TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

LIST OF PHOTOGRAPHS

LIST OF APPENDICES

8.0 AQUATIC ENVIRONMENT

The Aquatic Environment chapter provides information on the existing conditions for fish and fish habitat, freshwater mussels and aquatic Species at Risk in the P4 Project Local and Regional Assessment Areas, including data gathered from desktop studies and field investigations and information provided by local communities on their traditional subsistence and cultural activities that involve the aquatic environment. The linkages between the Project activities and the aquatic environment were examined to determine the potential effects of the Project activities on fish, freshwater mussels, aquatic Species at Risk and their habitats and mitigation measures to avoid or minimize the potential effects were identified. The residual effects remaining after the application of mitigation measures were then summarized and evaluated using the approach and significance criteria outlined in **Chapter 6** (Environmental Impact Assessment Scope and Approach).

8.1 Existing Conditions

The Project aquatic environment study area includes watercourses and waterbodies located between Berens River First Nation and Poplar River First Nation as shown in **Figure 8-1**. Watercourses and waterbodies in the area include:

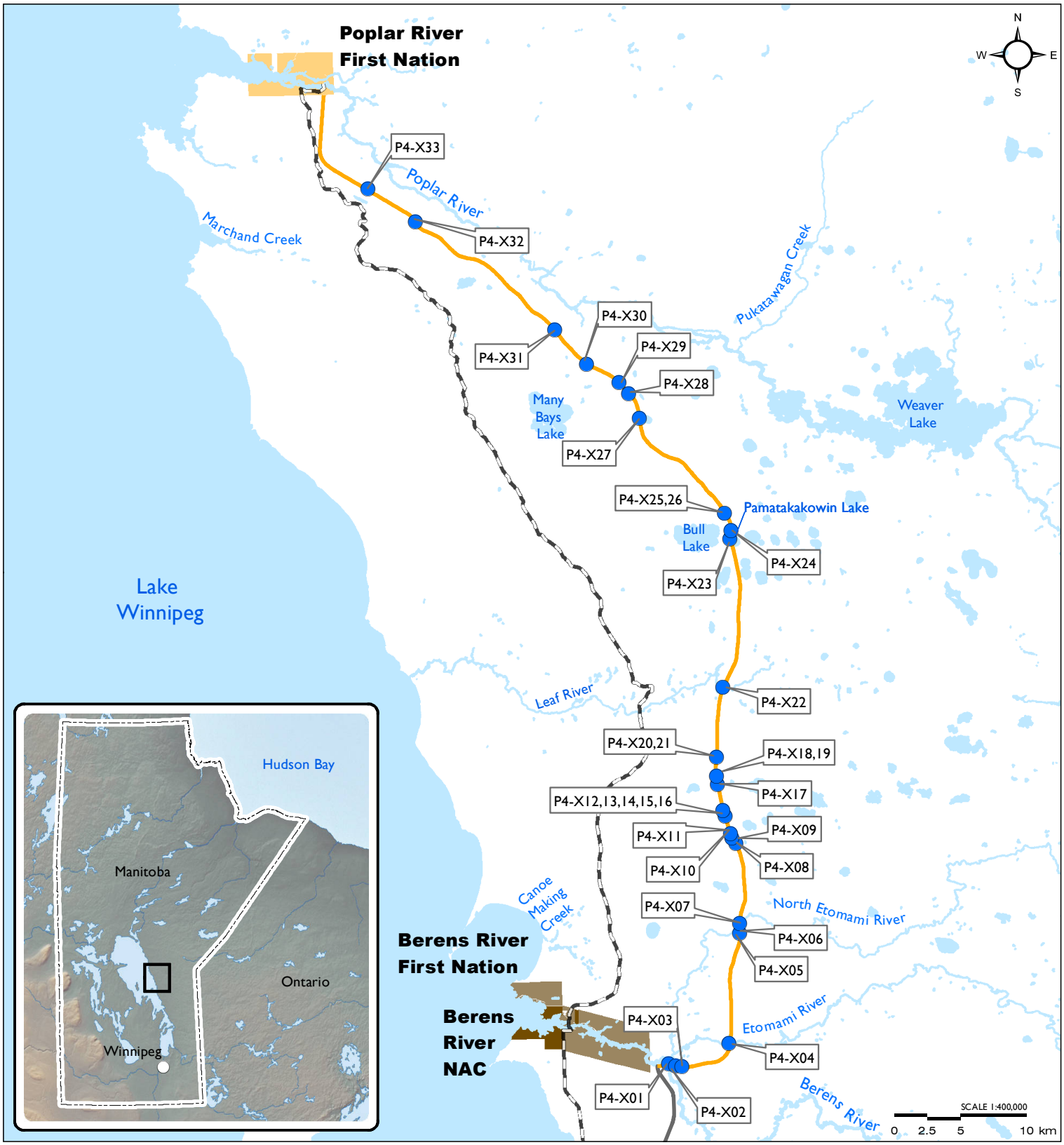
- Berens, Etomami, North Etomami, Leaf and Poplar rivers;
- Canoe Making, Marchand, Pukatawagan and Okeyakkoteinewin creeks;
- Weaver, Bull, Many Bays and Pamatakakowin lakes;
- Several unnamed tributaries of the above named watercourses and waterbodies; and
- Other named and unnamed smaller lakes, creeks, drains, ponds and wetland areas.

Chapter 3 (Project Description), **Section 3.3.2**, indicates that the proposed all-season road route will require the construction of 33 watercourse crossings. Crossings at fish-bearing watercourses include:

- Multi-span bridges at the Berens and Etomami Rivers;
- Clear-span bridges at the North Etomami and Leaf Rivers;
- Large diameter (>900 mm) culverts at Okeyakkoteinewin Creek; and
- Small diameter culverts (minimum 900 mm diameter) at five unnamed streams.

Equalization culverts will be installed at an estimated 23 non-fish-bearing watercourse crossings to maintain existing water flow and drainage patterns. Information on the design criteria for the proposed bridges and culverts to be installed as part of the Project is provided in **Chapter 3.**

Figure 8-1 illustrates the locations of the watercourse crossings along the all-season road. A list of the site names corresponding to each of the site numbers is provided in **Table 8.1,** as well as information on whether the watercourse provides fish habitat and is part of a Commercial, Recreational or Aboriginal (CRA) fishery as defined under the *Fisheries Act* (Fisheries and Oceans Canada 2015a), and the proposed crossing structure for each watercourse crossing. Detailed descriptions of the aquatic habitat at the watercourse crossings are provided in **Appendix 8-1** and are summarized within this chapter.



Project 4 - All-Season Road Connecting Berens River to Poplar River First Nation

Figure 8-1
Aquatic Environment Study Area and Water Crossings

- P4 All-Season Road Alignment (October 2015)
- Crossing
- P1 All-Season Road (South of Berens to PTH 304) - Under Construction
- 2013/2014 Manitoba Winter Road
- Berens River First Nation Reserve
- Poplar River First Nation Reserve
- Berens River Northern Affairs Community

Map Drawing Information:
ESRI Base Layers, Province of Manitoba, CanVec, GeoGratis, Dillon Consulting Limited

Map Created By: ECH
Map Checked By: MG/PS/LD
Map Projection: NAD 1983 UTM Zone 14N

DATE: 4/8/2016

MANITOBA East Side Road AUTHORITY

Table 8.1: List of Watercourse Crossing Sites

Site Number	Site Name	Provides Fish Habitat	Part of a CRA Fishery	Crossing Structure
P4-X01	Berens River	Y	Y	Multi-span bridge with 1 in-water pier
P4-X02	Unnamed drainage	N	N	Small Diameter Culvert
P4-X03	Unnamed Etomami River Tributary	Y	N	Single or Multiple Round Culverts
P4-X04	Etomami River	Y	Y	Multi-span bridge with 2 in-water piers
P4-X05	Unnamed North Etomami River Tributary	Y	N	Single or Multiple Round Culverts
P4-X06	Unnamed drainage	N	N	Small Diameter Culvert
P4-X07	North Etomami River	Y	Y	Clear-span bridge (no in-water piers)
P4-X08	Unnamed drainage	N	N	Small Diameter Culvert
P4-X09	Unnamed drainage	N	N	Small Diameter Culvert
P4-X10	Unnamed drainage	N	N	Small Diameter Culvert
P4-X11	Unnamed drainage	N	N	Small Diameter Culvert
P4-X12	Unnamed drainage	N	N	Small Diameter Culvert
P4-X13	Unnamed drainage	N	N	Small Diameter Culvert
P4-X14	Unnamed drainage	N	N	Small Diameter Culvert
P4-X15	Unnamed drainage	N	N	Small Diameter Culvert
P4-X16	Unnamed drainage	N	N	Small Diameter Culvert
P4-X17	Unnamed drainage	N	N	Small Diameter Culvert
P4-X18	Unnamed drainage	N	N	Small Diameter Culvert
P4-X19	Unnamed drainage	N	N	Small Diameter Culvert
P4-X20	Unnamed drainage	N	N	Small Diameter Culvert
P4-X21	Unnamed drainage	N	N	Small Diameter Culvert
P4-X22	Leaf River	Y	Y	Clear-span bridge (no in-water piers)
P4-X23	Unnamed drainage	N	N	Small Diameter Culvert
P4-X24	Unnamed Pamatakakowin Lake Tributary	Y	N	Single or Multiple Round Culverts
P4-X25	Unnamed drainage	N	N	Small Diameter Culvert
P4-X26	Unnamed drainage	N	N	Small Diameter Culvert
P4-X27	Unnamed creek	N	N	Small Diameter Culvert
P4-X28	Unnamed creek	N	N	Small Diameter Culvert
P4-X29	Unnamed Okeyakkoteinewin Creek Tributary	Y	N	Multiple Round or Steel Arch Culverts
P4-X30	Okeyakkoteinewin Creek	Y	Y	Steel Arch or Reinforced Concrete Box Culvert
P4-X31	Unnamed Okeyakkoteinewin Creek Tributary	Y	N	Single or Multiple Round Culverts
P4-X32	Unnamed drainage	N	N	Small Diameter Culvert
P4-X33	Unnamed drainage	N	N	Small Diameter Culvert

Source: Associated Engineering 2015; **Appendix 8-1**

North/South Consultants Inc. conducted detailed aquatic environmental studies in the area to identify and describe the aquatic habitats and aquatic species that may be potentially affected by the Project (**Appendix 8-1**). Summary information from these studies is provided throughout this chapter. Field surveys included the collection of fish, mussel and habitat data at proposed watercourse crossings along the all-season road alignment. Data collection included observations and measurements of instream parameters such as water depth, velocities and substrates, as well as information on the floodplain and/or riparian vegetation (streamside vegetation directly influenced by water levels) associated with the watercourses.

Detailed aquatic environmental desktop and field studies were conducted to identify and describe the aquatic habitat that may be potentially affected by the Project.

For the purpose of scoping the spatial extent of the aquatic environment study area for the environmental impact assessment, the spatial boundaries for the aquatic environment are described as follows:

Project Footprint is the physical space or directly affected area on which the Project components or activities are located. For the aquatic environment, the Project Footprint is the area of the watercourses directly affected by the road crossings, including the riparian zone areas and right-of-way associated with the watercourse crossing.

Local Assessment Area is the area beyond the Project Footprint which Project effects are measurable. For the aquatic environment, the Local Assessment Area includes areas upstream or downstream of the crossings that may be affected by the all-season road crossings (e.g., by changes in flow patterns).

Regional Assessment Area is the area beyond the Local Assessment Area within which most indirect and cumulative effects would occur. For the aquatic environment, the Regional Assessment Area would include areas upstream or downstream of the Local Assessment Area that are connected to watercourse reaches within the Project Footprint (e.g., the headwater areas of the affected rivers and creeks and Lake Winnipeg at the outlets of the Berens, Etomami, North Etomami, Leaf and Poplar rivers and Poplar Point Creek).

The Project area is located within the Berens River and Wrong Lake Ecodistricts. The rivers and creeks in the Regional Assessment Area flow toward Lake Winnipeg and are part of the Lake Winnipeg East drainage division (Smith *et al.* 1998). The aquatic environment within the Local Assessment Area adjacent to the Project Footprint provides a variety of habitats, ranging from small ephemeral and intermittent creeks, ponds and wetland areas to large rivers and lakes with permanent flows and depths. The smaller watercourses provide low to moderate quality aquatic habitats during spring runoff and major precipitation events, and the larger rivers and lakes provide high quality aquatic habitats year-round for fish and other aquatic organisms. The aquatic assessment was focused on the watercourses within the Project Footprint and Local Assessment Area that would be potentially affected

by Project activities. Additional information on fish habitat within the Project Footprint and Local Assessment Area is provided in **Section 8.1.2** and **Appendix 8-1**.

8.1.1 Traditional Knowledge

Capturing fish for food is a traditional subsistence activity of the Berens River First Nation and Poplar River First Nation communities that continues today as an important part of meeting community food and cultural needs. Traditional subsistence fishing activities expanded into commercial activities with the arrival of European settlers in Manitoba, with important fishing posts established at Berens River First Nation and other communities in the region (Leach 1971; Sigfusson 1992). In the early days of commercial fishing, fish were transported by boat during the open water season and by dog teams in the winter season, and later on by hauling sleighs with tractors that carved winter roads through the bush and over frozen lakes and rivers in the winter season (Leach 1971; Sigfusson 1992).

During workshops and interviews conducted with Berens River First Nation, Berens River Northern Affairs Community (NAC) and Poplar River First Nation as part of the Project Aboriginal and Public Engagement Program (**Chapter 4**), members from Poplar River First Nation shared that several species of fish inhabit the Poplar River and creeks in the area, including northern pike[1] (also referred to as jackfish), burbot, tullibee, sunfish, lake sturgeon, carp, walleye (also referred to as pickerel), suckers, whitefish, catfish, minnows and smelt, along with turtles and crayfish (CIER and Poplar River First Nation 2015). People from Berens River First Nation and Berens River NAC indicated that a number of fish species are harvested from the Berens, Etomami, North Etomami and Leaf rivers for food, income and cultural purposes. Fish species harvested from these rivers include channel catfish, lake sturgeon, lake whitefish, northern pike, walleye and sucker species such as shorthead redhorse (also referred to as red suckers). Local communities also indicated that they participate in commercial fishing activities in Lake Winnipeg (CIER 2015; CIER and Poplar River First Nation 2015). Fish species harvested from Lake Winnipeg include lake sturgeon, lake whitefish, northern pike, sauger, walleye, white bass, yellow perch and sucker species such as shorthead redhorse.

8.1.2 Fish Habitat

As noted above, the aquatic environment in the Local Assessment Area includes a range of ephemeral, intermittent and perennial watercourses that provide a variety of low to high quality fish habitat. The quality of the fish habitat is based on the availability of the flows, depths, substrates, cover, water quality, food items and connectivity to other aquatic environments required by different fish species for their particular life cycle needs (e.g., spawning, rearing, feeding, movement and overwintering). In general, fish habitat quality and species diversity increase as the size of the watercourse and permanence of flow (ephemeral, intermittent, or perennial) in the watercourse increases. Exceptions to this generality occur when there are barriers within the watercourse that affect flow patterns or fish movements (e.g., beaver dams and waterfalls). Some fish species move from larger lakes and rivers to smaller tributaries and creeks for their reproductive or other life cycle requirements. As such, the

[1] **Table 8.3** in **Section 8.1.3** provides the family, common name and scientific name for fish species referenced.

importance of smaller watercourses as fish habitat is often related to the connectivity of the smaller upstream headwater areas to larger downstream habitats.

The medium to large-sized rivers in the Regional Assessment Area (i.e., the Berens, Etomami, North Etomami, Leaf and Poplar rivers) provide perennial flows and substrates that create a diverse array of habitats that are available to fish and other aquatic organisms on a year-round basis. Habitat in these rivers includes reaches of fast-moving water (i.e., riffles and rapids) that pass over coarse substrates such as gravel, rock, boulders and bedrock, as well as reaches of with slow-moving waters (i.e., flats, runs and pools) and substrates of silt, sand and organic materials, as well as macrophytes (**Photograph 8-1**). These larger river systems support a higher number and diversity of fish species, including spring, summer and fall spawning species, due to the variety of habitats that are available year-round.

Okeyakkoteinewin Creek is a moderate-size watercourse with downstream connectivity to the Poplar River (**Photograph 8-2**). Moderately-sized watercourses, such as Okeyakkoteinewin Creek and its tributaries, provide spawning and rearing habitat for large-bodied fish such as northern pike that move into these areas during peak flows in the spring and provide spawning, rearing, feeding, movement and overwintering habitat for small-bodied fish species such as brook stickleback. Water temperatures in these moderately-sized creeks may approach 0°C during the winter and rise above 20°C during the summer.

Photograph 8-1: Berens River – Upstream view at the proposed crossing site, July 2014

Photograph 8-2: Okeyakkoteinewin Creek – Upstream view at the proposed crossing site, July 2014

Smaller watercourses, such as the many unnamed creeks surveyed during the detailed aquatic environmental studies, are typically shallow (<1 m of water depth) and may be part of wetland areas (e.g., bogs and fens) that drain into the larger creeks, rivers, or lakes (e.g., Berens, Etomami and North Etomami rivers) (**Photograph 8-3**). These creeks may have high flows during peak runoff periods in the spring, but may dry up by the summer season and flows will only reoccur under major rain events. Water temperatures in these streams may be near 0°C at ice break-up in April or May, but can rise rapidly to over 20°C by late May. Fish use of these small watercourses is dependent on flow.

Photograph 8-3: Unnamed Tributary of Okeyakkoteinewin Creek– Upstream view at the proposed crossing site, July 2014

Under adequate flow conditions, these smaller watercourses may be used by large-bodied fish, such as northern pike, for spawning and rearing habitats and small-bodied fish species, such as brook stickleback, for spawning, rearing, feeding and movement needs. These small streams generally provide little to no over-wintering habitat for fish as they have no flow and/or typically freeze to the bottom. There are also a number of small boreal wetland areas within the study area that are mostly unconnected to fish bearing waters and are often hypoxic (i.e., very low dissolved oxygen levels) or anoxic (i.e., devoid of dissolved oxygen) during winter (**Photograph 8-4**). Due to the lack of adequate flows and connectivity, these areas do not support most fish species. Exceptions are small-bodied fish species, such as brook stickleback, which are tolerant of very low dissolved oxygen levels.

(**Source**: North/South Consultants Inc. 2015)

Photograph 8-4: Unnamed Drainage at Site 14 – Small intermittent channel within a boreal wetland with no downstream connection, July 2014

To assess the potential environmental effects of the proposed all-season road on fish habitat in the Local Assessment Area, the 33 watercourse crossing sites were classified based on the presence/absence of fish and the quality of the habitat provided by the watercourse in the vicinity of each proposed crossing site. **Table 8.2** provides a summary of the classification of fish habitat at the watercourse crossing sites.

To assess the type and level of potential environmental effects on fish habitat in the Local Assessment Area, the 33 watercourse crossing sites were classified based on the presence/absence of fish and the quality of the habitat provided.

Sites P4-X01, P4-X04, P4-X07, P4-X22 and P4-X30 (Berens River, Etomami River, North Etomami River, Leaf River and Okeyakkoteinewin Creek, respectively [see **Figure 8-1** for locations]) were classified as having moderate to high quality habitat suitable year-round for large-bodied and small-bodied (forage) fish species. This classification was based on the presence of perennial flows, the diversity of habitats available year-round for fish and the presence of CRA[2] fish species in these watercourses.

[2] Per the federal *Fisheries Act*, fish habitat includes aquatic habitat that supports fish species that are part of, or support, a Commercial, Recreational or Aboriginal (CRA) fishery (e.g., lake sturgeon, lake whitefish, northern pike, walleye) (Fisheries and Oceans Canada 2015a).

Table 8.2: Summary of Fish Habitat Classification at Watercourse Crossing Sites in the Local Assessment Area

Fish Habitat Classification	Site Names and Numbers[1]	Basis for Classification
Moderate to high quality habitat suitable for large-bodied and small-bodied (forage) fish species	▪ Berens River (Site P4-X01) ▪ Etomami River (Site P4-X04) ▪ North Etomami River (Site P4-X07) ▪ Leaf River (Site P4-X22) ▪ Okeyakkoteinewin Creek (Site P4-X30)	Perennial flow; diversity of habitats available year-round; supports CRA fish species.
Marginal habitat, generally only suitable for small-bodied (forage) fish species	▪ Unnamed Tributary of Etomami River (Site P4-X03) ▪ Unnamed Tributary of North Etomami River (Site P4-X05) ▪ Unnamed Tributary of Pamatakakowin Lake (Site P4-X24) ▪ Unnamed Tributaries of Okeyakkoteinewin Creek (Sites P4-X29 and P4-X31)	Sites are located on small 1st or 2nd order streams that are often poorly connected to downstream fish-bearing waters due to numerous ephemeral barriers (e.g., beaver dams, instream vegetation).
'No Fish Habitat'	▪ Unnamed Drainages (Sites P4-X02, P4-X06, P4-X08-P4-X21, P4-X23, P4-X25, P4-X26, P4-X32 and P4-X33) ▪ Unnamed Creeks (Sites P4-X27 and P4-X28)	Absence of a channel at the crossing and/or lack of connectivity to downstream/upstream fish bearing watercourses or waterbodies.

Note: 1 Refer to **Figure 8-1** for locations of watercourse crossings by site number.
Source: **Appendix 8-1**

Five of the proposed culvert sites were classified as having marginal habitat, suitable for forage fish species and occasionally large-bodied fish species such as northern pike during periods of adequate flows and connectivity:

- Site P4-X03 (Unnamed Tributary of Etomami River);
- Site P4-X05 (Unnamed Tributary of North Etomami River);
- Site P4-X24 (Unnamed Tributary of Pamatakakowin Lake);
- Site P4-X29; and
- Site P4-X31 (both Unnamed Tributaries of Okeyakkoteinewin Creek).

These sites, shown on **Figure 8-1**, are located on small 1st or 2nd order streams that are often poorly connected to downstream fish-bearing waters due to numerous ephemeral barriers. These watercourses typically have small watersheds with limited flows and are often impounded by beaver dams. The limited flows may result in shallow depths and low dissolved oxygen concentrations in these areas, which make them unsuitable as habitat for large-bodied fish.

The remaining 23 watercourse crossings where equalization culverts are proposed (sites P4-X02, P4-X06, P4-X08 to P4-X21, P4-X23, P4-X25- P4-X28, P4-X32 and P4-X33 [unnamed creeks or drains]) were assessed as 'No Fish Habitat' based on the absence of a defined channel at the crossing and/or lack of connectivity to downstream or upstream fish-bearing watercourses or waterbodies. Most of these sites

are not found on hydrographic datasets (i.e., National Hydro Network 1:50,000; CanVec) and are peatlands with no significant headwaters or overwintering habitat nearby.

Additional information on the quality, type and availability of fish habitat in the Local Assessment Area is provided in the aquatic environment technical report prepared by North/South Consultants Inc. (**Appendix 8-1**). The report provides details on the methods and parameters used for the study, as well as the results of the assessment conducted for each proposed watercourse crossing.

8.1.3 Fish Community

A total of 42 fish species from 16 different families are known to be present in the Local Assessment Area watercourses.

Based on the Traditional Knowledge and fisheries information collected for the Project, a total of 42 fish species from 16 different families are known to be present in the Local Assessment Area watercourses (CIER 2015; CIER and Poplar River First Nation 2015; **Appendix 8-1**). Detailed information regarding the fish surveys conducted by North/South Consultants Inc. for the Project is summarized throughout this **Section 8.1.3** and provided in **Appendix 8-1**. The fish species present in each watercourse crossed by the P4 all-season road is dependent on the characteristics of each watercourse and presence of suitable habitat (**Section 8.1.2**). The major river crossings are known to support species that are part of or support a CRA fishery (e.g., lake sturgeon, lake whitefish, northern pike, sucker species and walleye) (**Table 8.1**).

Other species of note include the channel catfish, which is the known fish host for the temporary parasitic stage of larvae (i.e., glochidia) of the mapleleaf mussel, which is a Species at Risk (**Section 8.1.4**).

Table 8.3 provides a list of the fish species known from the major watercourses in the Local Assessment Area.

Table 8.3: Known Fish Species Present in Major Watercourses of the Local Assessment Area

Family	Common Name	Scientific Name	Berens River[1]	Etomami River	North Etomami River	Leaf River	Poplar River[2]
Acipenseridae	Lake sturgeon	*Acipenser fulvescens*	✓				✓
Catostomidae	Longnose sucker	*Catostomus catostomus*	✓				✓
	Quillback	*Carpiodes cyprinus*	✓				
	Shorthead redhorse	*Moxostoma macrolepidotum*	✓				
	Silver redhorse	*Moxostoma anisurum*	✓				
	White sucker	*Catostomus commersonii*	✓		✓	✓	✓
Centrarchidae	Black crappie	*Pomoxis nigromaculatus*	✓				✓
	Rock bass	*Ambloplites rupestris*	✓				✓
Cottidae	Slimy sculpin	*Cottus bairdii*					✓
Cyprinidae	Blackchin shiner	*Notropis heterodon*	✓				✓
	Blacknose shiner	*Notropis heterolepis*	✓				✓
	Common carp	*Cyprinus carpio*	✓				✓[4]
	Emerald shiner	*Notropis atherinoides*	✓	✓	✓		✓
	Fathead minnow	*Pimephales promelas*	✓				✓
	Golden shiner	*Notemigonus crysoleucas*	✓				✓
	Longnose dace	*Rhinichthys cataractae*	✓				✓
	Mimic shiner	*Notropis volucellus*	✓				✓
	Spottail shiner	*Notropis hudsonius*	✓		✓	✓	✓
	Weed shiner	*Notropis texanus*	✓				✓
Esocidae	Northern pike	*Esox lucius*	✓				✓
Gadidae	Burbot	*Lota lota*					✓
Gasterosteidae	Brook stickleback	*Culea inconstans*	✓				
	Ninespine stickleback	*Pungitius pungitius*	✓				✓
Hiodontidae	Goldeye	*Hiodon alosoides*					✓[3]
	Mooneye	*Hiodon tergisus*	✓				
Ictaluridae	Black bullhead	*Ameiurus melas*	✓				

Family	Common Name	Scientific Name	Berens River[1]	Etomami River	North Etomami River	Leaf River	Poplar River[2]
	Brown bullhead	*Ameiurus nebulosus*	✓				
	Channel catfish	*Ictalurus punctatus*	✓				✓
	Tadpole madtom	*Noturus gyrinus*	✓				✓
Moronidae	White bass	*Morone chrysops*	✓				✓
Osmeridae	Rainbow smelt	*Osmerus mordax*					✓[4]
Percidae	Iowa darter	*Etheostoma exile*					✓
	Johnny darter	*Etheostoma nigrum*	✓				✓
	Log perch	*Percina caprodes*					✓
	River darter	*Percina shumardi*	✓				✓
	Sauger	*Sander canadensis*	✓				
	Walleye	*Sander vitreus*	✓	✓	✓	✓	✓
	Yellow perch	*Perca flavescens*	✓				✓
Percopsidae	Trout perch	*Percopsis omiscomaycus*	✓	✓	✓		✓
Salmonidae	Cisco	*Coregonus artedi*	✓	✓			✓[4]
	Lake whitefish	*Coregonus clupeaformis*	✓				✓
Sciaenidae	Freshwater drum	*Aplodinotus grunniens*	✓				✓

Source: **Appendix 8-1** and the following:
1 – Bulloch *et al.* (2002); COSEWIC (2006a); North/South Consultants Inc. (2014); Stewart and Watkinson (2004).
2 – COSEWIC (2006a); Franzin, Stewart, Hanke and Hering (2003).
3 – As reported in NLHS 2013a.
4 – CIER and Poplar River First Nation (2015).

8.1.4 Mussels

Mussel surveys were conducted in areas that contained suitable habitat for these organisms. Mussels feed and breathe by burrowing into lake, river, stream, pond or reservoir bottom substrates and filtering water through soft fleshy tubes referred to as siphons. In general, freshwater mussels are most successful in stable, sand-gravel substrate mixtures and are largely absent from substrates with heavy silt loads (McMahon 1991 in Watson 2000). Freshwater mussels often use the gills of fish for the larval stage of their reproductive cycle, which also serves as a means of transport and distribution for mussel species (**Figure 8-2**).

The aquatic environment studies included mussel surveys in the Berens, Etomami, North Etomami and Leaf rivers as described in **Appendix 8-1**. The remaining small tributaries and creeks crossed by the proposed all-season road alignment were not sampled as these areas were not considered to provide suitable habitat for mussels.

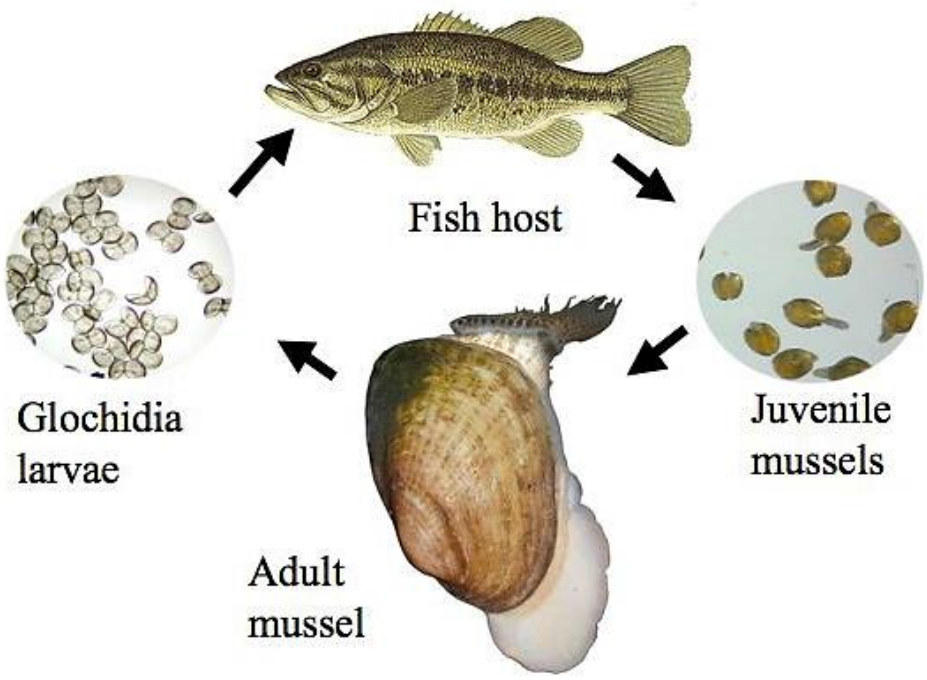


Figure 8-2: Freshwater Mussel Reproductive Cycle (Freshwater Mussel Conservation Society 2015)

The Berens River was the only location where mussels were found. Mussel species collected included fat mucket (*Lampsilis siliquoidea*), mapleleaf mussel (*Quadrula quadrula*), threeridge (*Amblema plicata*) and wabash pigtoe (*Fusconaia flava*). The collected threeridge mussels were empty valves; as such, the presence of this species near the crossing cannot be confirmed as the valves may have drifted into the study reach from upstream areas.

The Berens River was the only site within the Project area where freshwater mussels were found.

The collection of the mapleleaf mussel from the Berens River is the first documented occurrence of the species in this watershed; therefore, the population size and distribution within the river are unknown. The mapleleaf mussel is a Species at Risk that is protected under both provincial and federal legislation. Additional information on the mapleleaf mussel and other aquatic Species at Risk in the Local Assessment Area is provided in **Section 8.1.5**.

8.1.5 Aquatic Species at Risk

For this environmental impact assessment, aquatic Species at Risk were defined as federal aquatic species designated by the Committee on the Status of Endangered Wildlife in Canada (COSEWIC) for listing on Schedule 1 of the *Species at Risk Act (SARA)*, including aquatic species in the risk categories of extirpated, endangered, threatened and special concern (Canadian Environmental Assessment Agency [CEA Agency] 2014a); provincial aquatic species listed as Endangered or Threatened under the *Manitoba*

Endangered Species and Ecosystems Act (*MBESEA*); and aquatic species listed as very rare (provincial status of S1) or rare (provincial status of S2) throughout their range as listed by the Manitoba Conservation Data Centre (MCDC) (Manitoba Conservation Data Centre 2015).

Three aquatic Species at Risk are present or potentially present in the Local Assessment Area:

- *Lake sturgeon;*
- *Mapleleaf mussel; and*
- *Shortjaw cisco.*

There are three aquatic Species at Risk[3] either present or potentially present in the Local Assessment Area watercourses or waterbodies that are listed as threatened or endangered by the *MBESEA*, or the federal *SARA* and are also known species of conservation concern due to their threatened or endangered status as listed by COSEWIC, or as a species of conservation concern by the MCDC. These aquatic Species at Risk include lake sturgeon, mapleleaf mussel and shortjaw cisco (*Coregonus zenithicus*). **Table 8.4** provides information on the three species regarding their conservation status, preferred habitat, known presence in Manitoba and known presence in the Local Assessment Area.

Table 8.4: Potential Species at Risk in the Local Assessment Area

Species	Conservation Status			Preferred Habitat	Known Presence in Local Assessment Area
	***MBESEA*/MCDC**	***SARA***	**COSEWIC**		
Mapleleaf Mussel (Saskatchewan-Nelson population)	Endangered/S2	Endangered	Endangered	Medium to large rivers in firmly packed coarse gravel and sand to a substrate of firmly packed clay/mud.	Berens River
Lake Sturgeon (Red -Assiniboine R – L. Winnipeg population)	Not Listed/S2[1]	Under Consideration	Endangered	Large rivers and lakes, generally at depths of 5-10 m over substrates of mud, clay, sand or gravel.	Berens River, Poplar River
Shortjaw Cisco	Not Listed/S3	Threatened/S2[2]	Threatened	Deep areas of lakes.	Not documented to be present; very low probability of presence

Note: 1 Current Status: Province wide regulatory measures restricting harvest apply (Government of Manitoba 2015a, MCWS 2012a).
2 Shortjaw cisco are listed as Threatened under Schedule 2 of the *SARA*. Protection and recovery measures are developed and implemented for species on Schedule 1. Species on Schedule 2, such as the Shortjaw cisco, were designated at risk by COSEWIC before *SARA* was legislated and are in the process of being reassessed using *SARA* criteria prior to being listed on Schedule 1.

Sources: COSEWIC (2003, 2006a, 2006b); MCWS (2015a); MCDC (2015); Species at Risk Public Registry (2015); Government of Manitoba (2015a).

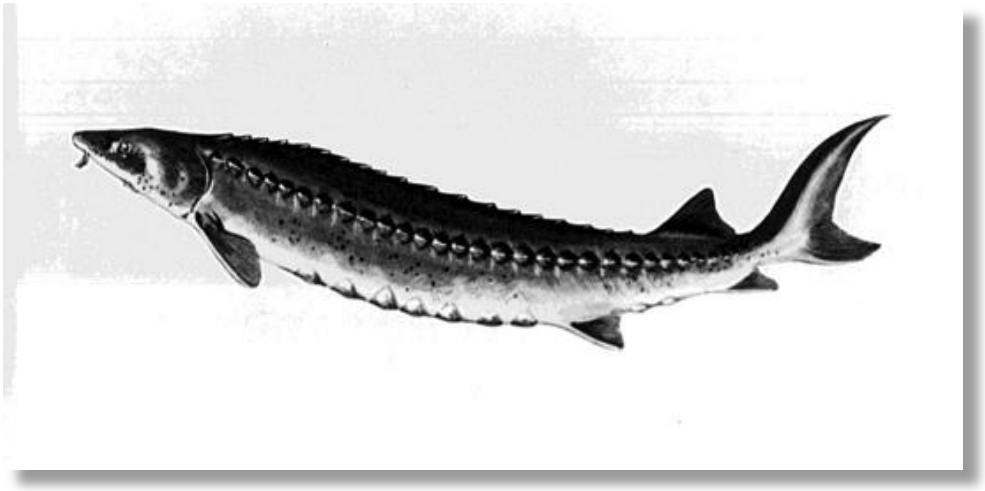
[3] For the purpose of this Environmental Impact Assessment, Species at Risk include those species listed in Schedule 1 of the federal *Species at Risk Act* and those species listed as Endangered or Threatened in *The Endangered Species and Ecosystems Act* of Manitoba or by the Committee on the Status of Endangered Wildlife in Canada (COSEWIC). 'Species of Special Interest' are those species listed by COSEWIC as extirpated, endangered, threatened or of special concern.

8.1.5.1 Lake Sturgeon

Limited suitable lake sturgeon habitat is present in the vicinity of the proposed watercourse crossings.

Historically, the North American distribution of lake sturgeon, pictured in **Photograph 8-5**, ranged from western Alberta eastward to the St. Lawrence drainage of Quebec, and from the southern Hudson Bay drainage southward to lower Mississippi drainage in northern Mississippi and Alabama (COSEWIC 2006a). The distribution of lake sturgeon in Canada includes rivers of Hudson Bay, the Great Lakes and inland lakes, and rivers of Alberta, Saskatchewan, Manitoba, Ontario and Quebec, including Lake Winnipeg (COSEWIC 2006a). Lake sturgeon in the Regional Assessment Area are part of the Red River - Assiniboine River - Lake Winnipeg population and are found in the Assiniboine River, the Red River, Lake Winnipeg and eastern tributary rivers to Lake Winnipeg, with the exception of the Winnipeg River which contains a separate population (COSEWIC 2006a).

Threats to lake sturgeon include over fishing, dams, habitat degradation, contaminants and introduced species, with commercial fishing cited as the most significant factor in the historical decline of lake sturgeon populations (COSEWIC 2006a).



(**Source**: Nicholson 2007)

Photograph 8-5: Lake Sturgeon

Within the Regional Assessment Area, lake sturgeon have been documented to be present in the Berens River and the Poplar River (Dick *et al.* 2006; Nicholson 2007). Lake sturgeon are benthic feeders that can be found over sand substrates in the benthic areas of larger lakes and rivers. Their preferred spawning habitat is fast moving water, such as rapids or at the base of waterfalls.

The proposed crossing site on the Berens River is located in an area of moderate velocity run habitat with rocky substrates. This area may provide marginal foraging habitat for adults, and the deeper water areas beyond the crossing area may provide potential habitat for juvenile lake sturgeon. There is also

the potential for larval lake sturgeon to drift to these downstream habitats from potential spawning areas at English Rapids (located 1.5 km upstream of the proposed crossing) and Sturgeon Falls (located 7.4 km upstream of the proposed crossing). The habitat within the footprint of the crossing is not considered to be critical to the species.

8.1.5.2 Mapleleaf Mussel

In Canada, the mapleleaf mussel has been reported to only be present in Manitoba and Ontario (COSEWIC 2006b). In Manitoba, the mapleleaf mussel (pictured in **Photograph 8-6**) is found in the Assiniboine River, the Roseau River, the Red River (and the lower reaches of its tributaries), Lake Winnipeg, and most recently the Bloodvein River (COSEWIC 2006b; North/South Consultants Inc. 2010). The main threat to the mapleleaf mussel in Manitoba has been cited as habitat degradation due to decreasing water quality (COSEWIC 2006b).

(Source: COSEWIC 2006b)

Photograph 8-6: Mapleleaf Mussel

A single juvenile mapleleaf mussel was identified in the Berens River, approximately 150 m downstream from the proposed P4 all-season road crossing. Prior to this discovery of the mapleleaf mussel in the Berens River, the presence of this species had not been documented in the Local Assessment Area but has been documented to be present south of the Local Assessment Area in the Pigeon, Bradbury and Bloodvein Rivers (COSEWIC 2006b; North/South Consultants Inc. 2010, 2015). As noted in **Section 8.1.4**, the capture of the mapleleaf mussel from the Berens River is the first documented occurrence of the species in this watershed; therefore, the population size and distribution within the river are unknown.

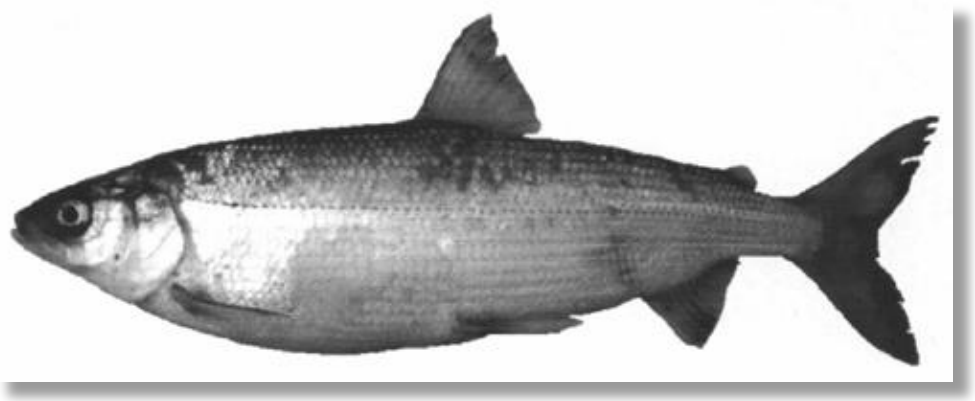
The substrates identified at the proposed centerline for the crossing site consisted of hard, compact substrates, cobble and bedrock, which is not suitable habitat for the mapleleaf mussel. Preferred habitat for mapleleaf mussels is present at a distance of about 30 m downstream and about 200 m upstream of the proposed centerline for the crossing site, with areas of moderate current and gravel/sand substrates.

A single juvenile mapleleaf mussel was identified downstream of the bridge crossing site in the Berens River.

Preferred habitat for mapleleaf mussel was not found to be present at the proposed crossing sites on the Etomami, North Etomami, or Leaf rivers or the small tributary streams along the proposed Project alignment. Other than the specimen captured in the Berens River, there were no freshwater mussels identified near the proposed crossing sites and channel catfish, the host fish of mapleleaf mussel, was not captured in gill nets in the Etomami, North Etomami and Leaf rivers.

8.1.5.3 Shortjaw Cisco

The shortjaw cisco (pictured in **Photograph 8-7**) is best known from the Canadian Great Lakes, but this species is also distributed throughout central Canada (COSEWIC 2003). Historical information and current studies being conducted on the relationships among lake cisco and shortjaw cisco in Manitoba and the Canadian Great Lakes show that the distribution of the shortjaw cisco in Manitoba is typically limited to lakes with areas of deep, cold waters such as Big Athapapushkow Lake, Clearwater Lake, George Lake, Lake Winnipeg, Lake Winnipegosis and Reindeer Lake (COSEWIC 2003; Fisheries and Oceans Canada 2013; Franzin 2003; LeClaire, M., personal communication, October 22, 2015). There are no spawning data for Manitoba, but in the Great Lakes shortjaw cisco spawn on the lake bottom over clay substrates in the spring or fall (COSEWIC 2003).



(Source: COSEWIC 2003)

Photograph 8-7: Shortjaw Cisco

The shortjaw cisco has not been documented to be present in the lakes, rivers or creeks within the P4 all-season road Local Assessment Area, and their preferred habitat is not present at proposed watercourse crossing locations for the proposed all-season road alignment. This species has not been

reported to be present in tributaries on the east side of Lake Winnipeg, and, given that this species prefers cold water areas of deep lakes, is not expected to be present in rivers or streams in the Local Assessment Area.

8.1.6 Valued Components

As indicated in **Chapter 6** (Environmental Impact Assessment Scope and Approach), the evaluation of environmental effects is focused on Valued Components (VCs). The VCs identified for the aquatic environment are: fish habitat; fish and harvested fish; and aquatic Species at Risk. The assessment of the potential effects of the Project activities on the selected VCs was conducted in accordance with the environmental assessment methods outlined in **Chapter 6**.

The Valued Components identified for the aquatic environment are:

- *Fish habitat;*
- *Fish and harvested fish; and*
- *Aquatic Species at Risk.*

As per the federal *Fisheries Act*, 'fish habitat' includes aquatic habitat that supports fish species that are part of, or support, a CRA fishery (Fisheries and Oceans Canada 2015a). Examples of fish species that are part of, or support, a CRA fishery include lake whitefish, northern pike, walleye and sucker species.

8.2 Environmental Effects and Mitigation

The assessment of the potential effects of the Project activities on the Aquatic Environment VCs was conducted as described in **Section 6.4** of **Chapter 6**, and included the following approach:

- Identification of the interactions among the selected VCs and the Project construction and operations and maintenance activities;
- Identification of the potential environmental effects of the Project prior to the implementation of mitigation measures;
- Initial screening of the potential environmental effects via examination of the magnitude/geographic extent, duration, frequency, reversibility and ecological context of the potential effects, as well as the probability of the occurrence of the predicted effect, prior to the implementation of mitigation measures;
- Identification of appropriate mitigation measures and their application to reduce or avoid potential adverse effects; and
- Prediction of residual adverse environmental effects remaining after mitigation and determination of the significance of those residual adverse effects.

8.2.1 Valued Components and Project Interactions

Chapter 3 (Project Description) provides information on the Project description and the equipment, materials and activities to be used for the construction and operations and maintenance of the P4 all-season road. Based on this information, a list of the Project activities was developed to identify those having the potential to interact with the Aquatic Environment VCs. **Table 8.5** provides a summary of the

key Project activities expected to interact with the Aquatic Environment VCs. These interactions were identified based on the desktop and field investigations conducted for the aquatic environment in the Project study area, and incorporate Traditional Knowledge on the aquatic environment as provided by the local communities.

Table 8.5: Key Project Activity Interactions with Aquatic Environment Valued Components

Project Activities	Aquatic Environment VCs		
	Fish Habitat	Fish and Harvested Fish	Aquatic Species at Risk
Construction Phase			
Operation and staging of equipment, machinery and vehicles and transportation of equipment as necessary during construction phase*.	✔	✔	✔
Clearing road right-of-way including clearing vegetation, salvaging, burning, stockpiling, grubbing and mechanical brushing.	✔	✔	✔
Blasting.	✔	✔	✔
Road construction including topsoil stripping, soil removal, rock placement/compaction, rock crushing, traffic control/signage and contouring.	✔	✔	✔
Grading and gravelling of road surface.	✔	✔	✔
Bridge construction including construction of components, batching/pouring concrete, steel girder placement.	✔	✔	✔
Culvert installation including coffer damming, stream excavation, geotextile material placement, filling, crossing streams, culvert placement, backfilling and compaction.	✔	✔	✔
Erosion and sediment control including placing silt fencing and re-vegetation.	✔	✔	✔
Establishment of staging areas and temporary components (i.e., quarry and borrow areas, temporary access and crossings, staging areas, camps).	✔	✔	✔
Solid and liquid waste management.	✔	✔	✔
Storage and handling of hazardous materials.	✔	✔	✔
Site cleanup including waste removal, contaminated soil removal, stockpiling and recycling materials.	✔	✔	✔
Closure and reclamation of temporary components (quarry and borrow areas, access, crossings, staging areas) including excavation, slope stabilization, re-vegetation and barrier installation.	✔	✔	✔
Operations and Maintenance Phase			
Road maintenance including vegetation maintenance, grading, washout repair and traffic controls.	✔	✔	✔
Ditch maintenance including excavation and debris removal.	✔	✔	✔
Bridge and culvert maintenance including seasonal inspections and debris removal.	✔	✔	✔
Erosion and sediment control including re-vegetation.	✔	✔	✔
Clearing snow.	✔	✔	✔
Operation and staging of equipment, machinery and vehicles and transportation of equipment as necessary during maintenance.	✔	✔	✔

Note: *Other activities require the operation of equipment/vehicles/machinery. Therefore, influences on VCs for subsequent activities relate to how the completion of the activity potentially influences the VC.

8.2.2 Assessment of Potential Effects

As noted in **Section 6.4** of **Chapter 6**, the potential environmental effects of the Project activities on the VCs were assessed using the five steps outlined in **Section 6.4** and the assessment criteria described in **Table 6.3**. A number of different methods including desktop, stream classification, aerial survey and field investigations were conducted to collect, record and analyse information on the aquatic environment in the P4 all-season road Project Footprint, Local Assessment Area and Regional Assessment Area. This information was used to quantify the potential effects of Project activities on the selected VCs where quantification was possible and to qualify the potential effects where quantitative data were unavailable.

ESRA worked alongside local communities to check that their interests and needs are reflected in the planning of the proposed Project and watercourse crossings through the Aboriginal and Public Engagement Program (**Chapter 4**). Input received from Elders, elected officials and community members of Berens River First Nation and NAC and Poplar River First Nation was used to validate and refine the proposed all-season road alignment (**Chapter 2**, Project Justification and Alternatives Considered) and contributed to the use of appropriate designs and the application of environmental protection measures for the pre-construction, construction and post-construction stages of the Project. The final designs of the Project bridge and culvert crossings will be determined by professional hydraulic engineers for the range of hydrologic and hydraulic conditions found within the local watercourses, along with input from fisheries biologists and application of federal and provincial regulations and guidelines for the protection of fish and fish habitat.

Traditional information regarding potential effects of the proposed Project on the aquatic environment was obtained through the Aboriginal and Public Engagement Program for the Project (**Chapter 4**). During a workshop conducted with Berens River First Nation and NAC, the communities identified the fish species harvested for food, income and cultural purposes, as well as the areas where these harvesting activities occur (CIER 2015). Poplar River First Nation shared that there are a number of fish species that are important to the community (**Section 8.1.1)** and that the Poplar River is extremely important to the community: “it is where we get our life from; it is the source of our clean drinking water; it is the most important place on earth, it is our survival, our livelihood” (CIER and Poplar River First Nation 2015). In general, most of the workshop participants were satisfied with the proposed road location. Community members felt that there could be runoff from the road that enters the local waterways, which could potentially affect the fish and/or water. Some community members believed that beavers will block the culverts and cause flooding and that high water in the spring will flood over culverts at the larger creeks, such as Okeyakkoteinewin Creek (CIER and Poplar River First Nation 2015).

Proposed mitigation measures that will be used to prevent or minimize potential Project effects on fish or fish habitat, including harvested fish species, were also discussed with community members and are presented in the sections below. These measures will be used to prevent and/or minimize the potential effects of road runoff, flooding, or beaver activity at the proposed P4 bridge and culvert crossings.

8.2.3 Mitigation

As part of ESRA's commitment to environmental protection and sustainability, the design and routing of the proposed all-season road has been developed with an acute awareness of the importance of the ecological and cultural resources of the area, including the value of the aquatic environment to the people and animals of the region. As described in **Chapter 2** (Project Justification and Alternatives Considered), the final alignment for the proposed all-season road was selected following consideration of a number of alternative routes, as well as road and watercourse crossing design options that were proposed, reviewed and rejected in terms of potential effects on the people, air, water, land, fish, vegetation, wildlife, Heritage Resources, Traditional land use and Traditional activities. The aquatic and other environmental components that contribute to the ecological and cultural resources of the area were examined individually and collectively to find the best possible alignment for the proposed all-season road that achieves the connection of communities to much needed services and amenities, while respecting and preserving the ecological and cultural resources of the region.

Many potential effects of road developments can be minimized or avoided prior to construction and operations and maintenance phases through proper design. The following measures have been incorporated into the Project design to mitigate potential disruptions to the Aquatic Environment VCs of fish habitat, fish and harvested fish and aquatic Species at Risk:

- Where possible, roads will be located a minimum of 100 m from waterbodies except when crossing a watercourse. Where this is not feasible, a buffer of undisturbed vegetation equal to 10 m plus 1.5 times the slope gradient, or 30 m, whichever is greater, will be left between the road and adjacent waterbodies. These buffers will minimize runoff velocity and volume during rain events, which will encourage the settling and filtration of possible sediment and contaminant migration. The buffers will also serve to preserve riparian functions such as allochthonous inputs into streams (e.g., leaves, insects and woody debris), shading and bank stability.
- Culvert and bridge crossings will be designed to direct stormwater runoff from the road surface into vegetated areas or retention ponds to decrease the velocity and volume of runoff and encourage the settling of sediment and removal of contaminants from the water column.
- Bridge and culvert crossing structures will be designed to maintain existing flow regimes with no changes to flows or flow patterns and to meet fish passage criteria and requirements.
- Limits are placed on the size of blasting areas and on the magnitude of blast charges (e.g., use more holes with smaller charges).

Information on the route selection process is provided in **Chapter 2** (Project Justification and Alternatives Considered) and information on the design mitigation features and measures that were used to reduce or avoid a number of potential environmental effects are described in **Chapter 3** (Project Description) and **Chapter 5** (Environmental Protection and Sustainable Development).

Chapter 5 also outlines the environmental protection and management plans that will be implemented for the Project. ESRA has developed a series of Environmental Protection Specifications (General

Requirements 130 [GR130s]) that are distributed to contractors as part of the contract agreements for clearing and construction works (**Chapter 5**, **Appendix 5-4**). These plans and specifications will provide information on the appropriate aquatic environmental protection measures and environmental protection plans to be used before, during and after the proposed works and will incorporate the following regulatory guidance information:

- Fisheries and Oceans Canada's "Manitoba Restricted Activity Timing Windows for the Protection of Fish and Fish Habitat" (Fisheries and Oceans Canada 2015b);
- Fisheries and Oceans Canada's "Measures to Avoid Causing Harm to Fish and Fish Habitat" (Fisheries and Oceans Canada 2015c); and
- The Manitoba Stream Crossing Guidelines for the Protection of Fish and Fish Habitat (Fisheries and Oceans Canada and Manitoba Natural Resources 1996).

8.2.4 Effects on Fish Habitat, Fish and Harvested Fish and Aquatic Species at Risk

A description of the existing conditions for fish habitat, fish and harvested fish and aquatic Species at Risk in the Project study area is provided in **Section 8.1**. There are potential temporary, short-term effects as well as longer term or permanent effects of Project clearing, construction and operations and maintenance activities that may affect the aquatic environment in the Project Footprint and/or Local Assessment Area. The potential environmental effects on fish habitat due to Project clearing, construction and operations and maintenance activities include the potential environmental effects outlined in **Appendix 8-1**, as well as potential effects identified by members of local communities and through professional knowledge and experience with the effects of the construction of roads, bridge and culverts on the aquatic environment. The information below outlines the potential environmental effects of the proposed Project on the aquatic environment in the study area.

Changes in Flows, Flow Patterns, or Flooding

The improper design and/or installation of bridge or culvert crossings can lead to effects such as the constriction or alteration of natural flows and flow patterns, erosion of upstream or downstream areas and perched culverts. These effects may cause changes to fish movements and behaviour, prevent fish passage through culverts with high velocities and result in some fish being unable to complete spawning and migratory activities. Erosion of upstream and downstream areas could also result in increased transport and release of sediment to the watercourse.

Erosion and Sedimentation of Streams

Vegetation removal and improper construction practices near watercourses can result in increased erosion, which may lead to the release and/or transport of sediment to lakes, rivers and creeks. Clearing streamside vegetation may result in decreased bank stability and exposure of bare soils that are susceptible to erosion. Heavy machinery and equipment working near the watercourse can damage vegetative cover and cause rutting and erosion of floodplains and channel banks.

Loss of Instream Habitat

A crossing design that includes the placement of permanent structures below the ordinary high water mark will have direct effects to fish habitat. Infilling of river or creek substrates due to the footprint of bridge piers or culverts will result in the permanent alteration or destruction of instream habitat. The armouring of channel banks below the ordinary high water mark may alter the quality and productivity of instream habitat; however, depending on design, certain types of armouring such as riprap may increase habitat productivity by providing suitable substrates for aquatic insect production (i.e., fish diet items) and cover for fish.

Loss of Riparian Vegetation

Riparian vegetation consists of a variety of streamside grasses, forbs, shrubs and trees that contribute nutrients to lakes, rivers and creeks through leaf litter, woody debris and terrestrial insect drop. The removal of riparian vegetation to accommodate temporary crossings, culvert crossings, bridge approaches, or line of sight requirements may reduce nutrient inputs into the aquatic food web. In many streams, terrestrial insects contribute to the diet of fish. In addition, leaf litter and other organic matter are consumed by aquatic invertebrates, which is another important food source for many fish species (Allan *et al.* 2003 in North/South Consultants Inc. 2015). Riparian vegetation also provides bank stability and slows, filters and absorbs runoff water, which helps reduce soil erosion (Government of Manitoba 2011).

Introduction of Deleterious Substances

Introduction of deleterious substances into watercourses can degrade water quality, resulting in toxic effects to aquatic organisms, including fish. Harmful substances may enter the watercourses from a variety of sources during Project construction through accidental spills or leaks and in runoff. Examples include:

- **Cast-in-Place Concrete Structures** - Construction of cast-in-place concrete structures such as bridge abutments, footings and bridge decks may result in accidental releases of concrete or concrete wash water into the watercourse. Uncured or partly cured concrete and other lime containing materials (e.g., Portland cement, mortar and grout) have a high pH and are extremely toxic to many aquatic organisms, including fish. Accidental discharges into an aquatic environment may result in an increase in the pH of the water. Elevated pH can damage fish tissue and increase the toxicity of other substances in the water, such as ammonia. Concrete and concrete wash water can also contain sediments and spills can result in increased turbidity and sedimentation of the stream.
- **Construction Vehicles, Machinery and Equipment** - Hydrocarbons such as oil, fuel, gasoline, lubricants, or hydraulic fluids can enter watercourses during the operations and maintenance and fuelling of construction vehicles and machinery near watercourses. Hydrocarbons are

considered deleterious substances that may kill fish or other aquatic biota directly, or may result in impaired health, vigour, or productive capacity.

- **Stormwater and Road Runoff** - Stormwater and road runoff from impervious surfaces such as bridge decks and approaches can contain a number of pollutants including suspended solids, hydrocarbons, metals, nutrients and road salts. During and after significant rainfall events, stormwater runoff into streams can cause short-term changes in water quality. Stormwater and road runoff may also result in physical impacts to streams, including bank and channel erosion and/or sediment deposition due to increased runoff frequency, velocity and volume.

- **Explosives** - Explosives used in blasting use oxidizing agents such as ammonium nitrate, calcium nitrate and sodium nitrate. Nitrates from these materials may enter the watercourse due to accidental spills, leaching from wet blastholes, or in runoff from undetonated explosives in blast rock. Increased nitrate levels can have toxic effects on aquatic organisms and cause eutrophication of surface waters. In addition, if ammonium nitrate is introduced into water, it dissociates to form ammonia, which can have both lethal and sublethal effects on fish.

Disruption of Habitat due to Blasting

The compressive shock wave resulting from the detonation of explosives near watercourses can cause serious harm to fish habitat. Shock waves with overpressure levels greater than 100 kilopascals (kPa) can rupture the swim bladder and vital organs such as the liver and kidney (Wright and Hopky 1998). The vibrations generated by a blast can also damage incubating eggs. Other impacts to habitat include physical alteration of habitat, sedimentation of streams from particles generated by blasting and introduction of deleterious substances.

Temporary Crossings

The construction and use of temporary crossings can result in loss or damage to riparian vegetation and erosion and sedimentation of streams. Temporary crossings such as fords can disrupt sensitive fish life stages, such as spawning and incubation periods, resulting in decreased reproductive success.

Improved Access to Sensitive Habitats

Project construction may result in improved access to sensitive habitats by both work crews and the public. Motorized vehicles such as ATVs may disturb stream banks and riparian areas leading to erosion and sedimentation of streams. Improved access could also result in increased fishing opportunities in waterbodies at watercourse crossing sites along the proposed route where fishing currently occurs (e.g., Berens River) and in waterbodies not previously or conveniently accessible for fishing.

Introduction of Aquatic Invasive Species

There are currently a number of aquatic invasive species listed by the Province of Manitoba (MCWS 2015b) and the Invasive Species Council of Manitoba (ISCM 2015) known to be present in Lake Winnipeg and/or its tributaries that have the potential to be introduced to the rivers and streams in the Project

study area. These organisms include four fish species - common carp, mosquitofish (*Gambusia affinis* or *Gambusia holbrooki),* rainbow smelt and round goby *(Neogobius melanostomus)* - and four invertebrate species - quagga mussel (*Dreissena rostriformis*), rusty crayfish *(Orconectes rusticus),* spiny waterflea (*Bythotrephes longimanus*) and zebra mussel (*Dreissena polymorpha*) (ISCM 2015). Common carp and rainbow smelt have been reported to be present in the Poplar River and common carp are also present in the Berens River (**Table 8.3**).

The presence of the spiny waterflea has been confirmed in the Winnipeg River and Lake Winnipeg (MCWS 2015b). This organism is a Prohibited Species under *The Fisheries Act* and possession and transportation of spiny waterflea in Manitoba is illegal. Rusty crayfish is a non-native, invasive species of crayfish that have recently been found in Falcon Lake that can reduce native crayfish populations. Rusty crayfish represent a significant environmental concern to Manitoba as they are an aggressive invasive species, are prolific spawners and can severely reduce lake and stream vegetation, which in turn can deprive native fish of cover, spawning habitat and food (MCWS 2015b). Effective May 1, 2007, it is illegal to possess crayfish, including possession for consumption (MCWS 2015b). The Province of Manitoba no longer issues experimental commercial fishing licenses for the harvest of crayfish and has listed rusty crayfish on the amended Prohibited Species list of the *Manitoba Fisheries Regulations* under *The Fisheries Act* (MCWS 2015b).

Zebra mussels are small non-native, clam-like, aquatic animals that are a significant environmental and economic concern to Manitoba (MCWS 2015b). The species is native to Eastern Europe and Western Asia and has caused millions of dollars in damage to the Laurentian Great Lakes area, as well as costing the North American economy billions of dollars to control (MCWS 2015b). MCWS fall 2015 monitoring reports show that zebra mussels are now present in the north basin of Lake Winnipeg, southeast of George Island; the Manitoba portion of the Red River; and Cedar Lake immediately west of Grand Rapids. Under the federal *Fisheries Act*, it is illegal to possess or transport zebra mussels and penalties for possessing zebra mussels may result in fines or prosecution under this *Act* (MCWS 2015b).

8.2.4.1 Fish Habitat, Fish and Harvested Fish and Aquatic Species at Risk

Information regarding the existing conditions for fish habitat in the Project Local Assessment Area and Regional Assessment Area is provided in **Section 8.1.2**. Effects and mitigation of construction and operations and maintenance on fish habitat are provided in Sections **8.2.4.1.1** and **8.2.4.1.2** and are applicable to fish and harvested fish(**Section 8.2.4.2**) and aquatic Species at Risk (**Section 8.2.4.3**).

8.2.4.1.1 Construction Effects and Mitigation

Using the approach described above in **Section 8.2**, the overall level of effect of the potential construction effects on fish habitat, fish and harvested fish and aquatic Species at Risk prior to the implementation of mitigation measures was examined. **Appendix 8-2** provides a summary of the potential construction effects on fish habitat, fish and harvested fish and aquatic Species at Risk prior to the implementation of mitigation measures and the determined overall level of potential effect.

Based on the screening of potential effects in **Appendix 8-2**, the following potential adverse effects were identified as having a low level of effect:

- Introduction of deleterious substances;
- Disruption of habitat due to blasting;
- Temporary crossings;
- Improved access to sensitive habitats;
- Improved access to fishing opportunities at watercourse crossings; and
- Introduction of aquatic invasive species.

A description of the mitigation measures that will be used to prevent or minimize the above noted potential adverse effects are provided below.

Introduction of Deleterious Substances

Where possible, roads will be located a minimum of 100 m from waterbodies except when crossing a watercourse. Where this is not feasible, a buffer of undisturbed vegetation equal to 10 m plus 1.5 times the slope gradient, or 30 m, whichever is greater, will be left between the road and adjacent watercourses. Construction crews will be adequately trained on the handling, storage and disposal of deleterious substances. Spill clean-up kits will be available on site. Appropriate fuelling/hazardous chemical buffers will be implemented. Deleterious substances will be stored a minimum of 100 m from the high water mark. Equipment, machinery and vehicles used to construct watercourse crossings will be kept clean and free of debris or leaks. Vehicle, machinery and equipment cleaning, fuelling and maintenance will be conducted a minimum of 100 m from the high water mark.

Uncured or partly cured concrete will be kept in isolation from watercourses. Water that has contacted uncured concrete will be isolated from watercourses until it has reached a neutral pH. Equipment used in concrete work will be cleaned away from watercourses to prevent wash water from entering waterways. Culvert and bridge crossings will be designed to direct storm water and road runoff into vegetated areas or armoured approaches to decrease the velocity and volume of runoff and encourage the settling of sediments and prevent the transport of deleterious substances.

With the application of the above mitigation measures, the potential adverse effect of the introduction of deleterious substances on fish habitat, fish and harvested fish and aquatic Species at Risk in the Project Footprint and/or Local Assessment Area is not expected to be significant.

Disruption of Habitat Due to Blasting

Explosive materials will be handled and stored in a manner to minimize accidental spills or releases into watercourses. Explosive materials will be stored a minimum of 100 m from the high water mark. Storage and transport containers will be regularly inspected and maintained. Crew members working with explosives will be trained in spill containment and clean-up procedures. Ammonium nitrate-fuel oil mixtures will not be used in or near watercourses. Blasting will not be conducted in watercourses. Explosives will be detonated at sufficient distance from the watercourse to confirm that overpressure

levels do not exceed 100 kiloPascals (kPa) at the land-water interface. With the application of mitigation measures, the potential adverse effect of disruption of habitat due to blasting on fish habitat, fish and harvested fish and aquatic Species at Risk in the Project Footprint and/or Local Assessment Area is not expected to be significant.

Temporary Crossings

Whenever possible, existing trails, roads and cut lines will be used as access to temporary crossings. Temporary crossings will be located within the 60 m cleared Project right-of-way to avoid riparian impacts outside of the right-of-way. Placement and removal of temporary crossing structures will be timed to avoid fish migration periods. Approaches will be stabilized as required to protect stream banks (e.g. swamp pads, logs). Fording in flowing waters will avoid periods of fish spawning, incubation and migration and will avoid known fish spawning and rearing areas. Ice bridges will be constructed of clean water, ice and snow only and will not block naturally occurring flows. The withdrawal of water used in the construction of ice bridges will not exceed 10% of the instantaneous flow. When an ice bridge is no longer required or the crossing season has ended, ice bridges will be notched at the centre to prevent the obstruction of fish movement and encourage melting at the centre of the bridge to prevent channel erosion and flooding. Snow fills will be constructed of clean snow and will not restrict stream flows. When a snow fill is no longer required or the crossing season has ended, compacted snow will be removed prior to the spring freshet. Temporary crossing structures will be removed when no longer required and the crossing site will be restored to its original conditions. Watercourse crossings will be inspected following the first storm event and first freshet to confirm that there are no visible signs of bank and/or channel instability.

The use of these mitigation measures will prevent or minimize the potential adverse effects of temporary crossings on fish habitat, fish and harvested fish and aquatic Species at Risk in the Project Footprint and/or Local Assessment Area. As such, the potential adverse effect of temporary crossings on fish habitat, fish and harvested fish and aquatic Species at Risk in the Project Footprint and/or Local Assessment Area is not expected to be significant.

Improved Access to Sensitive Habitats and to Fishing Opportunities at Watercourse Crossings

To decrease the potential for increased access at watercourse crossings, construction access routes and winter roads will be decommissioned and rehabilitated. Unnecessary access to sensitive areas by work crews will be prohibited. Access to major watercourse crossings along the proposed all-season road corridor will be restricted using measures such as slope treatment, guardrails and other public safety measures. The application of existing Province of Manitoba fisheries management actions (e.g., restrictions on fishing periods, use of catch and release only, limits on allowable catch and licenses and conservation closures) can be applied to further decrease the potential adverse effect of improved access to fishing opportunities at watercourse crossings in the Project Footprint and/or Local Assessment Area. As such, the potential adverse effect of improved access to sensitive habitats and to

fishing opportunities at watercourse crossings on fish habitat, fish and harvested fish and aquatic Species at Risk in the Project Footprint and/or Local Assessment Area is not expected to be significant.

Introduction of Aquatic Invasive Species

There are new federal and provincial regulations that pertain to preventing the spread of aquatic invasive species (federal - SOR/2015-121; provincial - 173/2015). Contractors will be required to comply with the provisions of these regulations within the legislation (i.e., *Canada Fisheries Act* and Manitoba *Water Protection Act*). Information on preventing the spread of aquatic invasive species (AIS) will be provided to local communities via the Aboriginal Public Engagement Program (APEP) and also through the Manitoba Conservation and Water Stewardship (MCWS) AIS program. With the application of mitigation measures, the potential adverse effect of the introduction of aquatic invasive species on fish habitat, fish and harvested fish and aquatic Species at Risk in the Project Footprint and/or Local Assessment Area is not expected to be significant.

Based on the screening of potential effects in **Appendix 8-2**, the following potential adverse effects were identified as having a moderate level of effect:

- Changes in flows, flow patterns, or flooding;
- Erosion and sedimentation of streams;
- Loss of instream habitat; and
- Loss of riparian vegetation.

A description of the mitigation measures that will be used to prevent or minimize the above noted potential adverse effects are provided below.

Changes in Flows, Flow Patterns, or Flooding

Potential changes in flows, flow patterns or flooding can be prevented with the use of proper hydraulic design and incorporation of fish passage criteria and requirements in bridge and culvert designs. The P4 all-season road watercourse crossings will be designed to maintain existing flow regimes with no changes to flows or flow patterns and to meet fish passage criteria and requirements. As such, the potential adverse effect of changes in flows, flow patterns or flooding on fish habitat, fish and harvested fish and aquatic Species at Risk in the Project Footprint and/or Local Assessment Area is not expected to be significant.

Erosion and Sedimentation of Streams

Where possible, roads will be located a minimum of 100 m from waterbodies except when crossing a watercourse. Where this is not feasible, a buffer of undisturbed vegetation equal to 10 m plus 1.5 times the slope gradient, or 30 m, whichever is greater, will be left between the road and adjacent watercourses. Appropriate erosion and sediment control (ESC) measures will be in place prior to the commencement of clearing and construction (e.g., silt fencing, silt curtains). Machinery will remain above the high water mark except where temporary fording of a watercourse is required. Vegetation

will be retained as long as possible to minimize the exposure time of disturbed/bare soils to potential erosion. Clearing within 30 m of a watercourse shall be by hand. Clearing limits will be clearly marked prior to riparian vegetation removal to avoid unnecessary damage to or removal of vegetation. Slash or debris piles will be stabilized and stored above the high water mark until disposal.

ESC measures will be regularly inspected and maintained to confirm effectiveness throughout construction. Clearing near watercourses will be temporarily suspended during very wet or muddy conditions. Overburden will be adequately stabilized and stored well above the high water mark. Disturbed areas will be stabilized through revegetation with native plant species or other appropriate means (e.g., erosion control blankets) following completion of the works. ESC measures will remain in place until disturbed areas are stabilized and revegetated. Watercourse crossings will be inspected following the first storm event and first freshet to confirm that there are no visible signs of bank and/or channel instability.

The area of permanent alteration and destruction of instream fish habitat is a minor fraction of the fish habitat available in each of the affected watercourses.

Materials used to construct watercourse crossings will be clean and free of debris. Earthworks near watercourses will be temporarily suspended during very wet or muddy conditions. Instream construction will be conducted in isolation from flowing water to mitigate downstream sediment transfer (e.g., with the use of cofferdams, channel diversions and silt curtains). Whenever possible, construction work over soft floodplains will be conducted under frozen conditions to minimize rutting and erosion. Construction of the Okeyakkoteinewin Creek culvert will be conducted under frozen conditions to avoid damage to the soft floodplain at this site.

The use of these mitigation measures will prevent or minimize the potential adverse effects of erosion and sedimentation on fish habitat, fish and harvested fish and aquatic Species at Risk in the Project Footprint and/or Local Assessment Area. As such, the potential adverse effect of erosion and sedimentation on fish habitat, fish and harvested fish and aquatic Species at Risk in the Project Footprint and/or Local Assessment Area is not expected to be significant.

Loss of Instream Habitat and Riparian Vegetation

Table 8.6 provides a summary of the permanent changes in instream and riparian zone habitat that are expected to occur at the watercourses that support CRA fish species due to Project construction activities (i.e., the installation of bridges or culverts at the watercourse crossing sites).

The permanent destruction and alteration of instream fish habitat at the crossings is unavoidable due to the footprint of the required structures (culverts and bridges). The total area of fish habitat that will be affected includes the permanent destruction of approximately 206.5 m^2 of instream habitat. These areas represent a very small fraction of the fish habitat that is available in each of the affected watercourses.

Table 8.6: Summary of Net Fish Habitat Change Due to Construction of the P4 All-Season Road

Site	Watercourse	Instream Destruction (m^2)	Instream Alteration (m^2)[1]	Riparian Destruction (m)[2]	Riparian Alteration (m)[3]
P4-X01	Berens River	5.8	161.5	36.0	48.0
P4-X04	Etomami River	11.7	323.0	36.0	48.0
P4-X07	North Etomami River	0	0	36.0	48.0
P4-X22	Leaf River	0	0	36.0	48.0
P4-X30	Okeyakkoteinewin Creek	189.0	0	36.0	0[4]
Total		206.5	484.5	180.0	192.0

Source: **Appendix 8-1**

Note: 1 Instream alteration consists of the addition of riprap below the high water mark. Riprap is expected to increase the diversity and productivity of the stream and is therefore not considered an adverse effect.
2 Calculated as the width of the roadbed on each bank.
3 Calculated based on a 60 m cleared right-of-way on each bank.
4 Existing riparian consists of low growing vegetation. Alteration due to clearing for line of sight safety requirements is not expected.

The works will also include the permanent alteration of approximately 484.5 m^2 of instream habitat. Instream construction activities conducted in fish bearing watercourses will be timed to avoid fish spawning and incubation periods in spring (April 1-June 15), summer (May 1-June 30) and fall (September 15-April 30). A fish salvage will be conducted within the isolated work area of fish-bearing watercourses prior to the commencement of instream work. The instream alteration summarized in **Table 8.6** consists of the addition of riprap below the ordinary high water mark. The rock used as riprap has many angular surfaces and creates spaces that can provide habitat for aquatic invertebrates (i.e., fish food items) and spawning, rearing, feeding and cover areas for some fish species. As such, riprap is expected to increase the habitat diversity and productivity of the watercourse and is therefore not considered an adverse effect.

The construction works will also require the permanent destruction of approximately 180 m of riparian habitat to accommodate the width of the bridge or culvert crossing and associated roadbed and approaches and the alteration of approximately 192 m of riparian habitat as part of initial right-of-way clearing activities. The amount of area to be permanently altered/destroyed had been minimized to the extent possible as part of the watercourse crossing designs. The clearing of areas of riparian zone vegetation located within the right-of-way but outside of the road bed width will include the removal of tall trees and shrubs, but tree/shrub root masses and low lying vegetation such as grasses and forbs will be retained. As such, the riparian zone functions of bank stability and erosion protection, as well as some inputs of vegetative debris and terrestrial insects, will be maintained at these areas throughout the Project construction activities. The removal of deciduous and coniferous trees and shrubs in the riparian zone may have a minor temporary effect on the contribution of leaf litter, woody debris, or terrestrial insect drop to that area of the watercourse. However, leaf litter, woody debris and terrestrial insects may also be transported from upstream areas and the potential effect on fish habitat due to the loss of leaf litter, woody debris, or terrestrial insect drop at the crossings is considered to be not significant. After construction, the vegetation within these right-of-way roadside areas will be left to

regenerate within the limits of safe roadway operation, which will further reduce and mitigate the potential effect of the alteration of riparian zone habitat.

There were no adverse potential effects identified in **Appendix 8-2** as having a high level of effect.

Additional information on the mitigation measures, environmental protection procedures and environmental protection specifications that will be implemented to prevent or minimize potential environmental effects on fish habitat, fish and harvested fish and aquatic Species at Risk in the Project Footprint and/or Local Assessment Area is provided in **Chapter 5** (Environmental Protection and Sustainable Development).

Sections of ESRA's Environmental Protection Procedures and ESRA's Environmental Protection Specifications (GR130s) that will be applied to avoid or minimize potential adverse effects to fish habitat harvested fish and aquatic Species at Risk are listed in **Table 8.7**. The list of mitigation measures in **Table 8.7** is not exhaustive, as mitigation and environmental protection measures for the Project will also include provisions outlined in Environmental Management Plans and ESRA's Environmental Protection Specifications (**Chapter 5**).

Table 8.7: ESRA's Protection Procedures and Specifications for Fish Habitat, Fish and Harvested Fish and Aquatic Species at Risk

Environmental Protection Procedures Section (Chapter 5, Appendix 5-3)	Environmental Protection Specifications (GR130s) (Chapter 5, Appendix 5-4)
Sec. 1 Clearing and Grubbing	GR130.6 General
Sec. 2 Petroleum Handling and Storage	GR130.8 Designated Areas and Access
Sec. 3 Spill Response	GR130.9 Materials Handling, Storage and Disposal
Sec. 5 Materials Handling and Storage	GR130.10 Spills and Remediation and Emergency Response
Sec. 6 Working within or near Fish Bearing Waters	GR130.15 Working Within or Near Water
Sec. 7 Stream Crossings	GR130.16 Erosion and Sediment Control
Sec. 8 Temporary Stream Diversions	GR130.17 Clearing and Grubbing
Sec. 11 Culvert Maintenance and Replacement	GR130.21 Cement Batch Plant and Concrete Wash-Out Area
Sec. 12 Blasting Near a Watercourse	
Sec. 16 Erosion and Sediment Control	
Sec. 17 Concrete Area Management Practices	
Sec 18 Dust Suppression Practices	

A summary of the potential environmental effects of construction and the mitigation measures that will be used to prevent or minimize the potential environmental effects from occurring are provided in **Table 8.8**.

Table 8.8: Summary of Potential Construction-Related Environmental Effects on Fish Habitat and Proposed Mitigation Measures

Construction Activities and Potential Environmental Effects	Proposed Mitigation Measures	Residual Effects	Significance Evaluation*
Permanent alteration/ destruction of instream habitat due to: ▪ Construction of bridges and culverts.	▪ The amount of area to be permanently altered/destroyed had been minimized to the extent possible as part of the watercourse crossing designs. ▪ Instream construction activities conducted in fish bearing watercourses will be timed to avoid fish spawning and incubation periods in spring (April 1-June 15), summer (May 1-June 30) and fall (September 15-April 30). ▪ Instream construction will be conducted in isolation from flowing water to mitigate downstream sediment transfer (e.g., with the use of cofferdams, channel diversions and silt curtains). ▪ A fish salvage will be conducted within the isolated work area of fish-bearing watercourses prior to the commencement of instream work. ▪ Temporary and permanent structures will avoid critical Species at Risk habitat, where possible and species surveys with relocation will be conducted if required.	Mitigation measures will reduce the magnitude and extent of the permanent alteration/destruction of instream habitat.	Not Significant
Permanent alteration/ destruction of riparian zone habitat due to: ▪ Construction of bridges and culverts.	▪ The amount of area to be permanently altered/destroyed had been minimized to the extent possible as part of the watercourse crossing designs. ▪ Riparian vegetation clearing within the right-of-way will be limited to the removal of trees and tall shrubs (to maintain line of sight safety requirements) with no removal of low growing vegetation beyond the road surface and shoulder. ▪ Clearing within 30 m of a watercourse shall be by hand. ▪ Clearing limits will be clearly marked prior to riparian vegetation removal to avoid unnecessary damage to or removal of vegetation. ▪ Disturbed areas will be stabilized through revegetation with native plant species or other appropriate means (e.g., erosion control blankets) following completion of the works.	Mitigation measures will reduce the magnitude and extent of the permanent alteration/destruction of riparian zone habitat.	Not Significant

Note: ***See Tables 8.11, 8.12 and 8.13** for the summary of the residual effects assessments for the Aquatic Environment VCs.
Sources: Fisheries and Oceans Canada 2015b; Fisheries and Oceans Canada 2015c; Fisheries and Oceans Canada and Manitoba Natural Resources 1996; **Appendix 8-1.**

8.2.4.1.2 Operations and Maintenance Effects and Mitigation

Activities associated with the operations and maintenance of bridge crossings are expected to include:

- Ongoing use of the bridge crossings as part of the new roadway system;
- Routine scheduled grading of the gravel road surface;
- Topping of the road with additional aggregate, as required;
- Clearing of mud, ice, snow, or other debris from the driving and walking surfaces of the bridges as required for access and safety;
- Clearing of vegetation, branches, ice, snow, or other debris around the piers and abutments, as required, to maintain hydraulic capacity;
- Repair and maintenance of protective coatings, lighting, guardrails and/or other road or bridge materials as required; and
- Regular inspections of the deck, footings, girders, abutments, piers and riprap associated with the bridge structure.

Activities associated with the operations and maintenance of culvert crossings are expected to include:

- Ongoing use of the culvert crossings as part of the new roadway system;
- Routine scheduled grading of the gravel road surface;
- Topping of the road with additional aggregate, as required;
- Clearing of mud, ice, snow, or other debris from the driving and walking surfaces of the culvert crossing as required for access and safety;
- Clearing of vegetation, branches, mud, ice, snow, or other debris from the culvert inlets, barrels and outlets as required to maintain hydraulic capacity;
- Repair and maintenance of protective coatings, lighting, guardrails and/or other road or crossing materials as required; and
- Regular inspections of the culvert structure and riprap associated with the culvert structure.

The Poplar River First Nation also identified that culverts could be blocked by beaver activity (CIER and Poplar River First Nation 2015). This potential effect will be mitigated by the routine operations and maintenance activity of clearing of vegetation, branches, mud, ice, snow, or other debris from the culvert inlets, barrels and outlets, as required, to maintain hydraulic capacity. Where risk of ongoing beaver activity at culverts occurs, “beaver cones” or similar measures will be installed.

Using the approach described above in **Section 8.2**, the overall level of effect of the potential operations and maintenance effects on fish habitat, fish and harvested fish and aquatic Species at Risk prior to the implementation of mitigation measures was examined. **Appendix 8-3** provides a summary of the potential operations and maintenance effects on fish habitat, fish and harvested fish and aquatic Species at Risk prior to the implementation of mitigation measures and the determined overall level of potential effect.

Based on the screening of potential effects in **Appendix 8-3**, the following potential adverse effects were identified as having a low level of effect:

- Temporary disturbance of instream habitat;

- Temporary localized release/transport of sediment and/or woody debris;
- Temporary localized release/transport of deleterious substances to the watercourse;
- Improved access to sensitive habitats;
- Increased fishing opportunities at watercourse crossings along the all-season road alignment; and
- Improved access to waterbodies at watercourse crossing sites may result in the introduction of aquatic invasive species.

With the exception of temporary disturbance of instream habitat, the mitigation measures that will be used to prevent or minimize the potential adverse effects are described in **Section 8.2.4.1.1** above.

Temporary Disturbance of Instream Habitat

Instream operations and maintenance activities conducted in fish bearing watercourses will be timed to avoid fish spawning and incubation periods in spring (April 1-June 15), summer (May 1-June 30) and fall (September 15 to April 30). Instream activities will be minimized to the extent possible. Unless considered an emergency work, debris removal will be timed to avoid periods of fish spawning, incubation and migration. Debris removal will be conducted by machinery operating from shore (above the high water mark) or by hand. With the application of mitigation measures, the potential adverse effect of the temporary disturbance of instream habitat on fish habitat, fish and harvested fish and aquatic Species at Risk in the Project Footprint and/or Local Assessment Area is not expected to be significant.

There were no adverse potential effects identified in **Appendix 8-3** as having a moderate or high level of effect.

Additional information on the mitigation measures, environmental protection procedures and environmental protection specifications that will be implemented to prevent or minimize potential environmental effects on fish habitat, fish and harvested fish and aquatic Species at Risk in the Project Footprint and/or Local Assessment Area is provided in **Chapter 5** (Environmental Protection and Sustainable Development).

Sections of ESRA's Environmental Protection Procedures and ESRA's Environmental Protection Specifications (GR130s) that will be applied to avoid or minimize potential adverse effects to fish habitat, fish and harvested fish and aquatic Species at Risk are listed in **Table 8.7**. Note that the list of mitigation measures in **Table 8.7** is not exhaustive, as mitigation and environmental protection measures for the Project will also include provisions outlined in Environmental Management Plans and ESRA's Environmental Protection Specifications (**Chapter 5**).

8.2.4.2 Fish and Harvested Fish

Fish and harvested fish include the fish species listed in **Section 8.1.1** and **Section 8.1.3** above. Lake sturgeon are a harvested species in the Regional Assessment Area, but as an aquatic Species at Risk, the potential effects, mitigation and residual effects for lake sturgeon are provided in **Section 8.2.4.3** below.

8.2.4.2.1 Construction Effects and Mitigation

Potential effects of Project construction on fish and harvested fish and the mitigation measures that will be applied to avoid or minimize potential adverse effects, are described in **Section 8.2.4.1.1** and **Table 8.8**.

8.2.4.2.2 Operations and Maintenance Effects and Mitigation

Potential effects of Project operations and maintenance on fish and harvested fish and the mitigation measures that will be applied to avoid or minimize potential adverse effects, are described in **Section 8.2.4.1.2**.

8.2.4.3 Aquatic Species at Risk

Three aquatic Species at Risk were identified for the Local Assessment Area: lake sturgeon, mapleleaf mussel and shortjaw cisco (see **Section 8.1.5**). The shortjaw cisco has not been documented to be present in the Local Assessment Area watercourses or waterbodies and is not expected to be present in the Local Assessment Area (**Section 8.1.5**). Lake sturgeon and mapleleaf mussel have been documented to be present in the Berens River but are not documented to be present in other watercourses or waterbodies in the Local Assessment Area. As such, potential environmental effects on lake sturgeon or mapleleaf mussel are limited to the construction and operations and maintenance effects of the multi-span bridge at the Berens River crossing and the roadway associated with the Berens River crossing.

8.2.4.3.1 Construction Effects and Mitigation

Lake sturgeon are a managed species in Manitoba (MCWS 2012a). Under the Manitoba Fishery Regulations 1987, lake sturgeon caught during recreational angling or commercial fishing must be released; this restriction is the primary regulatory tool protecting lake sturgeon from incidental or unintentional harvest (MCWS 2012a). Lake sturgeon management efforts in Manitoba have indicated that limiting mortality is the single most effective means of sustaining lake sturgeon populations (MCWS 2012a). The protection of habitat is also an important factor in maintaining populations; however, lake sturgeon in several parts of the province have demonstrated that they can adapt to substantial habitat alterations but are unable to adapt to excessive levels of harvest (MCWS 2012a).

The instream habitat destruction summarized in **Table 8.6** includes an estimated 5.8 m^2 of marginal foraging habitat for lake sturgeon in the Berens River. The instream habitat that will be affected is an area of moderate velocity dominated by bedrock substrates. The area does not represent critical spawning or rearing habitat and is a very small area in comparison to the amount of similar habitat that is available in the Berens River. The instream alteration summarized in **Table 8.6** consists of the addition of riprap below the ordinary high water mark. The rock used as riprap has many angular surfaces and creates spaces that can provide habitat for aquatic invertebrates and spawning, rearing, feeding and cover areas for some fish species. As such, riprap is expected to increase the habitat diversity and productivity of the watercourse and is therefore not considered an adverse effect.

The assessment of the potential environmental effects of construction and proposed mitigation on aquatic Species at Risk is provided in **Section 8.2.4.1.1** and **Table 8.8**. In the event that aquatic Species at Risk are found in other watercourses in the Local Assessment Area, the mitigation measures outlined in **Section 8.2.4.1.1** and **Table 8.8** will be applied.

8.2.4.3.2 Operations and Maintenance Effects and Mitigation

The assessment of the potential environmental effects of operations and maintenance and proposed mitigation on aquatic Species at Risk is provided in **Section 8.2.4.1.2**. The mitigation measures referred to in **Section 8.2.4.1.2** will be used to prevent or minimize potential environmental effects on aquatic Species at Risk in the Berens River. In the event that aquatic Species at Risk are found in other watercourses in the Local Assessment Area, the mitigation measures outlined in **Section 8.2.2.1.2** will be applied.

8.3 Summary of Project Residual Effects and Conclusion

There are no residual effects to fish and harvested fish and aquatic Species at Risk. The residual effects remaining after mitigation for fish habitat in the Project Footprint and Local Assessment Area during the construction phase of the Project are identified as:

- The permanent destruction of 180 m of riparian zone habitat during construction; and
- The permanent destruction of 206.5 m^2 of instream habitat during construction.

The permanent destruction of 180 m of riparian zone habitat and 206.5 m^2 of instream fish habitat at the crossings is unavoidable due to the footprint of the required structures (culverts and bridges). These areas represent a very small fraction of the instream fish habitat and riparian zone habitat that is available in each of the affected watercourses.

The instream habitat destruction summarized in **Table 8.6** includes 5.8 m^2 of marginal foraging habitat for lake sturgeon in the Berens River. The instream habitat that will be affected is an area of moderate velocity dominated by bedrock substrates. The area that will be destroyed does not represent critical spawning or rearing habitat, and is a very small area relative to the amount of similar habitat that is available in the Berens River.

There were no residual effects remaining after mitigation for fish habitat, fish and harvested fishand aquatic Species at Risk in the Project Footprint and Local Assessment Area for the operations and maintenance phase of the Project.

Chapter 5 (Environmental Protection and Sustainable Development) provides a description of the environmental protection measures and plans that will be implemented during Project phases. As indicated in **Chapter 14** (Monitoring and Follow-up), the follow-up and/or monitoring activities that will be used to confirm that mitigation measures are successful in preventing residual effects on fish habitat, fish and harvested fish and aquatic Species at Risk in the Project Footprint and Local Assessment Area include:

- Monitoring of TSS/turbidity levels during construction activities (including cofferdam and silt curtain removals) on fish-bearing watercourses;
- Regular site inspections to confirm that appropriate construction best management practices and mitigation measures are implemented, adequately maintained and effective; and
- If mapleleaf mussel relocation is required during construction of the P4 Project, the relocated mussels will be monitored for growth and survival.

Additional information on the follow-up and/or monitoring activities for fish habitat including habitat for fish and harvested fish and aquatic Species at Risk is provided in **Appendix 8-1**.

Based on the proper implementation of mitigation and follow-up measures (e.g., Fisheries and Oceans Canada 2015c) and availability of similar aquatic habitat in the Local Assessment Area watercourses, it is expected that there will be no serious harm to CRA fish species, including aquatic Species at Risk, as a result of the Project.

Table 8.9 provides a summary of the Project-related residual effects assessment for fish habitat, fish and harvested fish and aquatic Species at Risk in the Project Footprint and Local Assessment Area. With the use of appropriate mitigation, residual adverse effects of Project construction, operations and and maintenance activities on fish habitat, fish and harvested fish and aquatic Species at Risk in the Project Footprint and Local Assessment Area are not expected to be significant.

The assessment of the potential cumulative effects of the Project on the aquatic environment is provided as a separate stand-alone chapter of this EIA (**Chapter 13,** Cumulative Effects).

Table 8.9: Summary of Residual Project Effects and Significance Conclusions for Fish Habitat

Residual Effects	Residual Effects Characteristics/Level Rating						Ecological Context	Significance Conclusion
	Direction	Duration	Magnitude	Extent	Frequency	Reversibility		
Construction Phase								
▪ Permanent destruction of 206.5 m^2 of instream habitat and 180 m of riparian zone habitat.	N-	III	I	I	I	III	I	N

KEY: (see also **Chapter 6, Section 6.4** for full definitions and Level of Effect criteria for determination of Significance)

Direction:
N- Negative
P+ Positive

Duration:
Short-term = Level I
Medium-term = Level II
Long-term = Level III

Magnitude:
Negligible or Low = Level I
Moderate = Level II
High = Level III

Extent:
Project Footprint = Level I
Local Assessment Area = Level II
Regional Assessment Area = Level III

Frequency:
Once = Level I
Intermittent = Level II
Continuous = Level III

Reversibility:
Reversible (short-term) = Level I
Reversible (long-term) = Level II
Irreversible = Level III

Ecological Context:
Low = Level I (Effect results in minimal disruption of ecological functions and relationships in the area).
Moderate = Level II (Effect results in some disruption of non-critical ecological functions and relationships in the area).
High = Level III (Effect results in disruption of critical ecological functions and relationships in the impacted area).

Significance Conclusion:
S = Significant residual effect
N = No significant residual effect