winnipeg River and Pine Creek that will require clearing.

Riparian areas also contribute nutrients to aquatic ecosystems through litter (leaf and other organic material) and terrestrial insect drop, which provide food for aquatic invertebrates and fish. Removal of riparian vegetation can therefore result in a decrease of nutrient input into the aquatic food web.

The north and south shores of the Black River and the north shore of the Sandy River at the transmission line crossing locations of the Final Preferred Route were burned in 1999, and thus currently contain young regenerating forest. In addition, riparian areas immediately adjacent to the water usually consist of sedge/grass or shrub communities, which will not be disturbed, or would be disturbed minimally. The riparian areas of the O'Hanly and Manigotagan rivers contain mature forest, although generally not immediately next to the water. The effects identified above due to riparian vegetation removal are small in magnitude, site-specific, and can be mitigated (see Section 6.3).

Bank Erosion and Sedimentation Due to Improper Construction Practices

Vegetation removal and improper construction practices within the ROW in riparian areas at crossing locations can result in decreased bank stability, bank slumping and exposure of bare soil. This could lead to erosion and subsequent sedimentation into watercourses. In particular, machinery operating near watercourses can also create ruts and compact soils, especially in saturated, floodplain areas next to watercourses. Compacted soils can channelize water flow effectively, leading to less infiltration and greater surface erosion.

Eroded soil inputs into watercourses can increase the concentration of TSS and increase turbidity. This can reduce light penetration, thereby reducing photosynthesis by primary producers (algae, aquatic macrophytes) and limiting the distribution of primary producers. As primary producers form the base of the aquatic food web, these effects can have implications for higher trophic levels: aquatic invertebrates and fish. Elevated suspended sediment concentrations and turbidity can impair feeding success of fish, particularly for salmonid species, which are visual feeders (Berg and Northcote 1985). Very high concentrations of suspended sediment can also clog the gills of fish (Wood and Armitage 1997)

Large inputs of sediments can bury aquatic invertebrates and their substrates, as well as affect fish spawning areas. Sedimentation can reduce the amount of spawning habitat available as well as reduce spawning success. Fish eggs are deposited in the interstitial spaces between coarse substrates (e.g., cobble, gravel, sand) and rely on adequate diffusion of dissolved oxygen from the water to the eggs and removal of metabolic waste products from the eggs back to the water for proper egg and larvae development (Kondolf 2000). Sedimentation of fine particles caused by improper construction techniques can smother eggs, resulting in decreased fish spawning success.

As mentioned previously, Important fish habitat is only present at crossing locations on the four main rivers (O'Hanly, Black, Sandy and Manigotagan). Other watercourse crossing locations had either Marginal or No fish habitat. Of the water crossing locations on the watercourses with Important fish habitat, special attention will be required for activities occurring near the north and south banks of the Black River and the north bank of the Sandy River. These locations have low bank stability, in part due to high clay-content soils at the location and due to visible erosion caused by beaver activity (Appendix A). There are no known fish spawning sites at or immediately adjacent to (i.e., within 100 m) the proposed water crossing sites.

Alteration of Habitat from Structure Foundations and Installations

Foundations and installations necessary for transmission towers could affect fish habitat if they are located within the normal high water mark or within riparian areas. Under such instances, the physical footprint of the structures would necessitate the removal of riparian vegetation, as well as grubbing of the site, resulting in effects previously described above (i.e., loss of riparian vegetation and potential erosion and sedimentation).

Contamination from Structure Foundations and Installations

Foundations and anchors for the transmission towers could include rock sets, cast-in-place concrete piles or the use of pre-cast concrete screw piles. Construction of cast-in-place structures could result in accidental release of concrete wash water into watercourses. Uncured or partially cured concrete, as well as other constituents containing lime (Portland cement, mortar, grout) have a high pH (are very basic), are caustic and are toxic to aquatic life. Watercourses at crossing locations have slightly acidic to slightly basic pH. In addition, other characteristics of these watercourses, including low alkalinity (Kotak et al. 2005) means that these waters have little ability to buffer inputs of high pH water. Runoff of such wash water could have localized effects on pH in the watercourses. Additionally, wash water could also contain sediments, which could increase turbidity and sedimentation in watercourses.

6.2.1.2 Water Crossings at Transmission Line ROW and Temporary Access Trails and Roads

Temporary access trails and roads will be needed in some locations to provide access to the transmission ROW for clearing and other construction activities (e.g., construction of foundations, erection of towers, stringing of conductors and guy wires). While efforts will be made to use existing crossing locations and infrastructure (e.g., from previous logging roads), some new temporary water crossings may need to be developed. Temporary crossings can include ice bridges, snowfills and clear span bridges. In addition, watercourses could be crossed at the transmission line crossing locations. These crossings will likely include only ice bridges and/or snow fills.

Water crossings that involve alteration of the stream bank (such as for bridges) have the highest potential for introducing sediments into a watercourse, and require careful planning and erosion control plans. Installation of culverts can not only disturb banks and Stream channels, but, depending on the size and configuration, can also potentially restrict the width of a channel, increase water velocity through the culvert, and prevent fish passage (Fisheries and Oceans Canada and Manitoba Natural Resources 1996). No culverts are planned at transmission line crossings or in high fish habitat value streams.

6.2.1.3 Manigotagan Corner Station

Construction activities, including clearing and grubbing of the Manigotagan Corner Station Site, have no potential to affect waterbodies. The closest natural watercourse to the Manigotagan Corner Station Site (the Wanipigow River) is 1.8 km away, and there are no water connections (e.g., creeks) that would provide a flow path from the station site to the river. There is one old water-filled borrow pit located on either side of the station site, next to PR #304, which would only provide for marginal (or no) fish habitat. The Manigotagan Corner Station Site will be 300 x 200 m, only half of which will be developed.

To terminate the Line PQ95 at the Manigotagan Corner Station Site as well as to connect to the existing 66 kV sub-transmission system, the following components will be installed: two 115-66 kV three phase power transformers, two 115 kV breakers, five 66 kV breakers, and 66 kv and 115 kV switches, fuses and arresters. Foundations for the equipment will also be installed and the developed portion of the site surrounded by a chain link fence. There are no construction activities or installation activities that would have potential to affect fish habitat.

6.2.1.4 Pine Falls Generating Station

Within the fenced area of the existing Switchyard, south of the Winnipeg River at the Pine Falls Generating Station, the following components will be added: one 115-66 kV transformer, one 66 kV breaker, modifications to the transformer and line protection. All equipment will be added to the existing site. This area is also enclosed by an earthen berm. There are no construction activities or installation activities that would have potential to affect the Winnipeg River.

The new Line PQ95 would cross the Winnipeg River enclosed in an existing cable tray, located on the underside of the road on the spillway side of the Pine Falls Generating Station.

6.2.1.5 Marshalling Yards

Marshalling yards are areas where equipment and construction materials are stored, as well as areas potentially used for the assembly of towers as part of construction of the transmission line. These areas would be located near the transmission line route where practical, and would take advantage of existing cleared sites, such as borrow pits, aggregate stock pile sites or former forestry wood stock pile sites. As these sites already exist, the potential environmental effects relate mainly to the storage of materials (including petroleum products) and potential releases to aquatic environmental through spills or leaks. All materials will be removed from marshalling yards at their completion of use.

6.2.1.6 Accidental Spills and Leaks of Substances Harmful to Aquatic Environments

Petroleum products such as gasoline and diesel fuels, oil, lubricants and hydraulic fluids can leak from machinery, be released through maintenance and refueling activities, and be released through accidental spills. If these occur in proximity to water, these deleterious substances can enter a watercourse and directly or indirectly affect aquatic organisms (including fish). Depending on the volume of product entering the water, effects can range from acute and severe (e.g., lethal) to chronic and sublethal. Many hydrocarbon products are also persistent, and remain in sediments for long periods of time and accumulate in higher trophic levels in the aquatic food web.

6.2.1.7 Increased Access and Effects on Fish Habitat and Fishing Opportunities

The construction of the transmission line ROW and of access roads/trails to the ROW can improve access to sensitive fish habitats. In particular, if the access or ROW is located near spawning areas of fish, improved access could result in high and unsustainable fishing pressure, particularly during spawning periods. However, none of the proposed crossing locations are located near known fish spawning areas. Additional traffic by all-terrain vehicles and four-wheel drive trucks to access such sites can also result in disturbance to riparian vegetation, rutting, stream bank erosion and sedimentation. The locations of access roads and trails are not yet known, however, where practical, existing trails and access roads will be utilized.

6.2.2 Operations and Maintenance Phase

6.2.2.1 Transmission Line

Inspections of Right of Way and Structures

Periodic inspections of the ROW and tower structures will be conducted. The inspections are done using a combination of aerial surveys and ground-based surveys. For ground inspections, access is made by a variety of methods, including snowmobile, flex track type or road vehicles. Ground inspections during non-frozen soil conditions would only occur in emergency situations, potentially resulting in soil compaction and rutting in proximity to watercourses.

Vegetation Management

Vegetation management is used to control vegetation in and adjacent to the ROW that is not compatible with safe and reliable operation of the transmission line. Danger trees adjacent to the ROW that could interfere with the transmission line are typically hand-felled. Vegetation management can occur in both non-frozen and frozen (winter) periods, and can include hand cutting where local conditions warrant it (e.g., in sensitive riparian zones), hand cutting with treatment of tree stumps with a herbicide (to prevent suckering of the tree), selective basal and foliar herbicide application, mechanical cutting in areas of dense tree growth and winter shear blading (generally for trees with a diameter greater than 2.5 cm). Hand cutting only removes the above ground tree or shrub biomass and does not disrupt the roots or surrounding soil. Machinery used in mechanical cutting or shearing can cause soil compaction, erosion and sedimentation if done incorrectly in riparian areas.

Herbicide treatment (of stumps) or above ground foliage could be potentially be utilized as part of a vegetation management strategy. Herbicide use in areas close to water could result in accidental (through spills) or unintentional (through aerial drift or runoff) entry into watercourses. The entry of herbicides into a waterbody depends on the properties of the herbicide, hydrology, application practices and weather. Once in a waterbody, herbicides can reduce photosynthesis or other processes in primary producers (e.g., algae, macrophytes), thereby reducing their biomass and distribution.

6.2.2.2 Manigotagan Corner Station

Vegetation Management

Vegetation within the footprint area of the Manigotagan Corner Station Site will be controlled by a combination of mechanical (e.g., mowing, weed snippers) or chemical (e.g., herbicide) methods. As there are no natural water features (rivers, creeks) in proximity to the station, there are no potential effects on aquatic ecosystems.

6.3 Proposed Mitigation Measures and Residual Effects

Many of the potential effects of the project (and in particular, for the transmission right of way clearing) on aquatic ecosystems can be mitigated through timing of construction activities. Under frozen soil conditions, potential effects to the aquatic environment are greatly lessened. Other specific mitigation measures, outlined below, greatly reduce or eliminate potential environmental effects. Mitigation measures help to avoid, minimize, and when necessary, compensate for project effects. Mitigation measures are based on applicable legislation (e.g., the *Fisheries Act,* the *Pesticides and Fertilizers Control Act*), various standards and guidelines (e.g., Manitoba Stream Crossing Guidelines for the Protection of Fish and Fish Habitat), best management practices and the years of experience that Manitoba Hydro has in constructing and operating similar projects. The initial stages of the SSEA process was used to determine the Preferred Route for the transmission line. This provided an important first step in mitigation through spatial avoidance of the transmission route through sensitive habitats (aquatic and terrestrial), cultural or heritage sites and private property.

Once mitigation measures are identified and applied to the various project activities, a residual effects assessment was conducted. Residual effects are those environmental effects that remain following application of mitigation measures. The residual effects assessment on the aquatic VEC was based on six criteria:

- Direction
  - Positive (a beneficial or desirable change), Negligible (no change) or Negative (an adverse or undesirbable change)
- Magnitude
  - Negligible (no detectable or measurable effect), Small (effect does not exceed baseline values or guidelines), Moderate (measurable effect that results in a short-term change, or meets and occasionally exceeds guidelines) or Large (effects sufficient to cause a change that exceeds baseline values or guidelines).
- Geographic Extent
  - Project Footprint (effects confined to the project footprint, including ROW), Local (direct and indirect effects that may extend beyond the project footprint, but not more than 5 km beyond the ROW or project components) or Regional (direct and indirect effects that extend beyon local effects, may include cumulative changes from other projects).
- Duration
  - Short-term (effects that occur during site preparation and/or construction phases of the project, from 1 to 5 years), Medium-term (effect that extends throughout construction and operational phases of the project, up to 50 years) or Long-term (effects lasting more than 50 years).

- Reversibility
  - Reversible (effect is reversible during the project's lifespan) or Permanent (long-term permanent effect).
- Frequency
  - Infrequent (effect may occur once during the life of the project), Sporadic/Periodic (effect may occur without predictable pattern over the life of the project) or Regular/Continuous (effect may occur periodically or continuously during the life of the project).

The residual effects assessment is summarized in Table 6-1.

Table 6-1 Assessment of Residual Environmental Effects on Fish Habitat

Potential Effect	Project Phase	Key Mitigation Measures	Residual Effect	Significance Criteria
Loss of riparian vegetation, increased erosion, increased TSS due to transmission line ROW clearing	Construction	• Follow DFO Operational Statement for Overhead Line Construction • Areas identified for selective clearing (e.g., buffer zones, sensitive sites) will be flagged prior to clearing • Environmentally sensitive areas located adjacent to watercourses or located on rugged terrain will be cleared by approved methods according to the contract specifications • Trees within established buffer zones will be selectively cleared using low ground disturbance methods that cause the least impact. Low growth vegetation such as grasses and shrubs within buffer zones will not be cleared. • Trees will not be felled into waterbodies.	• Loss of riparian vegetation, minor increase in erosion, minor increase in TSS	• Direction - Negative • Magnitude - Negligible • Geographic extent – Local • Duration – Short-term • Reversibility – Reversible • Frequency - Infrequent
Increased bank erosion and downstream TSS due to water crossing construction at ROW location (snow fills, ice bridges)	Construction	• Follow DFO Operational Statement for Ice Bridges and Snow Fills	• Minor bank erosion, minor increase in TSS	• Direction - Negative • Magnitude - Negligible • Geographic extent – Local • Duration – Short-term • Reversibility – Reversible • Frequency - Infrequent
Increased bank erosion and downstream TSS due to water crossing construction at Access Trails/Roads (including culverts, clear span bridges)	Construction	• Follow DFO Operational Statement for Fords and Bridges • Erosion protection and sediment control measures will be put in place at all project locations where surface drainage is likely to flow into fish bearing waters.	• Minor increase in bank erosion, minor increase in TSS, minor effect on migration of fish (culverts only)	• Direction - Negative • Magnitude - Small • Geographic extent – Local • Duration – Short-term • Reversibility – Reversible • Frequency - Infrequent

Table 6-1 Assessment of Residual Environmental Effects on Fish Habitat (continued)

Potential Effect	Project Phase	Key Mitigation Measures	Residual Effect	Significance Criteria
Release of deleterious substances to watercourses due to spills and leaks	Construction	• Petroleum product storage will be located a minimum of 100 m from the ordinary high water mark of waterbodies, riparian areas or wetlands. • Fuelling of equipment or portable storage tanks will be a minimum of 100 m from the ordinary high water mark of any waterbody. • Hazardous substances will be transported, stored and handled according to the procedures prescribed by provincial legislation and Manitoba Hydro policies • Emergency spill response and clean-up materials and equipment will be available at construction sites, marshalling yards, fuel storage facilities and standby locations.	• Spills/leaks of deleterious substances into watercourses	• Direction - Negative • Magnitude - Small • Geographic extent – Local • Duration – Short-term • Reversibility – Reversible • Frequency - Infrequent
Loss of riparian vegetation, increased erosion, increased TSS due to ROW vegetation management	Operation and Maintenance	• Follow DFO Operational Statement for Maintenance of Riparian Vegetation in Existing ROWs	• Loss of riparian vegetation, minor increase in bank erosion, minor increase in TSS	• Direction - Negative • Magnitude - Negligible • Geographic extent – Local • Duration – Medium-term • Reversibility – Reversible • Frequency – Regular/Continuous
Release of deleterious substances to watercourses due to spills and leaks	Operation and Maintenance	• Petroleum product storage will be located a minimum of 100 m from the ordinary high water mark of waterbodies, riparian areas or wetlands. • Fuelling of equipment or portable storage tanks will be a minimum of 100 m from the ordinary high water mark of any waterbody. • Hazardous substances will be transported, stored and handled according to the procedures prescribed by provincial legislation and Manitoba Hydro policies • Emergency spill response and clean-up materials and equipment will be available at construction sites, marshalling yards, fuel storage facilities and standby locations.	• Spills/leaks of deleterious substances into watercourses	• Direction - Negative • Magnitude - Small • Geographic extent – Local • Duration – Short-term • Reversibility – Irreversible • Frequency – Infrequent

6.3.1 Construction Phase

6.3.1.1 Transmission Line

The main potential effects to the aquatic environment of construction of the transmission line revolve around use of machinery and clearing of vegetation in riparian areas at water crossing locations, creation of stream crossings at the transmission line crossing locations and on access trails or roads, and accidental release of deleterious substances to water courses.

The Final Preferred Route will create 19 overhead line water crossings, 4 of which contain important fish habitat, 12 which contain marginal fish habitat and 3 of which do not contain fish habitat. Removal of riparian vegetation (in particular, trees) in the ROW is necessary to ensure safe and reliable use of the transmission lines. In addition, danger trees may be selectively removed outside of the ROW. Removal of riparian vegetation and use of vegetation clearing equipment in riparian areas could cause soil compaction, erosion and sedimentation and bank slumping. Clearing and construction of the transmission line will only occur during winter months, under frozen soil conditions. This alone will greatly reduce the potential for the effects noted above for all watercourse crossings (regardless of the presence and quality of fish habitat), including more sensitive sites (e.g., areas of low bank stability – north and south bank of the O'Hanly River, north bank of the Sandy River).

Forest Management Guidelines for Riparian Management Areas (MCWS 2008) provide examples of strategies for riparian management in the context of forestry activities, for minimizing soil disturbance and erosion. However, these guidelines apply to forestry activities and it is not possible to completely follow all management strategies in these guidelines. For example, under the guidelines, forestry activity is not permitted in the riparian zone (from the edge of merchantable timber and moving upland). Depending on the values for the waterbody (e.g., social concerns, water quality, fish habitat, wildlife) this exclusion zone may extend from the edge of the merchantable timber near the water up to 100 m away from the water. For any transmission line project, it is critical to remove all trees (including tree species of a non-merchantable size) to ensure safe and reliable operation of the transmission line, and thus, trees will have to be removed in the riparian zone. There are however, other aspects of the aforementioned forestry guidelines that can be adopted for The Project, including use of machine-free zones, maintaining shrub understory, felling timber away from a watercourse, and not depositing slash on banks.

In addition, Fisheries and Oceans Canada (DFO) have developed Operational Statements (procedures) for all aspects of the construction and operation of overhead transmission lines in riparian areas and water crossings. When proponents adhere to these Operational Statements, DFO considers the risk to fish habitat to be minimal, and no further EA or authorization is required under the *Fisheries Act*. The Operational Statement for Overhead Line Construction (DFO 2007a) provides the requirements for use and placement of equipment and structures in riparian areas, and the removal of vegetation along the ROW in riparian areas. Requirements in this Operational Statement, which Manitoba Hydro will comply with, are:

- construction activities to preferably occur under frozen ground conditions;
- Design and construct ROW approaches so that they are perpendicular to the watercourse;
- avoid building structures on meander bends, braided streams, alluvial fans, active flood plains or other areas that are unstable;
- wherever possible, place all temporary or permanent structures sufficiently above the high water mark;
- keep removal of riparian vegetation to a minimum;
- operate machinery on land and in a manner that minimizes disturbance to the banks of the watercourses;
- stabilize any waste materials (slash) that are removed; and
- re-vegetate areas that are disturbed.

In addition to the above, the following mitigation measures will be utilized where practical:

- restricting the removal of vegetation within riparian areas to tree species. Shrubs and understory species are to be maintained;
- in riparian areas with merchantable trees, use of hand felling or use of mechanical clearing (e.g., feller-buncher) with a 7 m wide machine free zone. In all other riparian areas, use of a 7 m machine free zone (except in instances where machinery need to cross the frozen watercourse to access the opposite bank);
- all clearing areas and sensitive areas will be clearly marked prior to operation;
- removal of shrubs and trees in such a way as to not disturb the root systems, in order to keep soil structure intact;
- placement of all structure foundations and installations above the high water mark and
- Placement of all debris (slash) above the high water mark. Ensure slash piles are secure.

6.3.1.2 Water Crossings at Transmission ROW and on Access Trails and Roads

Temporary water crossings during the construction phase will be required to transport machinery and materials to the ROW for construction activities. Existing trails and roads, with their existing crossings (bridges, culverts) will be used, as much as practical. Where existing access does not exist, or where water crossing structures (bridges, culverts) have been removed previously, new water crossings will be constructed or previous crossing locations will be used. Temporary culverts will not be used as a crossing structure. As construction will only occur in frozen conditions, environmental effects of crossing installations will be minimized and avoid sensitive periods for fish (e.g., spawning periods). Under the *Fisheries Act*, no one may carry out a work or undertaking that will cause the HADD of fish habitat, unless it has been authorized by DFO. DFO has developed Operational Statements for Temporary Stream Crossings (for fords and bridges)(DFO 2007b), Isolated or Dry Open-Cut Stream Crossings (DFO 2007c) and Ice Bridges and Snow Fills (DFO 2007d) to ensure compliance with *The Fisheries Act*. According to DFO, when all the requirements provided in the Operational Statements are followed, the proponent will be in compliance with subsection 35(1) of the *Fisheries Act*. As much as possible, and in particular, for larger creeks and rivers that are crossed by the transmission line, ice bridges and snow fills will be utilized. These types of crossings have the least effect on fish habitat. One-time fording of open water will not likely be required, as construction activities will take place in winter, although dry fording may be used across ephemeral creeks that are dry at the time of construction activities. The use of the different types of water crossings will be dictated by the local site conditions, but in all cases, the requirements of the Operational Statements will be followed. Mitigation measures found in these Operational Statements include, among others:

- Temporary water crossings will be constructed only where existing ones do not exist, or are not practical for use. Existing access trails or roads, and their associated crossing structures will be used as much as possible.
- Temporary crossings will include snow fills, ice bridges, bridges, or one-time fords.
- Crossings will be constructed on a straight portion of the watercourse, and at a perpendicular angle to the channel. Meander bends will be avoided.
- Clean materials (including snow) will be used in the construction of temporary water crossings. Upon project completion or before spring melt (whichever comes first), all materials will be removed.
- If water is used to build up an ice bridge, intakes will be sized and screened to prevent debris blockage and fish mortality.
- Where required, banks will be protected from erosion by use of pads, swamp mats, or other means. Sediment and erosion control measures will be inspected to ensure their effectiveness;
- Re-vegetate banks if necessary.
- Crossing structures will not impede water flow.
- Refueling and storage of fuel will be at least 100 m from the high water mark.

6.3.1.3 Accidental Spills and Leaks of Substances Hazardous to Aquatic Environments

The accidental release (e.g., through spills, leaks) of deleterious substances such as fuels, lubricants, hydraulic fluids and concrete wash water will be mitigated by:

- at all times during construction, materials will be available at the construction sites to contain and recover spills of fuel and other fluids;
- construction crews to be adequately trained in spill prevention and clean up procedures;
- all petroleum and allied products will be handled in compliance with the requirements of Manitoba Regulation 188/2001;
- harmful substances (e.g., fuels, chemicals, lubricants) will be stored more than 100 m from the high water mark of watercourses;
- re-fueling and maintenance of machinery will occur more than 100 m from the high water mark of watercourses;
- all machinery will arrive on site in a clean condition, free of leaks;
- emergency spill kits will be kept on site at all times; and
- neutralization of concrete wash water, and no release to the soil within 100 m of a watercourse

6.3.1.4 Manigotagan Corner Station

Construction activities at the Manigotagan Corner Station Site will include clearing of vegetation, grubbing of the site, installation of foundations and equipment (e.g., transformers, breakers, switches). Given the large distance (1.8 km) to the nearest watercourse (Wanipigow River), there is no potential for interaction of construction activities with the aquatic environment.

6.3.1.5 Pine Falls Generating Station

Construction activities at the Pine Falls Transmission station will all occur within the fenced and bermed area of the existing transmission site. Construction will only include installation of new equipment (transformers, breakers). Given that the entire site is bermed, there is no potential for interaction of construction activities with the aquatic environment.

6.3.2 Operation and Maintenance Phase

6.3.2.1 Transmission Line

Operation and maintenance of the transmission line involves regular inspections of the installations (towers, conductors) and vegetation management. These activities occur year-round. Vegetation management will follow DFOs Operational Statement for Maintenance of Riparian Vegetation in Existing Right-of-way (DFO 2007e), and include the following mitigation measures:

- vegetation in riparian areas will be maintained in such a way as to leave root systems intact, which will minimize soil erosion;

- riparian vegetation maintenance within 30 m of the high water mark will affect no more than one third of the woody vegetation (tree and shrub) within the ROW;
- where practical, and in particular near banks with low stability, where risk of erosion or bank slumping is likely, or in non-frozen periods, hand clearing of vegetation will be undertaken;
- methods of vegetation management will minimize bank disturbance. Appropriate protection measures will be used if rutting or erosion is likely to occur;
- all slash will be placed well above the high water mark and stabilized;
- if herbicides are utilized, preparation, application and clean up will follow appropriate best management practices. Application of herbicide will only be conducted by a certified applicator;
- disturbed areas in the riparian area will be stabilized through seeding, planting, mulching or through other appropriate means to prevent erosion and sedimentation in watercourses;
- erosion control measures will be routinely inspected to ensure their effectiveness;
- re-fueling and maintenance of machinery will occur more than 100 m from the high water mark of watercourses;
- all machinery will arrive on site in a clean condition, free of leaks; and
- emergency spill kits will be kept on site at all times

6.3.2.2 Water Crossings at Transmission ROW and on Access Trails and Roads

Water crossings or water crossing locations utilized for the construction phase may be utilized for access to the ROW for inspection and vegetation management purposes. Mitigation measures identified for the construction of such crossings were identified previously, and will be followed.

6.3.2.3 Manigotagan Corner Station and Pine Falls Generating Station Switchyard

Operations and maintenance at the Manigotagan Corner Station Site will include vegetation management and servicing of equipment. Given the large distance to the nearest watercourse, there are no interactions of these activities with the aquatic environment. Similarly, operations and maintenance at the Switchyard will include servicing of equipment. The area is isolated form the Winnipeg River by an earthen berm. There are no interactions with the aquatic environment, and thus, no residual effects at either station.

6.4 Interactions with Other Projects

The spatial boundary for the interactions with other projects is the Project Study Area. Potential interactions were determined for adverse residual effects to VECs that have the potential to interact with the effects of other past, current, or future projects and human activities. VECs with no residual effect or a positive residual effect are not included in the assessment. Finally, the assessment only includes adverse residual effects on VECs that overlap both spatially and temporally with the effects of other projects and human activities.

Project and human activities were selected for inclusion in the assessment based on the following criteria:

- Past Projects: Projects within the Study Area whose ongoing effects can be reasonably expected to change in the future and, as a result of those changes, interact with this Project's adverse residual effects.
- Current Projects: Projects in construction, development or operation within the Study Area.
- Future Projects: Projects approved for construction/development or in the permitting pipeline within the Study Area.
- Prospective Projects: Projects announced in the Study Area (e.g., wind farms, transmission expansion, government vision statements) but not yet moving along a development or permitting pathway, and any projected changes in land use patterns (e.g., changes in agricultural activity).

There are several past, on-going and proposed development projects in the region that currently has spatial overlap with, or will overlap spatially in the future with the Project. These are listed in Table 6.2. From an aquatic resource perspective, the greatest degree of overlap with some of these projects is through creation of/use of watercourse crossing locations and infrastructure. The Project will, as much as practical, utilize existing access trails and watercourse crossing locations that were created through past development projects (in particular, through past forestry activities). In this way, the reuse of such infrastructure will reduce the potential for project effects on the aquatic environment, by reducing the need to construct new crossings. Several main forestry roads in the region have been recently decommissioned by Tembec Inc., as partial fulfillment of their obligations under their former Environment Act Licence for Forest Management Licence Area 01. In addition, MCWS has also undertaken decommissioning of main forestry roads in the region as part of a strategy to improve the sustainability of the moose population in Game Hunting Area 26 (through limiting access and thus, moose hunting opportunities). Access decommissioning activities of Tembec Inc. and the provincial government also involved removal of stream crossing infrastructures (culverts, bridges). Where practical, the Project will utilize these stream crossing locations.

Table 6-2 Projects and Activities with the Potential to Interact with the Project

Sector	Project	Description	Location	Status	Timelines
Mining	San Gold Mine Expansion	• Planned expansion of San Gold's Gold Mine and tailings pond in Bissett, northeast of Project Study Area • Production is expected to double	Northeast of Project Study Area	Ongoing	
	Mineral Exploration	• The north end of the Project Study area overlaps with many mining claims and exploration activities (e.g. drill holes) • Mining claims are held by Golden Pocket Resources, DLW Gold Ventures Inc., Canada Bay Resources Ltd., and San Gold Corp.	North of Project Study Area	Ongoing/ Planned	
	Quarry Development	• There are 83 quarry leases within the Project Study Area, several in close proximity to the Project • Lease holders include private companies, as well as Manitoba Infrastructure and Transportation (MIT), and the East Side Road Authority • Development and expansion of existing and new quarries is likely, particularly for projects such as the East Side Road	Within the Project Study Area	Ongoing/ Planned	
Forestry	Timber Resource Harvesting	• Request for Proposal (RFP) to for timber resource harvesting in FML01 by Manitoba Conservation and Water Stewardship (Manitoba Conservation and Water Stewardship [MCWS]) • A potential respondent to the RFP would be a community and forest industry joint venture being spearheaded by the Manitoba Model Forest (Winnipeg River Integrated Wood and Biomass Project) • This would result in an estimated 400 to 450 direct jobs, up to 400,000 m^3 softwood/year and 200,000 m^3 hardwood/year	Within the Project Study Area	Planned	Within 1 – 3 years
Wildlife	Closure of Licensed and Rights Based Moose Hunting	• As of January 26, 2012, all licensed hunting in Game Hunting Area (GHA) 26 is closed • In addition, moose protection zones in areas of heavy moose concentration areas along roads and rivers are closed to hunting for rights-based peoples • Proposed decommissioning of roads by MCWS	GHA 26 within the Project Study Area	Ongoing/ Planned	2012

Table 6-2 Projects and Activities with the Potential to Interact with the Project (continued)

Sector	Project	Description	Location	Status	Timelines
Transportation & Communication Infrastructure	East Side Road Authority	• Construction of a 156 km all season gravel road along the east side of Lake Winnipeg from Provincial Road #304 east of Hollow Water to Berens River First Nation	North of Project Study Area	Ongoing	2010 - 2014
	Fibre Optic Cable	• The San Gold Mine in Bissett, and several community members have expressed an interest in fibre optic cable service in the area	Within and northeast of Project Study Area	Potential	Unknown
Cottage Development	Black River First Nation Cottage Development Initiative	• Expansion of cottage development within the Black River First Nations territory in conjunction with MCWS • Phase I of the project is underway with road development underway for servicing of 50 cottage lots • Future phases are planned for an additional 550 additional cottage lots	Black River First Nation Reserve at the west of the Project Study Area	Ongoing/ Planned	Phase I: underway (year 1 of 5) Phase II:– 5 – 10 years
	Hollow Water First Nation Cottage Development Plans	• Considering cottage development projects with MCWS	Hollow Water First Nation Reserve at the north end of the Project Study Area	Potential	Unknown
	Sagkeeng First Nation Cottage Development Plans	• Considering cottage development projects with MCWS	Sagkeeng First Nation Reserve at the southwest end of the Project Study Area	Potential	Unknown

Mineral exploration, particularly in the northern part of the Project Study Area, has increased significantly in the last few years, in part due to high commodity prices. Mineral exploration activities can require watercourse crossings to access areas for exploration. Depending on the location of exploration activities, access trails and watercourse crossings utilized by the Project could be re-used, or new watercourse crossings may be developed. The overall environmental footprint of the multiple industries on the landscape can be reduced through joint planning and use of access trails and watercourse crossings.

6.5 Monitoring and Follow-Up

Transmission line construction and maintenance activities pose a low risk to fish habitat. However, the most direct effects relate to erosion and sedimentation at water crossings, due to removal of riparian vegetation and use of machinery in riparian areas. Mitigation measures previously identified will greatly reduce or eliminate effects. Therefore, minimal monitoring and follow up is required.

Monitoring will include:

- Visual inspection of all riparian areas within the ROW and at water crossing locations along temporary access trails and roads for signs of erosion and sedimentation. Any disturbed site will be re-vegetated. If necessary, more aggressive erosion control methods such as erosion control blankets or other means will be used.

No aquatic monitoring is required for construction and maintenance of the Manigotagan Corner Station Site or the Switchyard.

7 CONCLUSIONS

The Final Preferred Route crosses a total of 19 watercourses. This includes 10 natural watercourses (creeks, rivers, beaver ponds) and nine man-made (anthropogenic) water features (highway drainage channels and water-filled borrow pits/quarries). Only four of the watercourse crossing locations contain important fish habitat, and none are located at known fish spawning sites. There are no known aquatic species at risk (invertebrates or fish) at or near the crossing locations. One VEC was selected for the aquatic environment: fish habitat. Fish Habitat includes both the physical habitat (represented by water depth and velocity) and water quality (represented by pH, dissolved oxygen, TSS and turbidity). The construction and operation/maintenance of overhead transmission lines poses a low risk to fish habitat. The effects assessment found that, of all project activities associated with the transmission line, only loss of riparian vegetation (through initial ROW clearing and from subsequent vegetation management) could lead to a potential effect through erosion and sedimentation at ROW water crossing locations. However, with application of proper mitigation measures, residual effects are expected to be negligible. Where possible, existing access trails and roads (and their associated water crossings) will be used to provide temporary access for construction and maintenance activities in the Line PQ95 ROW. Where required, temporary water crossings may be developed, in accordance with DFO Operational Statements. Mitigation measures in place for water crossings will ensure that residual effects will be negligible. Accidental release of deleterious substances (fuels, oils, hydraulic fluids) to watercourse will be mitigated through appropriate spill prevention techniques.

The project also includes the development of the Manigotagan Corner Station Site and additions of equipment to the Switchyard. Due to the large distance of the proposed Manigotagan Corner Station Site to the nearest waterbody (the Wanipigow River, 1.8 km from the station site) and due to all modifications to the Switchyard being undertaken within the existing, bermed site, there are no project interactions between the station activities (construction or operations and maintenance) with the aquatic environment.

Residual effects are expected to be negligible and the interaction of the LWESI transmission Project with other existing or future projects will result in residual effects that are not measurable.

8 REFERENCES

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9 GLOSSARY

Aboriginal Traditional Knowledge (ATK): Knowledge that is held by and unique to Aboriginal peoples. It is a living body of knowledge that is cumulative, dynamic and adapted over time. It often includes knowledge about the land and its resources, spiritual beliefs, language, culture, customs, laws and medicines.

Alternative Routes: As a standard practice for new transmission line projects, Manitoba Hydro develops several options for routing transmission lines. The options are then evaluated through a Site Selection and Environmental Assessment process to identify a preferred route.

Aquatic Macrophyte: Aquatic plants that grow in or near water, and can include floating (e.g., duckweed), submergent (e.g., pondweed) and emergent (e.g., cattail, rush) plants.

Bankfull Width: The width the water of a watercourse (creek, river) when water levels are at the top of the banks.

Benthic Invertebrates: Aquatic invertebrates (organisms without a backbone) that live on or in the bottom sediments of waterbodies (e.g., larval forms of insects, clams, crayfish).

Borrow Pits: Areas excavated (usually for sand or gravel) for construction purposes, such as construction of roads or highways.

Danger Trees: Trees located outside a cleared transmission line right-of-way but which may pose a risk of contact or short circuit with the line or structures. Danger trees are removed, usually by hand felling.

Deleterious Substances: Any substance that, if added to any water, would degrade or alter the quality of that water so that it becomes toxic or harmful to aquatic organisms and habitat.

Discharge: The volume rate of water flow in a watercourse, and can be expressed as cubic metres per second (m^3/s).

Dystrophic Water Body: A waterbody with brown or tea-coloured water, caused by high concentrations of humic acids from peatlands.

Ecoregion: An ecologically and geographically defined area that is smaller than an ecozone. The biodiversity of plants and animals that characterize an ecoregion are distinct from other ecoregions.

Ecozone: A broad, biogeographic classification of the earth's land surface, based on distribution patterns of terrestrial organisms.

Endangered Species: A wildlife species listed under the Species at Risk Act that is facing imminent extirpation or extinction.

Ephemeral Watercourse: A watercourse where water level and flow are highly dependent on precipitation events (rainfall or snowmelt), and where the watercourse channel can be dry for extended periods of time during dry weather.

Feller Bunchers: A type of mechanical (machine) harvester used in logging. A motorized vehicle with an attachment that can rapidly cut and gather several trees before felling them.

Floodplain Width: The width of water in a watercourse (creek, river) when water levels are higher than the banks, and flood adjacent areas. Floodplain areas are inundated periodically, and have vegetation communities that are different than the adjacent upland areas.

Forest Resource Inventory: A digital inventory and spatial database of tree species, vegetation community types and their attributes (such as age and volume).

Geographic Information System (GIS): A computerized information system that uses geo-referenced spatial and tabular databases to capture, store, update, manipulate, analyze and display information.

Grubbing: The act of removing roots from soil using a root rake, harrow or similar device.

High Water Mark (HWM): The visible high water mark of a waterbody of water where the presence and action of the water over many years create a distinct mark on the banks. A high water mark can be visible as a natural line or "mark" impressed on the bank or shore, the presence of a shelf, or changes in soil or vegetation characteristics.

Ice Bridge: A temporary crossing of a waterbody in winter. Creation of a ice bridge can include flooding the ice surface to create a thicker and stronger ice bridge to support heavy vehicles or machinery.

Important Fish Habitat: In the context of the LWESI project, important fish habitat is found in perennial watercourses that contain water and flow all year, and which have sufficient water depth to prevent freezing to the bottom as well as sufficient dissolved oxygen concentrations to support fish all year.

Intermittent Watercourse: A watercourse that contains water or flow for most of the year, but where flow can cease seasonally or periodically.

Large Woody Debris: Trees, logs, branches and other wood that fall into watercourses. Large woody debris provides important fish habitat, and can alter flow and channel characteristics of a watercourse.

Macroinvertebrates: An aquatic organism that lacks a back bone, and is visible to the unaided eye. Examples include clams, crayfish, water beetles, damsel flies, caddis flies.

Marginal Fish Habitat: In the context of the LWESI project, marginal fish habitat includes intermittent watercourses where water or water flow may not be present year-round, and where water depth is likely shallow enough to enable freezing to the bottom in winter. Dissolved oxygen concentrations are likely not sufficient (particularly in winter) to sustain fish. Fish habitat in only available for a portion of the year.

Microinvertebrates: An aquatic organism that lacks a back bone, and is more easily viewed by using a microscope. Examples include zooplankton such as cladocerans and copepods.

Mitigation: With respect to a Project, the elimination, reduction or control of the adverse environmental effects of the project.

Peatland: A diverse group of plant ecosystems that are characterized by very slow decomposition rates, leading to accumulation of peat over time. Includes bogs, fens and swamps.

Perennial Watercourse: A watercourse (e.g., creek, river, lake) that contains water in parts of its channel, and in the case of flowing water ecosystems, water flow throughout the entire year under typical climatic conditions.

Periphyton: A diverse community of algae that grow attached to substrates such as rocks, bottom sediments and aquatic plants.

Phytoplankton: A diverse group of algae that inhabit the water column in waterbodies. Phytoplankton (and algae in general) form the base of the aquatic food web, providing food for higher trophic levels.

Protected Species: Plant and animal species protected under the *Species at Risk Act* (Federal) or the *The Endangered Species Act*.

Quarry: An open excavation area or pit from which stone, gravel or sand is obtained by digging, cutting or blasting.

Residual Environmental Effect: An environmental effect that remains, or is predicted to remain, even after mitigation measures have been applied.

Right-of-way (ROW): A strip of land controlled and maintained for the development of a linear infrastructure such as a road or transmission [or distribution] line.

Riparian Ecosystem: The ecosystem located between aquatic and terrestrial environments. Riparian ecosystems generally have soil characteristics or vegetation communities that differ from adjacent aquatic and terrestrial ecosystems.

Riparian: Refers to terrain, vegetation or simply a position adjacent to or associated with a stream, flood plain, or standing body of water.

Site Selection and Environmental Assessment (SSEA): Process used to select a site or route for a transmission facility (i.e., a station or a transmission line) and assess any potential environmental impacts of that facility on the biophysical environment and socio-economic conditions.

Special Concern Species: A wildlife species listed under the *Species at Risk Act* that may become threatened or endangered because of a combination of the species' biological characteristics and identified threats.

Species at Risk: A wildlife species that is extirpated, endangered, threatened or of special concern.

Study Area: In the context of describing the existing aquatic environment for the LWESI project, the area bounded by the Winnipeg River in the south, Wanipigow River in the north, eastern shore of Lake Winnipeg in the west, and Manitoba-Ontario border in the east.

Threatened Species: A wildlife species listed under the Species at Risk Act that is likely to become endangered if nothing is done to reverse the factors leading to its extirpation or extinction.

Valued Environmental Component: Any part of the environment that is considered important by the proponent, public, scientists, and government involved in the assessment process; importance may be determined on the basis of societal or cultural values, or scientific interest or concern. For the aquatics assessment of the LWESI project, fish habitat was chosen as the aquatics VEC.

Wetted Width: The width of water in a watercourse (creek, river) at a particular moment in time. Wetted width can be much less than the bankfull width when water levels are low, exposing parts of the watercourse channel.

Zooplankton: A diverse group of small, aquatic organisms that lack back bones, inhabiting the water column in waterbodies. Zooplankton are important food items for small fish.