Appendix 8-1

Aquatic Environment Report

East Side Road Authority

Project 4: Berens River First Nation to Poplar River First Nation All Season Road

Aquatic Environment Report

August 2015

East Side Road AUTHORITY

EAST SIDE ROAD AUTHORITY

PROJECT 4:

BERENS RIVER FIRST NATION TO POPLAR RIVER FIRST NATION ALL SEASON ROAD

Aquatic Environment Report

August 2015

Prepared for

East Side Road Authority

by

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EXECUTIVE SUMMARY

The East Side Road Authority (ESRA) is designing and constructing an all season road from Berens River First Nation to Poplar River First Nation. Based on the preliminary alignment, 33 watercourse crossings will be constructed including culverts at 28 unnamed watercourses, a culvert at Okeyakkoteinewin Creek and multi span bridges at the Berens, Etomami, North Etomami and Leaf rivers.

Risk Assessment

A detailed aquatic environmental study was undertaken in summer 2014 to assess the risk that crossing construction would result in "serious harm to fish", pursuant to Section 35(1) of the *Fisheries Act* and to assess the potential impacts of the Project on aquatic habitats.

Under the *Fisheries Act*, "serious harm to fish" applies to fish and fish habitat that are part of or support a commercial, recreational or Aboriginal (CRA) fishery. The risk of serious harm to fish from crossing construction was assessed using a habitat-based approach. The approach considered the impact of the crossing on the productivity of relevant fish and fish habitat. The assessment was conducted based on the preliminary crossing design, literature review and results of field investigations.

Twenty-three culvert sites (sites P4-X02, P4-X06, P4-X08-21, P4-X23, P4-X25-28, P4-X32 and P4-X33) were assessed as "No Fish Habitat" based on the absence of a channel at the crossing and/or connectivity to downstream fish bearing waterbodies. These sites are typically peatland areas with no significant headwaters or nearby overwintering habitats.

Five culvert sites (sites P4-X03, P4-X05, P4-X24, P4-X29 and P4-X31) were assessed as marginal habitat, suitable for forage fish species. These sites are located on small, first or second order streams, and are often poorly connected to downstream fish-bearing waters due to numerous ephemeral barriers. They typically have small watersheds and limited flows which may result in degraded water quality due to low dissolved oxygen. These sites are not expected to support fish that are part of or support a CRA fishery. Channel infilling at these sites is expected to have no measureable effect on the downstream CRA fisheries provided that measures to avoid harm are implemented.

Okeyakkoteinewin Creek and the four bridge sites were assessed as habitats that support CRA fisheries. Okeyakkoteinewin Creek is a moderate size stream with downstream connectivity to the Poplar River. It provides seasonal habitat for large-bodied fish, including Northern Pike, as well as forage fish species. Although there is no known fishery on the creek itself, it contributes to the Poplar River fishery by providing spawning and rearing habitat for Northern Pike. The

proposed culvert is assessed as Low Risk of resulting in serious harm to fish. The affected habitat type is abundant in the area and is not considered critical or limiting to CRA fish species. Infilling within the footprint of the crossing will be small and localized. Culvert construction at the proposed site is expected to have no measurable effect on CRA fisheries productivity.

The Berens, Etomami, North Etomami and Leaf rivers are major perennial watercourses that provide important fish habitat to a variety of fish species, including spawning, rearing and overwintering. The preliminary crossing designs for these sites include two-span bridges with one instream pier at the Berens, North Etomami and Leaf rivers and a three-span bridge with two instream piers at the Etomami River. Channel infilling within the footprint of the instream piers is considered low risk of resulting in serious harm to fish. The infills will be small and localized and the type of habitat affected is abundant in the area and is not considered limiting or critical to CRA fish species. Construction of bridges at the proposed crossing sites is expected to have no measurable effect on CRA fisheries productivity.

Effects Assessment

Potential project-related effects on aquatic habitat were evaluated using a Valued Environmental Component (VEC) approach. Fish, fish habitat, defined as habitats that support fish that are part of or support a CRA fishery, and aquatic species-at-risk were selected as the aquatic VECs. Aquatic species-at-risk VECs included Shortjaw Cisco, Mapleleaf mussel and Lake Sturgeon.

The primary potential effects of road development on fish and fish habitat include erosion and sedimentation of streams, introduction of deleterious substances and habitat loss (riparian and instream) at watercourse crossing sites. Potential effects to species-at-risk include: the disruption of Mapleleaf mussel beds and juvenile Lake Sturgeon habitat due to placement of temporary instream structures; sediment introduction; and deleterious substances.

Mitigation is expected to minimize the frequency, magnitude and extent of sediment introduction into the aquatic environment during the construction phase of the Project. However, in-water construction activities, particularly during the installation and removal of coffer dams and silt curtains, may result in temporary, localized increases in total suspended solids. Additional sediment releases from right-of-way (RoW) run-off may also occur during construction. Unavoidable destruction and alteration of fish habitat will occur within the footprint of crossings and crossing approaches. Habitat loss will include approximately 218.68 m^2 of instream and 180 m of riparian habitat. An additional 192 m of riparian habitat within the cleared RoW will be altered from riparian forest to low growing vegetation. No adverse residual effects to species-at-risk are anticipated with the implementation of mitigation.

Inspection and monitoring will be conducted at stream crossing sites to ensure that the mitigation measures are effective and to identify where adaptive management is required. Environmental site inspections will be conducted before and regularly during construction to ensure that all appropriate mitigation measures are in place, properly maintained, and effective. Post-construction inspections will ensure that crossing sites have been adequately stabilized and disturbed areas are restored. Monitoring programs will include water quality monitoring at the Okeyakkoteinewin Creek and four bridge sites to monitor potential increases in turbidity/total suspended solids during instream construction activities. If Mapleleaf mussel relocation is required as a mitigation measure, post-construction monitoring will include growth, survival and movement of relocated mussels.

ACKNOWLEDGEMENTS

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Fisheries studies were conducted under Manitoba Water Stewardship Scientific Collection Permit 36-14.

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1.0 INTRODUCTION

The East Side Road Authority (ESRA) is designing and constructing an all season road (ASR) from Berens River First Nation to Poplar River First Nation (the Project). The Project is part of a larger initiative to provide improved, safe, and more reliable transportation service between all the communities on the east side of Lake Winnipeg.

The ASR Project is currently in the preliminary design phase with final stream crossing design in progress. Based on the preliminary alignment, the proposed ASR will intersect both small and medium-sized streams and several large rivers. Detailed aquatic environmental studies were undertaken in July 2014 to identify and describe aquatic habitats potentially affected by the project and to assess the potential impacts of the Project on these habitats. Specific objectives included:

- To describe the existing aquatic habitat within the project study area;
- To assess the risk of the project to fish and fish habitat at watercourse crossing sites;
- To identify watercourse crossings where ASR construction may cause "serious harm to fish[1]" pursuant to Section 35(1) of the federal *Fisheries Act*;
- To assess the potential effects of the project to the aquatic environment and propose measures to mitigate the effects;
- To assess the residual effects of the project on the aquatic environment; and
- To provide inspection and monitoring recommendations related to the aquatic environment for each phase of the ASR project.

The information provided in this report is intended to assist in project design and be used in support of an Environmental Impact Statement (EIS) to be submitted and reviewed under the *Canadian Environmental Assessment Act, 2012* (S.C. 2012, c. 19, s. 52; CEAA).

[1] Under the *Fisheries Act*, "serious harm to fish" applies to fish and fish habitat that are part of or support a commercial, recreational or Aboriginal fishery and includes the death of a fish or any permanent alteration to or destruction of fish habitat.

2.0 PROJECT OVERVIEW

The proposed ASR will extend from Berens River First Nation, north to Poplar River First Nation (Figure 1) and will consist of an 8.5 m wide road top centered within a 60 m cleared right-of-way (RoW). The Project is currently in the preliminary planning stage and the road alignment and crossing design are yet to be finalized. Based on the preliminary route, the ASR project will require construction of 33 watercourse crossings. Although subject to change, the crossing designs are expected to include:

- multi-span bridges at the Berens, Etomami, North Etomami and Leaf rivers;
- a culvert at Okeyakkoteinewin Creek; and
- culverts at 28 unnamed streams.

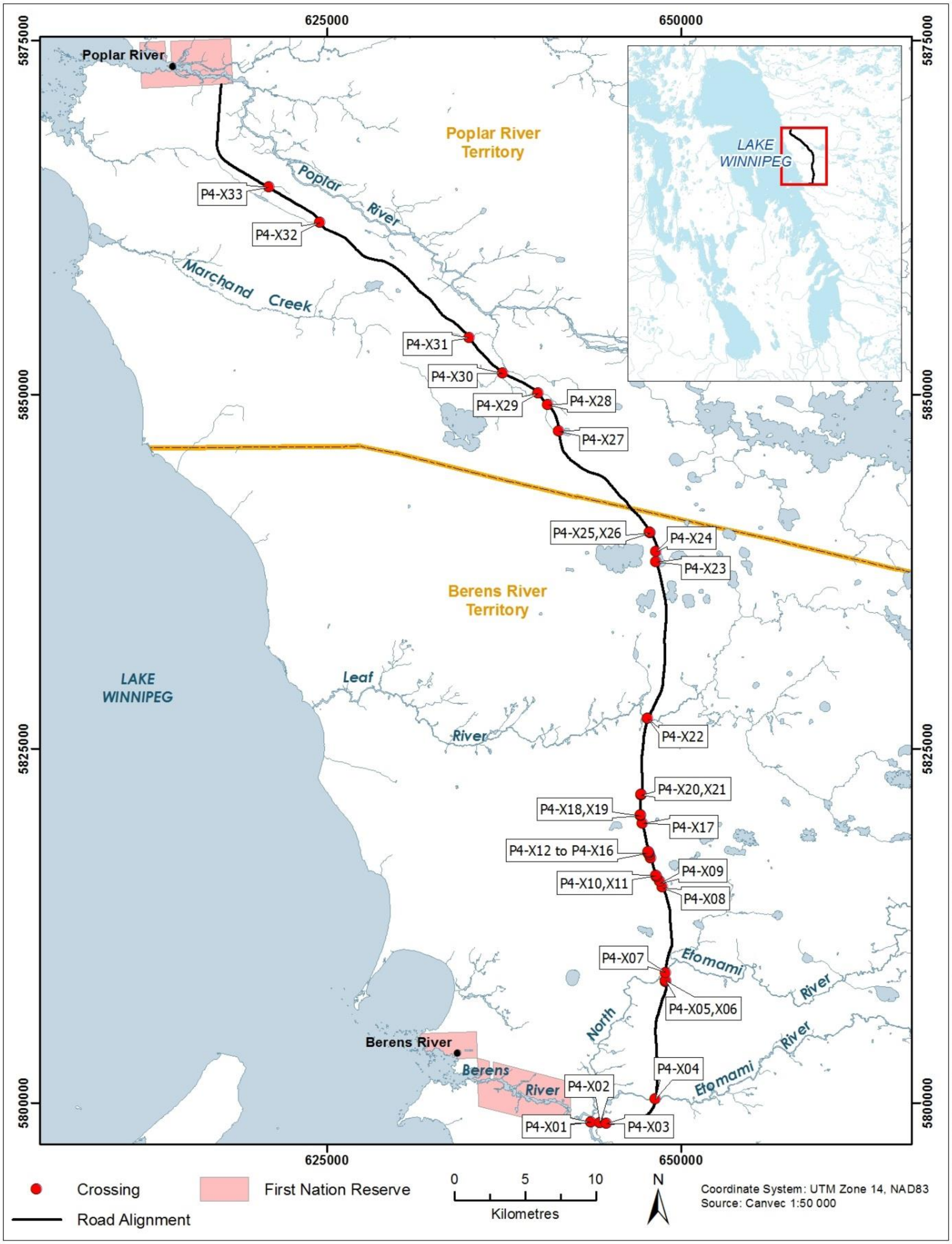

Figure 1. Project 4 – Berens River First Nation to Poplar River First Nation All Season Road study area and watercourse crossing locations.

3.0 EXISTING ENVIRONMENT

The Project is located on the east side of Lake Winnipeg, between the communities of Berens River First Nation and Poplar River First Nation. The east side of Lake Winnipeg is located within the Boreal Shield ecozone and encompasses the Lac Seul Upland ecoregion (Smith et al. 1998). Within the ecoregion, the Project traverses two ecodistricts; Berens River and Wrong Lake. These two ecodistricts are characterized by short, warm summers, and long, cold winters, with highest precipitation occurring from spring through summer.

The southern portion of the alignment intersects the Berens River ecodistrict. This ecodistrict is characterized by nearly level peatlands (bogs and fens) interspersed with small to large uplands of rock outcrops overlaid by shallow glaciolacustrine sediments (Smith et al. 1998). Drainage is considered poor to very poor due to the gentle topography and a landscape dominated by peatlands. Black spruce with ericaceous shrubs and mosses are common in bog peatlands and sedges and brown mosses in fens. Birch shrub and stunted tamarack are also found in fen peatlands. Upland areas are dominated by either black spruce, with alder and willow, or stands of trembling aspen, and balsam poplar.

North of the Leaf River, the Project lies largely within the Wrong Lake ecodistrict. The Wrong Lake ecodistrict is also dominated by peatlands, but with increased occurrences of bedrock outcrops (Smith et al. 1998). These outcrops are typically overlaid by shallow clayey glaciolacustrine sediments and till deposits. Forest vegetation is dominated by black spruce, particularly in poorly drained uplands and in bogs. In bogs, black spruce trees are typically stunted due to poor drainage and have an understory of dwarf birch, ericaceous shrubs and moss. Fen peatlands support sedges, shrubs and tamarack. In well-drained environments, mixed forests of white spruce, balsam fir, trembling aspen and balsam poplar are common.

The proposed ASR alignment extends east from the Berens River community, traverses the Berens River, then turns northward, crossing the Etomami, North Etomami and Leaf rivers, and connects to Poplar River First Nation from the south (Figure 1). The landscape is relatively undeveloped; in addition to the Berens River and Poplar River communities other infrastructure developments include a winter road connecting the two communities and an electrical transmission line.

3.1 AQUATIC HABITATS

All surface waters within the Project area flow west to Lake Winnipeg and are part of the Lake Winnipeg East drainage division (Smith et al. 1998). Waterbodies within the area include small and medium lakes, numerous small streams, and medium and large rivers, including the Berens, Etomami, North Etomami, Leaf and Poplar rivers. The smaller streams are often part of boreal wetlands such as bogs and fens that drain local areas into larger creeks, rivers or lakes and are usually less than one metre in depth. Within the study area, these types of streams typically drain to major rivers, such as the Berens, Etomami and North Etomami rivers. Discharges during spring flows may be a number of cubic metres per second, but become entirely dependent on precipitation during summer and can often reach zero during dry periods. Water temperatures in these streams may be near 0ºC at break-up in April or May, but can rise rapidly to the mid-twenties by late May. These streams may be used as spawning and nursery areas by larger fish species (e.g., Northern Pike) in spring, while smaller forage species such as minnows and stickleback may use the streams through the summer, if water volume is adequate. Due to shallow depths and low winter flows, small streams generally provide little or no over-wintering habitat.

Moderate sized streams in the study area may provide spawning habitat for larger fish, such as Northern Pike. For the remainder of the year, these streams may be used as a nursery for young fish and provide habitat for various species of minnows, darters, and sticklebacks. Over-wintering of smaller fish in these types of streams will often occur when deeper pools are available. Water temperatures approach 0ºC during winter, but will increase to the mid-twenties during summer. Large river systems, such as the Berens River, will provide year-round habitat for large numbers of fish species and due to perennial flows may support both spring and fall spawning species.

Small boreal wetland areas also occur within the study area. These habitats are generally not connected to fish bearing waters and typically become anoxic during winter. A few species of small-bodied fish that are tolerant of low oxygen levels may persist in these wetlands, but most are typically devoid of notable fish populations.

Thirty-six fish species have been documented in major watercourses located within the project area (Table 1).

3.1 WATER QUALITY

Historical water quality data for the area are limited to individual samples collected by Manitoba Conservation and Water Stewardship (MCWS 2014) from the mouth of the Berens and Poplar rivers. Based on these data, water quality of these rivers can be described as nutrient rich and moderately clear, with relatively low productivity (Appendix 1). Total phosphorus concentrations measured in each river (0.076 and 0.067 mg/L, respectively) were well above the narrative Manitoba guideline for the protection of aquatic species where a tributary enters a lake (0.025 mg/L; MWS 2011). Aluminum, copper, iron, lead, and silver concentrations measured in the Poplar River in 2001 also exceeded the Manitoba Water Quality Standards, Objectives, and Guidelines (MWQSOGs) for the protection of aquatic life (PAL; 0.1, 0.001, 0.3, and 0.001

mg/L, respectively). No other routine parameters or metals and major ions measured in the Berens River in 2008 or the Poplar River in 2001 exceeded the MWQSOGs.

Table 1. Documented fish species presence in major watercourses in the Berens River to Poplar River study area.

Common Name	Scientific Name	Berens River[1]	Etomami River	North Etomami River	Leaf River	Poplar River[2]
Black Crappie	*Pomoxis nigromaculatus*	X				X
Blackchin Shiner	*Notropis heterodon*	X				X
Blacknose Shiner	*Notropis heterolepis*	X				X
Black Bullhead	*Ameiurus melas*	X				
Brook Stickleback	*Culaea inconstans*	X				
Brown Bullhead	*Ameiurus nebulosus*	X				X
Burbot	*Lota lota*					X
Carp	*Cyprinus carpio*	X				
Channel Catfish	*Ictalurus punctatus*	X				X
Cisco	*Coregonus artedi*	X	X			
Emerald Shiner	*Notropis atherinoides*	X	X	X		X
Fathead Minnow	*Pimephales promelas*	X				X
Freshwater Drum	*Aplodinotus grunniens*	X				
Golden Shiner	*Notemigonus crysoleucas*	X				X
Iowa Darter	*Etheostoma exile*					X
Johnny Darter	*Etheostoma nigrum*	X				X
Lake Sturgeon	*Acipenser fulvescens*	X				X
Lake Whitefish	*Coregonus clupeaformis*	X				X
Logperch	*Percina caprodes*					X
Longnose Dace	*Rhinichthys cataractae*	X				X
Longnose Sucker	*Catostomus catostomus*	X				X
Mimic Shiner	*Notropis volucellus*	X				X
Mooneye	*Hiodon tergisus*	X				
Ninespine Stickleback	*Pungitius pungitius*	X				X
Northern Pike	*Esox lucius*	X				X
Quillback	*Carpiodes cyprinus*	X				
River Darter	*Percina shumardi*	X				X
Rock Bass	*Ambloplites rupestris*	X				X
Sauger	*Sander Canadensis*	X				
Shorthead Redhorse	*Moxostoma macrolepidotum*	X				

1 – Bulloch et al. (2002), COSEWIC (2006a), North / South Consultants (2014), and Stewart and Watkinson (2004).
2 – COSEWIC (2006a), Franzin et al. (2003).

Table 1. Continued.

Common Name	Scientific Name	Berens River[1]	Etomami River	North Etomami River	Leaf River	Poplar River[2]
Silver Redhorse	*Moxostoma anisurum*	X				
Slimy Sculpin	*Cottus bairdii*					X
Spottail Shiner	*Notropis hudsonius*	X		X	X	X
Tadpole Madtom	*Noturus gyrinus*	X				X
Troutperch	*Percopsis omiscomaycus*	X	X	X		X
Walleye	*Sander vitreus*	X	X	X	X	X
Weed Shiner	*Notropis texanus*	X				X
White Bass	*Morone chrysops*	X				X
White Sucker	*Catostomus commersonii*	X		X	X	X
Yellow Perch	*Perca flavescens*	X				X

1 – Bulloch et al. (2002), COSEWIC (2006a), North / South Consultants (2014), and Stewart and Watkinson (2004).
2 – COSEWIC (2006a), Franzin et al. (2003).

4.0 FISH HABITAT AND RISK ASSESSMENT

The methods and results of the fish habitat assessment and subsequent risk assessment are presented in the following sections.

4.1 METHODS

The aquatic environment data collection and analysis methods and habitat and risk assessment approach are described below.

4.1.1 Aquatic Environment Data Collection and Analysis

Aquatic environment field data were collected in July 2014 where the ASR alignment intersected watercourses. Data were collected through geographic information systems (GIS) and orthophoto analysis and during field surveys. The data were used to provide a physical description of fish habitat and assess potential fish use.

4.1.1.1 Watercourse Identification

Watercourse crossing sites were identified by ESRA and provided to North/South Consultants in shapefile format. The ASR alignment was also overlaid on the CanVec 1:50,000 hydrographic dataset (version 8; Natural Resources Canada 2007) using ArcGIS® 10.2 GIS software (Environmental Systems Research Institute [ESRI], Redlands, California) to identify any additional watercourse crossing sites.

4.1.1.2 Drainage Analysis

For each crossing site, the drainage area upstream of the proposed crossing and distance to the nearest downstream fish-bearing waterbody were calculated. For drainage area, watershed boundaries were created using the Prairie Farm Rehabilitation Administration (PFRA) Incremental Gross Drainage Area dataset (PRFA 2008). Most watercourses crossed by the alignment are minor streams and their drainage area is located within the larger watersheds mapped in the PFRA dataset. The watershed boundaries for these smaller streams were delineated from the larger watershed using the Shuttle Radar Topography Mission (SRTM) Digital Elevation Model (DEM) (USGS, n.d.). The upstream drainage area was then calculated using ArcGIS® 10.2.

The linear distance from each crossing to the nearest major fish bearing waterbody was determined using ArcGIS® 10.2. Distances were calculated based on the CanVec 1:50,000 hydrographic dataset.

4.1.1.3 Aerial Reconnaissance

Orthophoto analysis and aerial surveys were conducted to classify each watercourse by their size and connection to other fish bearing waterbodies.

4.1.1.3.1. Connectivity

The importance of fish habitat in smaller streams is often related to its connectivity to more extensive downstream habitats. For each stream crossing, downstream connectivity was assessed aerially in the field, and by orthophoto analysis. For each stream, the following features were noted:

- presence of a defined channel downstream of the crossing to the next major watercourse;
- permanent impediments to fish passage (e.g., waterfalls);
- ephemeral impediments to fish passage (e.g., beaver dams); and
- presence and extent of upstream habitat, including the three previous features.

Streams were assigned to one of four connectivity classes as presented in Table 2. The classifications were used to assess or support the known or expected migrations of large-bodied fish species. This was used in the risk assessment (Section 4.1.2) and in assessing the fish passage requirements for crossing design.

Table 2. Description of connectivity classes used to assess the connection of stream crossings to larger fish bearing waterbodies.

Connectivity Class	Class Description
Yes	Connection to downstream fish bearing waters apparent without impediments.
Yes – likely	Connection to downstream fish bearing waters apparent but permanent barrier visible but questionable if it presents a certain barrier; or ephemeral barriers present in low number and the crossing location is in close proximity to the downstream fish bearing water body.
Yes – unlikely	Connection to downstream fish bearing waters apparent, but due to the number of ephemeral barriers and the distance to the downstream water body, fish passage is considered unlikely in almost all years and, when possible, would not likely contribute to the productive capacity of the fishery.
No	Visible connection to downstream water body is not apparent, typically in the absence of a stream channel. Such streams typically diffuse into broad boreal wetlands.

4.1.1.3.2. Watercourse Classification

Based on aerial reconnaissance data, watercourses were classified as one of the following:

Class 1: Medium to Large Streams and Rivers

Class 1 streams are typically named watercourses that maintain perennial flow and contain important fish habitat.

Class 2: Small Streams

Class 2 streams are small watercourses where a distinct stream channel is visible upstream and downstream of the crossing. These include many unnamed creeks as well as smaller named streams with fish habitat ranging from Marginal to Important.

Class 3: Drains

Class 3 streams are drains that may or may not be identified as a watercourse in the CanVec hydrographic dataset. These systems do not have channel connectivity to larger fish bearing waters upstream or downstream. In some cases a small downstream channel may be present, but dissipates into a wetland before connecting to a larger watercourse. Where upstream habitat and habitat at the crossing is peatland, the site is classified as Class 3 even though a channel may be present further downstream. This reflects the lack of habitat at the site. Fish habitat is generally marginal or not present.

4.1.1.4 Channel Sinuosity

Channel sinuosity was calculated for Class 1 and larger Class 2 streams as follows:

Sinuosity = channel length / channel valley length

Channel and valley length were measured from digital orthophotos using ArcGIS® Explorer (ESRI, Redlands California). Channel length was measured along the centreline over a minimum valley length of 500 m.

4.1.1.5 Physical Assessments

Physical assessments were conducted at Class 1 and Class 2 streams. At each crossing location, two study areas were established; 400 m upstream and downstream of the proposed crossing location. The 800 m study reach was established in consideration of potential uncertainties in the location of the road alignment. In each study area a physical assessment of fish habitat was conducted.

4.1.1.5.1. General

Transects were established within the upstream and downstream study areas. The number and location of transects were determined based on the watercourse classification and site-specific conditions, respectively.

Class 1 Streams

Three transects were established within the proposed cleared RoW (60 m on centreline) to record riparian and bank conditions. Transects were typically located at the crossing centreline and 25 m upstream and downstream of the centreline. Side scan sonar was used to capture channel profile and stream bed characteristics (Section 4.1.1.5.12) therefore transects to record this information were not required as per Class 2 stream assessments.

Class 2 Streams

Three to five transects were established: one at the centreline of the crossing and one or two each within the upstream and downstream study areas.

4.1.1.5.2. Water Quality

Due to the potential for blasting near watercourses during the construction of the ASR, laboratory samples and *in situ* parameters were measured at sites assessed as supporting a CRA fishery, to establish baseline water quality.

Laboratory Samples

To minimize disturbance of streambed materials and contamination of the samples, surface water samples were collected from the center of the channel at each site by attaching a clean 500 mL plastic collection jar to an extendable fiberglass pole. The collection jar was triple rinsed with site water prior to sample collection then the laboratory bottle was filled from the collection jar. Where necessary, samples were preserved according to instructions provided by the analytical laboratory. After collection, samples were kept cool and in the dark until submission (within 48 hours) to ALS Laboratories in Winnipeg, MB (a Canadian Association for Laboratory Accreditations, Inc. [CALA] accredited laboratory). The samples were analysed for the following parameters:

- Ammonia;
- Nitrate, nitrite, and nitrate/nitrite;
- Total Kjeldahl nitrogen (TKN);

- Dissolved phosphorus (DP);
- Total phosphorus (TP);
- Total organic carbon (TOC).
- Total suspended solids (TSS);
- Turbidity; and,
- Chlorophyll *a* and phaeophytin *a*.

Field and trip blanks were also submitted to the laboratory and analyzed for the above parameters. Field blanks are intended to provide information on sample contamination from atmospheric exposure and sample handling techniques (i.e., cleanliness of sampling equipment, carry-over contamination from site to site), as well as potential laboratory contamination and/or error (British Columbia Ministry of Environment, Lands, and Parks [BCMELP] 1998). Field blanks were prepared by filling sample bottles with deionized water (both provided by the analytical laboratory) in the field and submitting the blanks along with the environmental samples.

Trip blanks are used for evaluating the potential for sample contamination that may occur from the container or preservatives through transport and storage of the sample, as well as laboratory precision (BCMELP 1998). Trip blanks were prepared in the laboratory by filling sample bottles with deionized water. Trip blanks were transported to the field sampling sites, but remained sealed, and were then submitted to the analytical laboratory in conjunction with environmental samples for analysis.

Field and trip blank results were evaluated for evidence of sample contamination. Values for any parameter that exceeded five times the analytical detection limit (DL) were considered to be indicative of sample contamination and/or laboratory error.

In situ Parameters

In situ water quality was measured at each site and included: temperature; dissolved oxygen (DO); pH; turbidity; specific conductance; and conductivity. Turbidity was measured using an Analite NEP-160 (McVan Instruments Pty Ltd. Scoresby, Australia); all remaining parameters were assessed using a YSI 556 MPS multi-meter (YSI Inc., Yellow Springs, Ohio). Habitat type of the sample site (e.g., riffle, pool, run) was recorded.

4.1.1.5.3. Discharge

In Class 2 streams, discharge was measured at or near the proposed crossing at a relatively straight section of channel, free of vegetation, rocks and obstructions that may interfere with velocity measurements. Discharge was not measured in Class 1 streams as depths exceeded the range of equipment.

To measure discharge, the total wetted width was divided into parcels – typically ten parcels for small streams and a minimum of twenty for larger systems. Depending on channel width, fewer than ten parcels may have been used. The parcel width was divided by two to obtain the distance of the first measurement location from the bank (i.e., distance to the center of the first parcel). Subsequent measurement locations were determined by adding the original parcel width to the previous distance. Where the measured water depth was less than one meter, velocity was measured at 3/5 of the total depth using a Swoffer velocity meter. Where the water depth was greater than one meter, velocity was measured at 1/5 and 4/5 of the total depth.

Stream discharge was calculated as:

$$Q = \Sigma\, wdv$$

where, Q = discharge
w = parcel width
d = parcel depth
v = velocity

4.1.1.5.4. General Morphology

The general stream morphology, including pattern, stage, confinement, flow regime and profile of the surveyed reach of the watercourse was visually assessed and described as follows:

- *Pattern* – the channel pattern was classified as straight, sinuous, irregular wandering, irregular meandering, regular meanders and tortuous meanders or braided.
- *Stage* – describes the water level in relation to bankfull and was classified as: Low (0 – 30% bankfull); moderate (30 – 90%); or high (>90%).
- *Confinement* – describes the ability of the channel to migrate laterally on a valley flat between surrounding slopes. Channel confinement was classified as: entrenched; confined; frequently confined; occasionally confined; or unconfined.
- *Flow Regime* – describes the permanence of flow. Flow regime was classified as:

  - Perennial - Contains water at all times throughout the year, except during extreme drought;
  - Ephemeral - Stream bed is above the water table; stream flow is a direct response to a precipitation event (snowmelt or rainfall); or
  - Intermittent - Carries water a considerable portion of the time, but ceases to flow occasionally or seasonally because bed seepage and evapotranspiration exceed available water supply.
- *Channel Profile* – describes the cross sectional shape of the channel and was classified as: notched; U-shaped; V-shaped; or planar.

4.1.1.5.5. Channel Profiles

At Class 1 streams, the wetted width (water's edge) and the channel width (bank to bank) were estimated at each transect using a laser range finder (±1 m). The channel profile was determined using side scan sonar (Section 4.1.1.5.12).

At Class 2 streams, the wetted width (water's edge) and the channel width (bank to bank) were measured at each transect. Water depth at 25%, 50%, and 75% of the wetted width, starting at the left bank, and maximum depth were recorded. The left and right bank designations were determined while facing upstream.

4.1.1.5.6. Riparian Area/Floodplain

At each transect the floodplain and riparian vegetation (vegetation directly influenced by the watercourse) width was measured perpendicular from each bank. The dominant vegetation type within the riparian zone and floodplain (if applicable) was classified as: none; grasses/sedge; shrubs; conifers; deciduous trees; or mixed forest. The riparian canopy cover over the stream was also estimated (%).

4.1.1.5.7. Substrate

At Class 1 streams, substrate composition was determined using side scan sonar (Section 4.1.1.5.12).

At Class 2 streams, substrate composition (%) was visually estimated at each transect. Substrate composition was based on the following size classifications:

Class	Size
fines	<2 mm
small gravel	2 – 16 mm

large gravel	17 – 64 mm
cobble	65 – 256 mm
boulder	>256 mm

4.1.1.5.8. Banks

At each transect, the following parameters regarding channel banks were collected:

- *Bank Materials* – Each bank was classified according to the dominant bank material. Materials were classified as: organic/mineral soils; mineral; mineral/rock; rock/boulder; and bedrock.
- *Bank Height* – The vertical height of each bank from the water's edge to the top of the bank was measured.
- *Bank Shape* – The shape of each bank was classified as follows:
    - Vertical steep sloping/vertical (45 – 90°);
    - Undercut protruding over the channel; or
    - Sloping gradual or shallow slope (<45°).
- *Bank Stability* – Bank stability was visually assessed as follows:
    - Highly stable banks well vegetated or covered in large boulders;
    - Moderate stability >50% vegetated or rocked and some undercut banks;
    - Low stability <50% of the bank is vegetated or rocked; or
    - Unstable massive slumping, large silt deposition, exposed soil.

4.1.1.5.9. Stream Gradient

Stream gradient (%) was measured using a clinometer aimed at eye level at another crew member or at a survey rod.

4.1.1.5.10. Habitat Inventory

The percent composition of habitat types in each study area was visually assessed. Habitat types were classified as follows:

Falls	vertical drop
Cascade	high gradient and velocity, extremely turbulent, armoured substrate
Chute	area of channel constriction, typically bedrock

Rapids	high velocity, deeper than a riffle, coarse substrate
Riffle	high velocity/gradient (vs. run), surface broken, shallow (<0.5m)
Run (glide)	moderate to high velocity, surface mostly unbroken, deeper than a riffle
Flat	low velocity, near-uniform flow, differential from a pool by high channel uniformity
Pool	portion of the channel with increased depth and reduced velocity, formed by channel scour
Impoundment	pools formed behind dam (dam from debris, beaver or landslide)
Dam	creates the impoundment (debris, beaver or landslide)
Backwater	localized area of reversed flow direction
Boulder Garden	significant occurrence of large boulders, providing significant instream cover, in association with other habitat unit such as riffle or run.

4.1.1.5.11. Cover

The total available cover for fish (%) was estimated for each study reach. Within the available cover, the composition of cover types (%) was determined. Cover types included the following:

- Large woody debris (or coarse woody debris)
- Overhanging vegetation (< 1 m from the water surface)
- Instream vegetation
- Deep pool
- Boulder
- Undercut banks
- Surface turbulence
- Turbidity

4.1.1.5.12. Bathymetry and Substrate Mapping

At Class 1 streams, boat-based habitat mapping was conducted using a Lowrance® HDS-5 with StructureScan® HD sonar imaging (Navico Inc.) and internal integrated global positioning system (GPS) receiver. Side imaging sonar captures detailed information on bottom topography and fish-attracting structure orientation. This device also was used to record water depths for bathymetric mapping.

Data Collection

The two transducers (skimmer and side scan) were mounted onto the transom of the boat and connected to the HDS-5 head. Care was taken to mount the transducer in an area that was relatively free of turbulent water and as far as possible from the propeller to minimize interference from water turbulence. Mounting depth was noted and later used as a correction factor for the depths recorded.

The boat was driven across the width of the river at 15-20 m intervals, down the centerline, and along each shoreline 400 m upstream and downstream of the crossing. Boat speed was maintained under 12 km/hr to minimize interference due to water turbulence.

Depth and geographic coordinate data (UTM) were collected along transects covering the study areas and logged to a flash memory card. Ponar grab samples were collected during each survey to verify substrate data collected by side scan sonar. For each ponar grab, substrate type and UTM location were recorded using a handheld GPS. Substrate type was based on the size classifications listed in Section 4.1.1.5.7. Ponar grab data are provided in Appendix 2.

Data Analysis

Shorelines of the Class 1 streams were digitized at a scale of 1:1500 from summer 2012 colour orthophotos (50 cm pixel), provided by ESRA, using ArcGIS® 10.2. Stream discharge and shoreline elevation were unknown at the time of orthophoto acquisition. The digitized shorelines were assumed to be representative of a normal flow condition for the studied streams.

The recorded data were exported from a Lowrance log file format (.sl2) to a Microsoft Excel format. Depths were corrected according to the transducer mounting depth. The corrected depth files were then imported into ArcGIS and projected to a UTM Zone 15 (NAD83) projection and saved to a GIS ready ESRI® shapefile format.

Prior to the creation of the bathymetric depth surfaces, shoreline zero depth points were created along the digitized shorelines at a 5 metre interval and merged with the corrected depth data set. The inclusion of these shoreline points allows the surface model to conform to the shoreline.

Bathymetric surfaces were interpolated from the corrected transducer depths using Surfer® 11 (Golden Software Inc.). A linear kriging variogram was used to create 5 m grid surfaces covering the extents of the survey. Final Surfer 11 format grid files were exported to an ESRI ascii format for import into ArcGIS® 10.2. Depth contouring and cartographic outputs were completed using ArcGIS® 10.2.

Substrate mapping techniques followed Kaeser and Litts (2010). Side scan images of the river bottom collected during field surveys were analysed using Dr. Depth®, where the positional and bearing information from the GPS data were used to georeference the side scan images of the riverbed and display them in a seamless mosaic. The side scan image mosaic was exported to an ESRI grid format and imported into ArcGIS® 10.2. Major substrate change boundaries were delineated and digitized from the imagery and validation data (ponar grabs) obtained during field studies were used to verify the visually delineated substrate classes. Final symbolization of substrate classes and cartographic output were generated in ArcGIS® 10.2.

4.1.1.6 Biological Assessments

Fish and mollusk sampling was conducted at each site to determine species presence and potential habitat use.

Fish

Fish sampling was conducted within the study reach to confirm fish presence and in Class 1 streams, to determine species use. Gear type was selected based on site-specific conditions and included backpack electrofishing and gillnetting. Backpack electrofishing surveys were conducted at small and medium-sized watercourses that could be waded. During each survey, the start and end of each pass were recorded with a handheld GPS. Sample duration, electrofisher settings, and number of passes also were recorded.

At larger waterbodies (typically Class 1), one standard index gillnet gang and one small-mesh gillnet gang were set for approximately 24 hours. The standard index gillnet gang was 137.2 m long and consisted of five 22.9 m long by 1.8 m deep panels of 1.5, 2.0, 3.0, 3.75, 4.25 and 5.0 inch twisted nylon mesh. Small-mesh gangs were 30 m long and consisted of three 10 m x 1.8 m deep panels of 8, 10 and 12.5 mm monofilament mesh. Gillnet set locations were recorded with a handheld GPS. Set and pull time and water depth were also recorded.

Captured fish were identified and enumerated according to species. Large-bodied fish species were measured for fork length (±1mm). All fish were released into the area from which they were captured. Results of the fish sampling program presented in this report have been limited to presence, abundance and size of the species captured.

Mollusks

Mollusk sampling was conducted in Class 1 streams with sampling targeted within the crossing area (30 m length of stream). Additional sampling was conducted outside of the crossing area, based on the presence and location of suitable habitat. Sampling methodology was selected based on site-specific conditions (i.e., depth) and included ponar grabs in deeper areas and visual inspection using a bathyscope in wadeable areas. Captured mussels were identified and enumerated by species and replaced at the area of capture.

4.1.1.7 Fish Habitat Assessment

The potential fish use within the surveyed reach was assessed at each crossing site. The assessment was based on the field data, drainage analysis results and existing watercourse information and included:

- Assessment of fish overwintering, spawning, rearing and feeding potential (rated low [marginal], moderate or high); and
- Identification of areas that may be sensitive to disturbance, particularly downstream of the crossing site.

4.1.2 Risk Assessment

Section 35(1) of the federal *Fisheries Act* (the Act) prohibits “serious harm” to fish and fish habitat that are part of or support a commercial, recreational or Aboriginal (CRA) fishery. “Serious harm” is defined as the death of a fish or permanent alteration to or destruction of fish habitat. The purpose of this fisheries protection provision is to “provide for the sustainability and ongoing productivity” of CRA fisheries (DFO 2013a).

Small, localized infills that are typically associated with stream crossings (e.g., culverts, multi span bridges) can directly impact fish populations and fisheries yields through habitat loss (DFO 2013b). The potential effects to fisheries productivity from such small-scale projects would be difficult to measure due to the relatively small area of impact (Randall et al. 2013). Thus, an assessment method that considers the relative amount of habitat change is the best approach to determine impacts to CRA fisheries productivity (DFO 2013b; Randall et al. 2013) and risk of serious harm.

DFO is currently developing a risk management framework to provide guidance in assessing the risk of serious harm to fish from a project or project activity. In the absence of a framework, a habitat-based approach was developed to assess the likelihood that ASR crossing construction would result in a serious harm to fish. This approach was developed based on review of the

Fisheries Protection Policy Statement (DFO 2013a) and relevant Canadian Science Advisory Secretariat Science Advisory Reports (DFO 2013b; Randall et al. 2013) and considered the following:

- the type of impact;
- the amount and quality of the affected habitat for each life history stage of fish species that are present; and
- the impact of the project on relevant fish and fish habitat.

The risk assessment is based on the Impacts to Fish and Fish Habitat criteria outlined by DFO (DFO 2013a). The risk assessment considered the residual effect at each crossing assuming that the mitigation measures would be applied as necessary. Each component of the risk assessment is described in the sections below.

A risk assessment was not conducted at crossings sites that did not support fish habitat or where an existing waterbody type was identified by DFO as not requiring authorization under the *Act* (e.g., agricultural and roadside ditches). In addition, DFO has developed a list of projects and project activities near waterbodies that are considered low risk of serious harm. These listed activities, which include clear span bridge construction, do not require authorization under the *Act* provided that measures to avoid harm are implemented. Consequently, an assessment of impacts to fish and fish habitat was not conducted where the preliminary design is a clear span bridge.

4.1.3 Impacts to Fish and Fish Habitat

The Impacts to Fish and Fish Habitat was assessed through a rating system using the following six criteria outlined in the *Fisheries Protection Policy Statement* (DFO 2013a) as follows:

1. **Residual Impact**

   Following the pathway of effects, potential impacts to fish and fish habitat were identified and after the application of avoidance and mitigation measures the residual impacts remaining were identified and listed for each site.

2. **Duration of Impact**

   Description: The amount of time that a residual effect will persist.

   Scale: Short term (days; low); medium term (weeks-months; medium); long term (years-permanent; high).

3. Extent of Impact

Description: The direct footprint of the development as well as indirectly affected areas, such as downstream areas.

Scale: Site or segment (localized; low); channel reach or lake region (medium); entire watershed or lake (high).

4. Availability and Condition

Description: The relative availability of the type and quality of habitat that is being impacted in the watercourse and/watershed.

Scale: Low - The habitat is common and widespread in the region and is relatively intact.

Medium - The habitat has a limited distribution within the region or river system, or is prevalent but degraded.

High - The habitat is rare or similar habitats are present within the area, but are threatened or have been significantly degraded.

5. Impact on Relevant Fish

Description: The resulting effect to fish from the project in consideration of the first four criteria and results of fish and fish habitat studies.

Low - The habitat is used for a range of life requisites by the relevant fish and is not critical or limiting. Habitat impacts are unlikely to result in a measureable effect to local fish populations.

Medium - The habitat is important and is used for a specific life function by the relevant fish, but it is not critical or limiting habitat. Similar habitat is available within the area, but may have a limited distribution. Habitat impacts may result in a small effect on local fish populations.

High - The habitat is critical to the survival of the affected species or the affected species is sensitive or rare. Habitat impacts will likely result in decreased fish production.

6. Avoidance and Mitigation Measures

The risk assessment assumes that all standard measures to avoid and mitigate harm will be implemented and the assessment is based upon the residual impacts that remain.

4.1.4 Categorization of Risk

Risk was assigned to each stream crossing site by reviewing the ratings of the criteria outline above and providing a qualification of the determined risk.

4.2 EFFECTS ASSESSMENT

The environmental effects assessment for the Project will use a Valued Environmental Component (VEC) approach. The potential effects, mitigation measures, and residual effects will be assessed relevant to the VEC's. Using existing literature, available project information and habitat assessment result these potential effects, mitigation and residual effects were described. The assessment of residual effects followed the "Reference Guide for the Canadian Environmental Assessment Act" and includes the identification of spatial and temporal criteria relative to potential effects as outlined in Appendix 3.

4.2.1 Valued Environmental Components

Fish and fish habitat and aquatic species at risk were selected as VEC's for the aquatic environment effects assessment. Fish is inclusive of all species, both harvested and non-harvested, and fish habitat is defined as habitat that supports fish species that are part of or support a CRA fishery. Fish and fish habitat were selected because:

- They are important aquatic environmental components potentially affected by the ASR project;
- Section 35 of the federal *Fisheries Act* prohibits against *Serious Harm* to fish or fish habitat that are part of or support a CRA fishery;
- Fish habitat encompasses a variety of biophysical parameters, including hydrology, channel and flow characteristics, substrate, cover, water and sediment quality, aquatic plants and benthic invertebrate communities; and
- Fish habitat it is often used as a surrogate for the productive capacity of aquatic habitats.

Aquatic species-at-risk were selected as VECs because:

- they are known to occur in the area;
- they may be potentially affected by the Project; and
- they are protected under provincial (MBESEA) and federal (SARA) legislation.

4.2.2 Measurable Parameters

Measurable parameters to be used to assess the potential effects of the Project on VEC's include:

- species presence;
- physical habitat (substrate composition; channel characteristics; cover for fish; habitat type);
- water quality (TSS and turbidity);
- hydrology (velocity and water depth); and
- riparian vegetation (riparian vegetation composition).

4.2.3 Net Habitat Change

Habitat change includes loss due to destruction and/or alteration of instream and riparian habitat. Habitat change was calculated for all crossing locations that support fish habitat. In calculating habitat loss, the best available information on crossing design was used. Where information was deficient, conservative assumptions were made.

4.2.3.1 Destruction

Habitat destruction will occur where crossing design requires the construction of permanent instream structures and placement of the road bed in riparian areas. Instream habitat destruction was calculated based on the dimensions (footprint) of permanent crossing structures located below the high water mark. For culvert crossings, the road bed width was assumed to represent the width of the instream destruction. Therefore the destructed area would equal the road bed width by the stream channel width at the crossing location.

For bridge crossings, the maximum length of a bridge span is 80 feet or 24.3 meters (ESRA pers. comm). Based on this criterion, clear span bridges would be constructed over watercourses less than 24.3 m wide and multi-span bridges over those greater than 24.3 m wide. The number of spans required for each bridge site was determined based on the channel width, maximum span length and guided by known bridge designs from ESRA's PR 304 to Berens River ASR Project. These include two single pier multi span bridges at Pigeon and Bradbury Rivers (AECOM 2013a,b) and a two pier multi span bridge at Long Body Creek (AECOM 2011). Where multi-span bridges are required, it was assumed that only the bridge piers would result in instream destruction and that all remaining bridge components (e.g., abutments) would be located above the high water mark. The pier dimensions used to calculate instream habitat loss was estimated based on the bridge design for Pigeon River, ESRA's PR 304 to Berens River ASR Project (AECOM 2013a).

4.2.3.2 Alteration

Riparian habitat within the RoW but outside of the road bed may be altered and maintained as low growth vegetation for line of sight. Alteration of instream fish habitat may occur where rip rap placement is required to reinforce bridge piers and protect channel banks. Rock placement along stream channels is expected to diversify habitats, provide cover for fish and increase productivity, as long as it does not have a harmful effect to flow patterns. Areas of habitat alteration will be determined following final design.

4.3 RESULTS

A detailed summary of the physical and biological data at streams crossed by the proposed ASR alignment, are provided in appendices 5 and 6. These data were used to determine the potential risk to fish habitat and assess the likelihood of serious harm resulting from construction of crossing structures. The results of these assessments are discussed in the following sections.

4.3.1 Water Quality

4.3.1.1 *In situ* Parameters

In situ parameters varied between the five stream crossings sampled in July 2014. The rivers were warmer than Okeyakkoteinewin Creek, and Berens River had higher DO and lower turbidity than the other study sites (Table 3). Turbidity of Etomami River was also slightly lower than that of the sites to the north, and specific conductance was highest at Okeyakkoteinewin Creek. All five stream crossings had pH below the Manitoba water quality guideline for the protection of aquatic life (6.5 pH units; MWS 2011).

4.3.1.2 Laboratory Analyses

The laboratory samples collected in the study area in July 2014 indicate that the sites have moderate to high nutrient concentrations as well as moderate clarity and low productivity (Table 4). Ammonia and nitrate concentrations were well within the MWQSOGs (site-specific guideline and 2.93 mg N/L, respectively; MWS 2011) but the guideline for TP in streams and rivers (0.05 mg/L) was exceeded at Site P4-X22. Nutrient concentrations vary dramatically between seasons (e.g., during freshet) and TP and ammonia concentrations could also exceed the guidelines at other times of the year or under different flow conditions. In contrast to the in situ conditions, only site P7-X04 had pH (measured at the laboratory) that was below the lower limit for PAL (6.5 pH units).

The QA/QC analyses indicated good accuracy and a lack of contamination of the laboratory samples, as all results were within five times the DLs (Table 4).

Table 3. *In situ* water quality measured at streams crossed by the Berens River FN to Poplar River FN All Season Road. Results in bold indicate values that do not fall within the Manitoba water quality guidelines for the protection of aquatic life.

Site ID	Watercourse	Sample Date	Temperature (°C)	Dissolved Oxygen (mg/L)	Oxygen Saturation (%)	Specific Conductance (µS/cm)	Conductivity (µS/cm)	Turbidity (NTU)	pH (pH units)
MWQSOG			-	*6.0 -6.5* [1]	-	-	-	-	*6.5-9.0* [2]
P4-X01	Berens River	22-Jul-14	20.8	8.32	93.0	49.0	45.1	4.7	***5.97***
P4-X04	Etomami River	22-Jul-14	20.9	7.04	79.4	36.9	34.0	12.46	***5.18***
P4-X07	North Etomami River	22-Jul-14	20.7	7.07	79.1	41.3	37.8	31.4	***5.30***
P4-X22	Leaf River	22-Jul-14	20.1	6.60	73.2	47.5	43.0	30.3	**5.36**
P4-X30	Okeyakkoteinewin Creek	22-Jul-14	16.8	6.77	70.1	62.1	52.2	28.4	***5.72***

1 - Cool and cold water objectives, respectively.
2 - The lower and upper limits of the guideline for protection of aquatic life.

Table 4. Laboratory water quality results for streams crossed by the Berens River First Nation to Poplar River First Nation All Season Road. Results in bold indicate values that do not fall within the Manitoba water quality guidelines for the protection of aquatic life.

			Nitrogen							
Site ID	Watercourse	Sample Date	Ammonia (mg N/L)	Nitrate/ Nitrite (mg N/L)	Nitrate-N (mg N/L)	Nitrite-N (mg N/L)	Total Kjeldahl Nitrogen (mg/L)	Dissolved Inorganic N[1] (mg/L)	Organic N[2] (mg/L)	Total N[3] (mg/L)
	Detection Limit		0.010	0.0051	0.0050	0.0010	0.20	-	-	-
MWQSOG			3.43-49.01	2.93	2.93					
P4-X01	Berens River	22-Jul-14	<0.010	0.0129	0.0129	<0.0010	0.52	0.0629	0.47	0.53
P4-X04	Etomami River	22-Jul-14	0.032	0.0116	0.0116	<0.0010	0.89	0.0436	0.86	0.90
P4-X07	North Etomami River	22-Jul-14	<0.010	0.0091	0.0091	<0.0010	0.97	0.0591	0.92	0.98
P4-X22	Leaf River	22-Jul-14	<0.010	<0.0051	<0.0050	<0.0010	1.02	0.0526	0.97	1.02
P4-X30	Okeyakkoteinewin Creek	22-Jul-14	<0.010	<0.0051	<0.0050	<0.0010	0.85	0.0526	0.80	0.85
QAQC										
Field Blank		22-Jul-14	<0.010	<0.0051	<0.0050	<0.0010	<0.20	0.0526	0.05	0.10
Trip Blank		22-Jul-14	<0.010	<0.0051	<0.0050	<0.0010	<0.20	0.0526	0.05	0.10

1 – Calculated as the sum of ammonia-N and nitrate/nitrite-N.
2 – Calculated as the difference between total Kjeldahl N and ammonia
3 – Calculated as the sum of total Kjeldahl N and nitrate/nitrite-N.
4 – Narrative guideline for streams.
5 – Lower and upper limits of the guideline for protection of aquatic life.

Table 4. Continued.

Site ID	Watercourse	Sample Date	Total Dissolved Phosphorus (mg/L)	Total Phosphorus (mg/L)	Total Organic Carbon (mg/L)	Water Clarity: Total Suspended Solids (mg/L)	Water Clarity: Turbidity (NTU)	pH (pH units)	Algal Pigments: Chlorophyll *a* (µg/L)	Algal Pigments: Phaeophytin *a* (µg/L)
Detection Limit			0.0010	0.0010/0.010	1.0/10	2.0	0.10	0.1	0.10	0.10
MWQSOG				*0.05* [4]				*6.5-9.0* [5]		
P4-X01	Berens River	22-Jul-14	0.0109	0.0214	20.0	5.2	3.90	7.28	3.30	2.49
P4-X04	Etomami River	22-Jul-14	0.0202	*0.032*	36.5	8.8	8.60	***6.49***	2.14	2.16
P4-X07	North Etomami River	22-Jul-14	0.0222	*0.042*	36.5	17.6	21.0	6.58	3.17	3.29
P4-X22	Leaf River	22-Jul-14	0.0230	***0.050***	<10	19.6	19.7	6.76	2.79	2.94
P4-X30	Okeyakkoteinewin Creek	22-Jul-14	0.0150	*0.030*	31.8	11.2	16.6	6.82	1.13	1.98
QAQC										
Field Blank		22-Jul-14	0.0015	<0.0010	<1.0	<2.0	<0.10	6.53	<0.10	<0.10
Trip Blank		22-Jul-14	0.0011	<0.0010	<1.0	<2.0	<0.10	6.19	<0.10	<0.10

1 – Calculated as the sum of ammonia-N and nitrate/nitrite-N.
2 – Calculated as the difference between total Kjeldahl N and ammonia
3 – Calculated as the sum of total Kjeldahl N and nitrate/nitrite-N.
4 – Narrative guideline for streams.
5 – Lower and upper limits of the guideline for protection of aquatic life.

4.3.2 Species Presence

Fish and mollusk species and aquatic species-at-risk presence in watercourses crossed by the ASR was assessed based on field sampling and literature review.

4.3.2.1 Fish

Thirty-six fish species have been reported within streams and rivers crossed by the proposed alignment. These species records are limited to five watercourses: Berens River (Site P4-X01); Etomami River (Site P4-X04); North Etomami River (Site P4-X07); Leaf River (Site P4-X22); and the unnamed Okeyakkoteinewin Creek Tributary (Site P4-X29).

Thirty-six fish species have been documented in the Berens River (Table 1), including a variety of large-bodied fish, such as Walleye, Northern Pike, suckers, Lake Whitefish, and Lake Sturgeon (Bulloch et al. 2002, COSEWIC 2006a, North/South Consultants 2014, and Stewart and Watkinson 2004). During 2014 field surveys, Walleye, Shorthead Redhorse, Rock Bass and Channel Catfish were captured in gill nets set near the crossing site.

Historical species presence was not found in the literature for the remaining study streams. Field sampling identified four species in the Etomami River: Cisco; Emerald Shiner; Troutperch; and Walleye. Four species were also captured in the North Etomami River, including Emerald shiner, Troutperch, Walleye and White Sucker. Spottail Shiner, Walleye and White Sucker were captured in the Leaf River and Brook Stickleback in the unnamed Etomami River tributary. Fish presence was not confirmed through field sampling in the remaining streams crossed by the ASR.

4.3.2.2 Mussels

The small tributary streams crossed by the ASR alignment are unsuitable for mussels. Mussels are typically found in medium to large river systems in areas predominately composed of silt/clay and sand and to a lesser extent gravel.

Wabash Pigtoe (*Fusconaia flava*), Mapleleaf (*Quadrula quadrula*), Fat Mucket (*Lampsilis siliquoidea*) and Threeridge (*Amblema plicata*) mussels were captured in ponar grabs and/or gill nets in the Berens River near the crossing site. All captured Threeridge mussels were empty valves and therefore the presence of this species near the crossing cannot be confirmed as the valves could have drifted into the study reach from upstream areas. Mapleleaf is a species-at-risk and is protected under both provincial and federal legislation. The potential risk to the species from the ASR Project is discussed in Section 4.3.2.3. No mussels were identified in the Etomami, North Etomami and Leaf rivers.

4.3.2.3 Species-at-Risk

The Manitoba *Endangered Species and Ecosystems Act* (MBESEA) was enacted to protect and enhance the survival of threatened and endangered species in Manitoba, to enable reintroduction of extirpated species into the province, and to designate species as threatened, endangered, extirpated, or extinct. At the federal level, the *Species at Risk Act* (SARA) is intended to protect wildlife species at risk in Canada. Within the *Act*, the Committee on the Status of Endangered Wildlife in Canada (COSEWIC) was established as an independent body of experts responsible for identifying and assessing wildlife species considered at risk. Wildlife species that have been designated by COSEWIC may then qualify for legal protection and recovery under SARA.

Currently the MBESEA lists one aquatic species-at-risk, Mapleleaf mussel, and SARA recognizes two aquatic species-at-risk with distributions that extend into the Lake Winnipeg East drainage area; Shortjaw Cisco and Mapleleaf mussel. Although not protected under SARA, Lake Sturgeon is designated as Endangered by COSEWIC (COSEWIC 2006a). In Canada, Lake Sturgeon populations have been greatly impacted by human activities and the species is currently under consideration for listing under SARA. Although they are not legally protected, the potential presence of sturgeon within the Project area was assessed in consideration of potential future listing under SARA.

Mapleleaf Mussel

The Mapleleaf mussel is listed as Endangered under MBESEA and SARA. The species is found in medium to large rivers with slow to moderate currents and firmly packed sand, coarse gravel or clay/mud substrate. On the east side of Lake Winnipeg, the species has been documented in the Bloodvein River (COSEWIC 2006b, North/South Consultants 2010). In Manitoba, habitat degradation due to decreasing water quality has been identified as the main threat to the species (COSEWIC 2006b).

The small tributary streams crossed by the ASR alignment are unsuitable for mussels and their preferred habitat is not present in the immediate crossing area of the Etomami, North Etomami and Leaf rivers. In these three rivers, freshwater mussels of any species were not identified near the crossing, and Channel Catfish, the host fish of Mapleleaf was not captured in gill nets.

A single juvenile Mapleleaf was identified in Berens River, approximately 150 m downstream from the proposed ASR crossing. This is the first documented occurrence of the species in the Berens River and the population size and distribution within the river are unknown. Based on the centreline location, direct impacts to Mapleleaf mussels and their habitat are not expected from the footprint of the bridge, as the habitat is unsuitable for the species. Substrates within the immediate crossing area consist of hard, compact substrates, cobble and bedrock. Preferred habitat is present immediately downstream (approx. 30 m) and approximately 200 m upstream from the crossing centerline. These areas consist of moderate current with gravel/sand substrates. Although suitable habitat is present near the crossing, impacts to Mapleleaf mussel in the vicinity of the proposed crossing are anticipated to be low provided that mitigation measures are in place (Section 5.3).

Shortjaw Cisco

The Shortjaw Cisco is listed as Threatened under SARA. In Manitoba, its distribution is believed to be restricted to large, deep lakes, including Lake Winnipeg. There are no records of this species from riverine habitats in Manitoba. Their preferred spawning habitat is unknown. Shortjaw Cisco has not been documented within streams in the ASR project area and their preferred habitat is not present on route; as a result, no risk to the species is expected.

Lake Sturgeon

Lake Sturgeon inhabit larger lakes and rivers. They are typically benthic and are commonly found over sand substrates. They spawn in fast moving water, such as rapids or at the base of falls. Lake Sturgeon has been reported in both the Ontario and Manitoba portions of the Berens River. In the Ontario portion the population status is “cautious” and increasing, whereas in Manitoba, population status and trends are unknown (COSEWIC 2006a). Historically, Lake Winnipeg populations were known to spawn in the lower reaches of the river (MCWS 2012).

The Berens River crossing site provides moderate velocity run habitat with rocky substrates. The immediate crossing area provides marginal foraging habitat for adults. Outside of the crossing deep water habitats provide potential juvenile habitat. Larval sturgeon may drift to these habitats from potential spawning areas at English Rapids and Sturgeon Rapids, located 1.5 km and 7.4 km upstream of the crossing, respectively.

Impacts to Lake Sturgeon in the vicinity of the proposed crossing are anticipated to be low provided that mitigation measures are in place (Section 5.3). The habitat within the footprint of the crossing is not critical to the species and the extent of instream impacts from construction of the bridge pier is small.

4.3.3 Risk Assessment

The results of the risk assessment are discussed in the following sections. The assessment includes a description of the existing habitat and the Availability and Condition and Impact on Relevant Fish Ratings for each site assessed as having fish habitat at the crossing.

4.3.3.1 Residual Impact, Extent and Duration of Impact

All season road crossings will include culverts at small and medium-sized streams, and multi-span bridges at four large rivers (Berens, Etomami, North Etomami and Leaf rivers). The Residual Impact, Extent and Duration of Impact assessment for each type of crossing structure is discussed below.

Culverts

In the absence of preliminary design information, culverts were assumed to be 30 m long (Section 4.1.3). Habitat loss within the footprint of the crossing will be permanent and therefore duration is rated as high, the extent of the affected habitat is small and rated as low. The overall assessment considers that some productivity will be maintained within the culvert following construction as culverts will be embedded and designed for fish passage.

Multi Span Bridge

Based on channel width and maximum bridge span length, the following bridge designs are expected: a two-span bridge with one instream pier at the Berens, North Etomami and Leaf rivers; and a three-span bridge with two instream piers at the Etomami River. Habitat loss within the footprint of the crossing will be permanent and therefore duration is rated as high, the extent of the affected habitat is small and rated as low.

4.3.3.2 Summary of Habitat Risk

Thirty-three watercourse crossings were identified on the proposed ASR alignment. Twenty-three proposed culvert sites (sites P4-X02, P4-X06, P4-X08-21, P4-X23, P4-X25-28, P4-X32 and P4-X33) were assessed as No Fish Habitat based on the absence of a channel at the crossing and/or connectivity to downstream fish bearing 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. A summary of these watercourses are provided in (Appendix 5).

Five proposed culvert sites (sites P4-X03, P4-X05, P4-X24, P4-X29 and P4-X31) were assessed as marginal habitat, suitable for forage fish species (Table 5; Appendix 6). These sites are located on small first or second order streams that are often poorly connected to downstream fish-bearing waters due to numerous ephemeral barriers. The streams to be crossed typically have small watersheds and limited flows which are often impounded by beaver dams. These flow conditions may result in degraded water quality due to low dissolved oxygen. Habitat at these crossings is considered unsuitable for large bodied fish. The Availability and Condition and Impacts on Fish were rated as Low. The quality of the habitat within the crossing footprints is considered marginal for CRA fishery species and there is a lack of direct access to the sites due to the poor connection to fish bearing waterbodies. Based on habitat assessment and duration and extent ratings the proposed culvert crossings are classified as Low Risk (Table 5).

The remaining five ASR crossings, including one culvert and four multi span bridges, were assessed as Low risk of causing serious harm to fish (Table 5). A risk assessment summary for each of these sites is provided below.

4.3.3.2.1. Culvert Crossings

The proposed Okeyakkoteinewin Creek culvert crossing (Site P4-X30) is located on a medium-size stream with downstream connectivity to the Poplar River (Appendix 6). The creek consists of a low gradient channel within a broad floodplain dominated by sedges and shrubs. The habitat is characterized as a uniform, flat habitat with soft substrates and instream vegetation for cover.

Based on depth and flow conditions, large-bodied fish use is expected to be seasonal. The low flow habitat and instream vegetation are suitable for spawning and rearing by Northern Pike. These fish would move into the creek from the Poplar River during spring to spawn. Instream vegetation also provides cover for spawning, rearing and feeding by forage fish. Forage fish species that are tolerant of low dissolved oxygen levels may also overwinter in deeper areas of the creek. There were no fish captured during field investigations.

The Availability and Condition and Impacts on Fish were rated as Low. There is no known fishery on this creek, but the habitat contributes to the Poplar River fishery by providing suitable spawning and rearing areas for pike. The type of habitat affected is common in the region and is not critical or limiting to the species. Pike are abundant and widespread and there are no known fisheries management issues. There is currently limited pressure on the fishery and productivity is not limited by habitat availability.

Based on the habitat assessment, and duration and extent ratings, the proposed culvert crossing at Okeyakkoteinewin Creek is classified as Low Risk. The Availability and Condition and Impacts on Fish were rated as Low. The quality of the habitat within the crossing footprints is considered marginal for CRA fishery species and there is a lack of direct access to the sites due to the poor connection to fish bearing waterbodies. Based on the habitat assessment and duration and extent ratings the proposed culvert crossings are classified as Low Risk (Table 5).

Although the crossing will result in the loss of habitat, the habitat type is abundant and is not critical CRA fishery species. Habitat impacts will be small in area and are expected to have no measurable effect on the ongoing productivity of the fishery.

4.3.3.2.2. Multi Span Bridge Crossings

Multi span bridges will be constructed at four sites; Berens River, Etomami River, North Etomami River; and Leaf River (Appendix 6). A habitat description and risk assessment for each crossing is summarized in the following sections.

Berens River (Site P4-X01)

The Berens River originates in northwestern Ontario and flows east to Lake Winnipeg. It provides year-round habitat for a diverse fish community (Table 1). The crossing is located approximately 10 km upstream from Lake Winnipeg at a constricted section of the river. The immediate crossing area consists of run habitat over a bedrock substrate. Off current areas, such as shallow bays, provide suitable staging and resting areas for fish. Macrophyte beds in these low flow habitats may be used for spawning, rearing and feeding by Northern Pike and forage fish species. Deep holes are present, ranging from 14-20 m, with sand/gravel substrates. Such habitat may provide foraging opportunities for several species including Lake Sturgeon. Walleye, Shorthead Redhorse, Rock Bass and Channel Catfish were captured near the crossing site.

The Availability and Condition and Impacts on Fish were rated as Low (Table 5). The supported CRA fisheries species are generally abundant and widespread within the region; however Berens River sturgeon populations in Ontario are “cautious” and increasing and are of unknown status in Manitoba (DFO 2010; status = Moderate). Although sturgeon are a species of special concern, the habitat at the crossing (run habitat with rocky substrates) is common within the Berens River system and is not critical or limiting to sturgeon or other supported CRA fisheries species. Further, there are no known threats to habitat; the area is relatively undeveloped and habitat within the Berens River remains intact.

Based on the habitat assessment and duration and extent ratings the proposed Berens River bridge is classified as Low Risk. The Availability and Condition and Impacts on Fish were rated as Low. The quality of the habitat within the crossing footprints is considered marginal for CRA fishery species and there is a lack of direct access to the sites due to the poor connection to fish bearing waterbodies. Based on habitat assessment and duration and extent ratings the proposed culvert crossings are classified as Low Risk (Table 5).

Table 5. Summary of Relevance to a Fishery, Scale of Negative Effects, and Risk Assessment related to construction and operation of the proposed Berens River First Nation to Poplar River First Nation ASR stream crossings.

Site	Stream Name	Crossing Structure	Fish Habitat Present	Supports a CRA Fishery[a]	Extent	Duration	Availability and Condition	Impacts on Fish	Risk of Serious Harm
P4-X01	Berens River	Two-span Bridge	Yes	Yes	Low	High	Low	Low	LOW
P4-X03	Unnamed Etomami River Tributary	Culvert	Yes	No	Low	High	Low	Low	LOW
P4-X04	Etomami River	Three-span Bridge	Yes	Yes	Low	High	Low	Low	LOW
P4-X05	Unnamed North Etomami River Tributary	Culvert	Yes	No	Low	High	Low	Low	LOW
P4-X07	North Etomami River	Two-span Bridge	Yes	Yes	Low	High	Low	Low	LOW
P4-X22	Leaf River	Two-span Bridge	Yes	Yes	Low	High	Low	Low	LOW
P4-X24	Unnamed Creek	Culvert	Yes	No	Low	High	Low	Low	LOW
P4-X29	Unnamed Okeyakkoteinewin Creek Tributary	Culvert	Yes	No	Low	High	Low	Low	LOW
P4-X30	Okeyakkoteinewin Creek	Culvert	Yes	Yes	Low	High	Low	Low	LOW
P4-X31	Unnamed Okeyakkoteinewin Creek Tributary	Culvert	Yes	No	Low	High	Low	Low	LOW

a – commercial, recreational or Aboriginal fishery.
b – “N/A” indicates where the Relevance to a Fishery was not rated as the habitat does not support fish that are part of or support a CRA fishery.

Although the crossing will result in a permanent loss of habitat that supports a CRA fishery, the impacted area is small and localized and is not expected affect the ongoing productivity of the fishery.

Etomami River (Site P4-X04)

The Etomami River is a moderate size, perennial watercourse that provides important fish habitat. The crossing site is located approximately 5.5 km upstream from the confluence with the Berens River and consists of a uniform, flat habitat with soft, fine substrates. Extensive macrophyte beds are present along channel margins and provide suitable spawning, rearing and feeding habitat for Northern Pike and forage fish species. In spring, species such as suckers and Walleye likely migrate past the crossing to spawning habitats located in upstream areas, including Kinnapik Rapids. Troutperch, Emerald Shiner and Cisco were captured near the crossing site.

The Availability and Condition and Impacts on Fish were rated as Low (Table 5). The habitat supports several life requisites for CRA fishery species, but is common within the region and is not critical or limiting. The supported CRA species are abundant and widespread within the area and there are no known management concerns. There are no threats to the supported fisheries or to the associated habitat. The area is relatively undeveloped and the habitat within the Etomami River remains intact.

Based on the habitat assessment and duration and extent ratings, the proposed Etomami River bridge is classified as a Low Risk (Table 5). Although the crossing will result in a permanent loss of habitat that supports a CRA fishery, the impacted area is small and localized and is not expected to affect the ongoing productivity of the fishery.

North Etomami River (Site P4-X07)

The North Etomami River is fed by Natchi Lake and flows east to the Etomami River. It is a moderate size river that provides important year-round habitat for fish. The crossing area is located 15 km upstream from the confluence with the Etomami River and consists of run habitat with a predominately bedrock/boulder/cobble substrate. Macrophyte beds located in shallow off-current areas and within a large downstream bay are suitable for spawning, rearing and feeding by Northern Pike and forage fish species and boulder and cobble areas within the main flow of the river provide feeding opportunity for sucker species. The site is of sufficient depth for overwintering, particularly downstream from the crossing, where depths reach 6-9 m in some areas. There are numerous falls and rapids located along the North Etomami River, including an unnamed set of rapids 1 km upstream from the crossing. Species, such as Walleye and suckers, may migrate through the site to spawning areas at the base of rapids in spring. Walleye, White Sucker, Troutperch, Emerald Shiner, and Spottail Shiner were captured near the crossing site.

The Availability and Condition and Impacts on Fish were rated as Low (Table 5). The habitat is common in the region and is not critical or limiting to CRA fisheries productivity. The supported CRA species are abundant and widespread within the area and there are no known management concerns. There are no threats to the supported fisheries or to the supporting habitat. There has been little development in the area and the habitat within the North Etomami River remains intact.

Based on the habitat assessment and duration and extent ratings, the proposed North Etomami River bridge is classified as a Low Risk (Table 5). Although the crossing will result in a permanent loss of habitat that supports a CRA fishery, the impacted area is small and localized and is not expected affect the ongoing productivity of the fishery.

Leaf River (Site P4-X22)

The Leaf River originates at Head Leaf Lake and flows east to Lake Winnipeg. It is a moderate size river that provides important, year-round fish habitat. The crossing site consists of run habitat with sand/gravel and boulder/cobble substrates. Immediately downstream from the crossing, there is a riffle area with boulder/cobble substrates, suitable for spawning by Walleye and spawning and feeding by suckers. Additional spawning habitat for these species is located at a series of riffles/rapids, approximately 1 km upstream from the crossing; fish would migrate through the crossing area to these upstream spawning sites in spring. Macrophyte beds in off current areas are suitable for spawning, rearing and feeding by forage fish species and may also be suitable for spawning by Northern Pike. Walleye, White Sucker and Spottail Shiner were captured near the crossing site.

The Availability and Condition and Impacts on Fish were rated as Low (Table 5). The habitat at the crossing is common in the region and is not critical or limiting to CRA fisheries productivity. The fishery species supported by the Leaf River are abundant and widespread within the area. There are no known threats to the fishery or to the associated habitats. The habitat within the Leaf River remains intact; the area is relatively undeveloped.

Based on the habitat assessment and duration and extent ratings, the proposed Leaf River bridge is classified as a Low Risk (Table 5). There will be a permanent loss of habitat within the footprint of the crossing; however, the impacted area is small and localized and is not expected to affect the ongoing productivity of the fishery.

5.0 EFFECTS ASSESSMENT

This section outlines the approach used to assess the effects of the Project on the aquatic environment and identifies the potential effects, prescribed mitigation measures and residual effects resulting from ASR construction and operation.

5.1 APPROACH

The environmental effects assessment for the Project uses a Valued Environmental Component (VEC) approach. The potential effects, mitigation measures, and residual effects are identified and assessed relative to the selected aquatic VECs, using the existing literature, available project information and habitat assessment results.

5.1.1 Valued Environmental Components

Fish and fish habitat and species-at-risk were selected as the VECs for the aquatic environment effects assessment as they are important environmental components that are potentially affected by the ASR.

5.1.1.1 Fish

Fish were selected as VECs because:

- they are important to people and the ecosystem they in habitat in the area;
- they may be potentially affected by the Project; and
- they are protected under the federal *Fisheries Act*.

A diverse community of fish, both harvested species and non-harvested species occur within the project area. The broad category of fish is consistent with protection afforded under the *Fisheries Act*, where the *Act* prohibits causing serious harm to fish or fish habitat that are part of or support a commercial, recreational or Aboriginal (CRA) fishery.

Species occurrence is the measurable parameters used to assess the potential effects of the Project on fish.

5.1.1.2 Fish Habitat

Fish habitat was defined as habitat that supports fish species that are part of or support a CRA fishery. It was selected because:

- Section 35(1) of the federal *Fisheries Act* prohibits the permanent alteration or destruction of fish habitat that supports fish and habitat that are part of or support a CRA fishery;
- it encompasses a variety of biophysical parameters, including hydrology, channel and flow characteristics, substrate, cover, water and sediment quality, aquatic plants and benthic invertebrate communities; and
- it is often used as a surrogate for the productive capacity of aquatic habitats.

Measurable parameters to be used to assess the potential effects of the Project on fish habitat include:

- physical fish habitat (substrate composition; channel characteristics; cover for fish; habitat type);
- water quality (TSS and turbidity);
- hydrology (velocity and water depth); and
- riparian vegetation (riparian vegetation composition).

5.1.1.3 Aquatic Species-at-Risk

Aquatic species-at-risk were selected as VECs because:

- they are known to occur in the area;
- they may be potentially affected by the Project; and
- they are protected under provincial (MBESEA) and federal (SARA) legislation.

Species-at-risk VECs were identified as species listed under the MBESEA and/or SARA that are potentially present within the project area. Potential presence was assessed based on current and historical range, documented occurrences within the study area, and preferred habitats.

Currently, there are two aquatic species-at-risk with distributions that extend into the Lake Winnipeg East drainage area; Shortjaw Cisco and Mapleleaf mussel. Lake Sturgeon has also been documented in tributaries on the east side of Lake Winnipeg. The species is designated as Endangered by COSEWIC and is currently under consideration for protection under SARA. Consequently, sturgeon was also included as a VEC in consideration of potential future listing under SARA.

Measurable parameters used to assess the potential effects of the Project on aquatic species-at-risk include:

- critical habitat;
- water quality (TSS and turbidity); and
- species occurrence.

5.1.2 Residual Effects Assessment

The residual effects were assessed following the “Reference Guide for the Canadian Environmental Assessment Act” (Federal Environmental Review Office [FEARO] 1994) and included the identification of spatial and temporal criteria relative to each potential residual effect. These criteria are outlined in Table 6.

Table 6. Residual affects assessment criteria following the Reference Guide for the *Canadian Environmental Assessment Act* (FEARO 1994).

Criterion	Low	Moderate	High
Magnitude (of the effect)	• Effect is evident only at or nominally above baseline conditions.	• Effect exceeds baseline conditions however is less than regulatory criteria or published guideline values.	• Effect exceeds regulatory criteria or published guideline values.
Geographic Extent (of the effect)	• Effect is limited to the project site/footprint.	• Effect extends into areas beyond the project site/footprint boundary.	• Effect is trans-boundary in nature.
Duration (of the effect)	• Effect is evident only during the construction phase of the project.	• Effect is evident during construction and/or the operational phase of the project.	• Effects will be evident beyond the operational life of the project.
Frequency (of conditions causing the effect)	• Conditions or phenomena causing the effect occur infrequently (i.e. < once per year).	• Conditions or phenomena causing the effect occur at regular intervals although infrequent intervals (i.e. < once per month).	• Conditions or phenomena causing the effect occur at regular and frequent intervals (i.e. > once per month).
Permanence (of effect)	• Effect is readily reversible over a short period of time (i.e. one growing season).	• Effect is not readily reversible during the life of the project.	• Effect is permanent.
Ecological Context (of effect)	• Evidence of environmental effects by human activities. Effect results in minimal disruption of ecological functions and relationships in the impacted area.	• Relatively pristine area. Effect results in some disruption of non-critical ecological functions and relationship in the impacted area.	• Pristine area / not affected by human activity. Effect results in disruption of critical ecological functions and relationship in the impacted area.

5.2 POTENTIAL EFFECTS

5.2.1 Fish

The primary potential effects of ASR construction and operation to fish include erosion and sedimentation, introduction of deleterious substances, altered flow regimes and mortality from entrapment in cofferdams.

5.2.1.1 Erosion and Sedimentation of Streams

Increased suspended sediments can negatively impact fish by impairing water clarity and respiration. Short- and long-term increases in turbidity impair feeding success by visual feeders (Berg and Northcote 1985, Gardner 1981). Suspended sediment can also be harmful to fish by clogging gills, decreasing oxygen exchange and reducing growth rates (Wood and Armitage 1997).

5.2.1.2 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 construction of the ASR through accidental spills and leaks and in run off.

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 operation, maintenance and fuelling of construction vehicles and machinery near watercourses. Hydrocarbons are considered deleterious substances, may kill fish or other aquatic biota directly, or may result in impaired health, vigor, or productive capacity. Polycyclic aromatic hydrocarbons (PAHs) can persist in stream sediments resulting in chronic exposure through direct contact or indirectly through food chain interaction (Collier et al. 2002). Effects of PAHs to fish include fin erosion, liver abnormalities, cataracts, and compromised immune systems (Fabacher et al. 1991, Weeks and Warinner 1984, 1986, O'Conner and Huggett 1988). In benthic invertebrates, PAH exposure can inhibit reproduction, delay emergence, and cause sediment avoidance and mortality.

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 run off 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.

5.2.1.3 Disruption of Fish and Habitat due to Blasting

The compressive shock wave resulting from the detonation of explosives near watercourses can cause serious harm to fish and fish habitat. Shock waves with overpressure levels greater than 100 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 (Section 5.2.1.1) from particles generated by blasting and introduction of deleterious substances (Section 5.2.1.2).

5.2.1.4 Temporary Crossings

The construction and use of temporary crossings can result in loss or damage to riparian vegetation (Section 5.2.2.3), and erosion and sedimentation of streams (Section 5.2.2.1). Temporary crossings, such as fords, can disrupt sensitive fish life stages, such as spawning and incubation periods, resulting in decreased reproductive success.

5.2.1.5 Improved Access to Sensitive Habitats

ASR 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.

5.2.2 Fish Habitat

The primary potential effects of ASR construction and operation to fish habitat are erosion and sedimentation of streams, introduction of deleterious substances and habitat loss. These and other potential effects of the Project on fish habitat are discussed below.

5.2.2.1 Erosion and Sedimentation of Streams

Vegetation removal and improper construction practices near watercourses can result in increased erosion leading to sedimentation of streams. 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.

There are multiple negative effects associated with increased levels of suspended and deposited sediment, including impacts to primary producers, invertebrates, and fish. A decrease in light penetration due to higher turbidity (suspended sediment) can lead to decreased photosynthesis by primary producers. Since primary producers form the base of the food chain, decreases in photosynthesis can impact higher trophic levels, such as invertebrates and fish. Large influxes of deposited sediment can bury aquatic invertebrates, an important food item for many fish species, resulting in reduced invertebrate species diversity and abundances. Fine sediment deposition over existing larger substrates may result in habitat loss for invertebrate species that anchor to coarse substrates.

Sedimentation may result in the loss of spawning habitats and/or decreased spawning success for some fish species. Infilling of existing coarse or rocky substrates with finer materials may create unsuitable spawning habitat for some fish species, smother deposited eggs or inhibit larval emergence from spawning substrates (Kondolf 2000).

5.2.2.2 Loss of Instream Habitat

A crossing design that includes the placement of permanent structures below the high watermark will have direct effects to fish habitat. Infilling of stream substrates due to bridge piers will result in the permanent loss of instream habitat. The armouring of channel banks below the high watermark may alter the quality and productivity of instream habitat; however, depending on design, certain types of armouring such as rip rap may increase habitat productivity by providing suitable substrates for insect production (i.e. fish diet items) and cover for fish.

5.2.2.3 Loss of Riparian Vegetation

Riparian vegetation contributes nutrients to streams and lakes through litter and terrestrial insect drop. The removal of riparian vegetation to accommodate temporary crossings, bridge approaches and line of sight requirements may reduce nutrient inputs into the aquatic food web. In many streams, terrestrial insects contribute to the diet of fish. Further, leaf litter and other organic matter are consumed by aquatic invertebrates, another important food source for many fish species (Allan et al. 2003).

5.2.2.4 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 construction of the ASR through accidental spills and leaks and in run off.

Stormwater Runoff

Stormwater 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 runoff may also results in physical impacts to streams, including bank and channel erosion and/or sediment deposition due to increased runoff frequency, velocity and volume.

5.2.2.5 Disruption of Habitat due to Blasting

The compressive shock wave resulting from the detonation of explosives near watercourses can cause serious harm to fish and fish habitat. Shock waves with overpressure levels greater than 100 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 (Section 5.2.1.1) from particles generated by blasting and introduction of deleterious substances (Section 5.2.1.2).

5.2.2.6 Temporary Crossings

The construction and use of temporary crossings can result in loss or damage to riparian vegetation (Section 5.2.2.3), and erosion and sedimentation of streams (Section 5.2.2.1). Temporary crossings, such as fords, can disrupt sensitive fish life stages, such as spawning and incubation periods, resulting in decreased reproductive success.

5.2.2.7 Improved Access to Sensitive Habitats

ASR 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.

5.2.3 Aquatic Species-at-Risk

The primary potential effects of ASR construction and operation to aquatic species-at risk are habitat degradation and disruption. These and other potential effects of the Project on aquatic species-at risk are discussed below.

5.2.3.1 Shortjaw Cisco

Shortjaw Cisco are typically found in large, deep lakes, including Lake Winnipeg. There are no records of this species from riverine habitats in Manitoba. Shortjaw Cisco has not been documented within streams crossed by the ASR and their preferred habitat is not present on route; as a result, no effects to the species are expected.

5.2.3.2 Mapleleaf Mussel

The primary potential effects of ASR construction and operation to Mapleleaf mussel are limited to the Berens River and include erosion and sedimentation, introduction of deleterious substances, and disturbance of mussel beds.

Erosion and Sedimentation of Streams

Increased suspended sediments can negatively impact mussels by clogging gills and interfering with filter feeding (Ellis 1936). Reduced light penetration can decrease primary production, which is used as a food item by mussels. The deposition of fines may smother mussels and can create a hardpan layer in stream substrates by infilling interstitial spaces. This layer may create unsuitable habitat by reducing the ability of mussels to burrow.

The Mapleleaf requires a host fish to complete its life cycle. Female mussels release glochidia in packets called conglutinates, which may mimic prey items of Channel Catfish, their host fish species. Reduced visibility due to increased sediment may limit host fish-mussel interactions, reducing reproductive success (DFO 2010).

Introduction of Deleterious Substances

The release of deleterious substances into watercourses can degrade water quality for mussels. Heavy metals (e.g., arsenic, cadmium, copper, mercury, and zinc) can accumulate in the tissues of freshwater mussels and become toxic (DFO 2010). As discussed in Section 5.2.1.2, harmful substances may enter the watercourses due to accidental spills and leaks from construction equipment, caste-in-place concrete works, blasting residues and in stormwater runoff.

Temporary Instream Structures

The Project is still in the preliminary design phase and bridge construction methods have not been determined. Based on the extent and proximity of suitable habitat to the crossing site, if temporary crossings or cofferdams are required, there is the potential that they may be placed over Mapleleaf habitat. This could result in harm to or death of mussels located within the structure's footprint.

Impacts to Host Fish Species

The natural distribution of the Mapleleaf is limited by the distribution and abundance of Channel Catfish. Mapleleaf mussels rely on the catfish for the completion of its life cycle. Potential project-related impacts that may negatively affect the Channel Catfish are described in Section 5.2.1, and include erosion and sedimentation of streams, introduction of deleterious substances, habitat loss and habitat disruption (e.g., blasting, temporary crossings).

5.2.3.3 Lake Sturgeon

Potential impacts to Lake Sturgeon in the Berens River include the potential effects to fish habitat, as discussed above.

Instream Structures

Altered flow regimes due to permanent and temporary instream structures, and disturbance due to in water construction activities may restrict movements during critical spawning and larval drift periods. If temporary structures (e.g., cofferdams, temporary crossings) are required, they may be placed over potential juvenile Lake Sturgeon habitat. This may result in the temporary displacement of juveniles into suboptimal habitats, decreasing survival and recruitment.

5.3 MITIGATION

The following section describes measures to avoid or minimize the potential impacts of the Project to fish habitat and aquatic species-at-risk. These include measures to be followed when working at or near watercourses that are fish habitat or are directly connected to fish bearing waters, as well as site specific-measures based on the fish habitat and species-at-risk information collected in the field. Mitigation measures are presented by project phase including: design; construction; and operation and maintenance.

5.3.1 Design

Many potential effects of road developments, including introduction of deleterious substances and channel erosion and sedimentation, can be minimized through proper design. The following measures will be incorporated into the project design to mitigate potential disruptions to fish habitat and 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 will be left between the road and adjacent waterbodies. These buffers will minimize runoff velocity and volume during rain events, encouraging the settling of sediment and contaminants. They will also preserve riparian function such as allochthonous inputs into streams, shading, and bank stability;

- Culvert and bridge crossings will be designed to direct stormwater runoff into a vegetated area or retention pond to decrease the velocity and volume of runoff and encourage the settling of sediment and removal of contaminants; and

- Crossings will be designed to maintain existing flow regimes and be passable by fish.

5.3.2 Construction

5.3.2.1 Deleterious Substances

To minimize the potential introduction of deleterious substance into 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 at all times; and
- All deleterious substances will be stored a minimum of 100 m from the high water mark.

Additional measures related to construction vehicles and equipment, concrete work and explosives are provided in sections 5.3.2.2, 5.3.2.7 and 5.3.2.8, respectively.

5.3.2.2 Construction Vehicles and Equipment

To mitigate the introduction of deleterious substances and erosion and sedimentation of streams from construction vehicles and equipment:

- All materials used to construct watercourse crossings will be clean and free of debris;

- Construction vehicles and equipment will arrive on site clean and free of leaks;
- Vehicle and equipment fueling and maintenance will be conducted a minimum of 100 m from the high water mark; and
- All machinery will remain above the high water mark except where temporary fording of a watercourse is required.

5.3.2.3 Erosion and Sediment Control

To protect stream banks and floodplains from erosion and minimize sediment introduction to watercourses:

- Appropriate erosion and sediment control (ESC) measures will be in place prior to the commencement of construction;
- ESC measures will be regularly inspected and maintained to ensure effectiveness throughout construction;
- Clearing and earthworks near watercourses will be conducted under favourable weather conditions and will be temporarily suspended during storm events;
- Whenever possible, construction work over soft floodplains will be conducted under frozen conditions to minimize rutting and erosion;
- Overburden will be adequately stabilized and stored well above the high water mark;
- All disturbed areas will be stabilized through re-vegetation with native plant species or other appropriate means (e.g., erosion control blankets) following completion of works;
- Riprap placed below the high water mark will be clean and free of debris; and
- All ESC measures will remain in place until all disturbed areas are re-vegetated.

5.3.2.4 Vegetation Removal

To minimize erosion in riparian areas and prevent unnecessary clearing or alteration of riparian habitats:

- Vegetation will be retained as long as possible to minimize the exposure time of disturbed/bare soils to potential erosion;
- Clearing limits will be clearly marked prior to riparian vegetation removal to avoid any unnecessary damage to or removal of vegetation;
- Any necessary ESC measures will be in place prior to the start of clearing; and

- Riparian vegetation clearing within the RoW will be limited to the removal of select vegetation that is required to maintain line of sight safety requirements (i.e., tress and tall shrubs). All low growing vegetation will be maintained.

5.3.2.5 Instream Work

The following measures will be implemented during all works conducted below the high water mark:

- Instream construction activities conducted in fish bearing watercourse will be timed to avoid fish spawning and incubation periods;
- Instream construction will be conducted in isolation of flowing water to mitigate downstream sediment transfer;
- A fish salvage will be conducted within the isolated work area prior to the commencement of instream work;
- If instream work is to occur over suitable Mapleleaf mussel habitat, the affected area will be surveyed for mussels. If Mapleleaf mussel presence is confirmed within the footprint, a mussel relocation program will be implemented where feasible; and
- All construction vehicles and machinery will remain above the high water mark during instream construction activities.

5.3.2.6 Temporary Crossings

General

- 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 ASR RoW to avoid riparian impacts outside of the RoW;
- Temporary crossings will be located away from potential Mapleleaf mussel habitat whenever possible;
- If Mapleleaf mussel habitat cannot be avoided, a mussel survey will be conducted prior to placement of the crossing. If Mapleleaf mussel presence is confirmed within the footprint, a mussel relocation program will be implemented where feasible;
- Placement and removal of temporary crossing structures will be timed to avoid high fish migration periods;

- Approaches will be stabilized as required to protect stream banks (e.g. swamp pads, logs); and
- All temporary crossing structures will be removed when no longer required and the crossing site will be restored to its original conditions.

Fords

If fording is required to transport materials during the construction of the ASR, the following measures will be implemented:

- Fording in flowing waters will avoid periods of fish spawning, incubation and migration; and
- Fording will avoid known fish spawning and rearing areas and Mapleleaf mussel habitats.

Ice Bridges and Snow Fills

If temporary ices bridges or snow fills are required to cross watercourses during construction of the ASR, the following measures will be implemented:

- 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 no longer required or the crossing season has ended, ice bridges will be notched at the centre to prevent the obstruction of fish movement. Notching will also encourage melting at the centre of the bridge, preventing channel erosion and flooding;
- Snow fills will be constructed of clean snow and will not restrict stream flows; and
- When a snow fill is no longer required or the crossing season has ended, compact snow will be removed prior to freshet.

5.3.2.7 Concrete Work

To avoid water quality impacts from accidental releases of uncured or partly cured concrete or concrete washwater:

- Uncured or partly cured concrete will be kept in isolation from watercourses;
- Any water that has contacted uncured concrete will be isolated from watercourses until it has reached a neutral pH; and

- Equipment used in concrete work will be washed away from watercourses to prevent wash water from entering waterways.

5.3.2.8 Blasting

To mitigate the accidental release of explosive materials into watercourses, erosion and sedimentation of streams, and the potential lethal and sublethal effects to fish due to shockwaves:

- Explosive materials will be handled and stored in 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;
- All 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; and
- Explosives will be detonated at sufficient distance from the watercourse to ensure that overpressure levels do not exceed 100 kPa at the land-water interface.

5.3.2.9 Access to Watercourses and Sensitive Areas

To mitigate the disruption of sensitive areas due to increased access:

- Construction access roads and winter roads will be decommissioned and rehabilitated;
- Unnecessary access to sensitive areas by work crews will be prohibited; and
- Access to major watercourse crossings along the ASR will be restricted using measures such as slope treatment and fencing.

5.3.3 Post-Construction

Post-construction mitigation measures will be implemented to ensure long term stability of watercourse crossing areas:

- All stream crossings will be inspected following the first storm event and first freshet to ensure that there are no visible signs of bank and channel instability;
- Disturbed areas will be re-vegetated following completion of works; and

- All stream crossings will be inspected to ensure that adequate levels of vegetation has established in disturbed areas adjacent to watercourses.

5.3.4 Operation and Maintenance

Mitigation measures related to operation and maintenance activities are discussed in the following sections.

5.3.4.1 Bridge Maintenance

Debris Removal

- Unless considered an emergency work, debris removal will be timed to avoid periods of fish spawning, incubation and migration; and
- Debris removal will be conducted by machinery operating from shore (above the high water mark) or by hand.

Protective Coatings

- Removal and application of protective coatings will be conducted in a way that prevents deleterious substances (e.g., paint, paint flakes, blasting abrasives, solvents, etc.) from entering the watercourse (e.g. use of barges or shrouding);
- Paints, solvents and other deleterious substances will be stored and mixed on land (i.e., not on bridge decks) to prevent accidental releases into watercourses;
- Equipment will be cleaned where wash water will not enter the watercourse; and
- Waste materials (e.g., paint flakes, abrasives, etc.) will be properly contained and disposed.

Structural Repairs

- Any in water work will be timed to avoid periods of fish spawning, incubation and migration;
- Appropriate erosion and sediment control measures will be implemented prior to commencement of repair work and will be regularly inspected to ensure their effectiveness;
- Repairs and reinforcements will be conducted in a manner that prevents bridge materials from entering the watercourse;

- Waste materials will be stabilized and/or disposed of in an appropriate manner that prevents entry into the watercourse; and
- Disturbed areas will be restored and re-vegetated to mitigate erosion and sediment introduction into the watercourse.

5.3.4.2 Vegetation Management

- Vegetation management required to maintain line of sight safety requirements within the RoW will include the removal of trees and tall shrubs. All low growing vegetation will be retained; and
- Slash or debris piles should be stabilized and stored above the high water mark until disposal.

5.3.5 Site-Specific Mitigation

Site-specific mitigation measures are presented in Table 7.

Table 7. Site-specific mitigation for watercourse crossing on the Berens River First Nation to Poplar River First Nation All Season Road Project.

Crossing	Watercourse	Crossing Structure	Sensitivity/Concern	Mitigation
P4-X01	Berens River	Multi span bridge	Spring, summer and fall spawning fish species present; in water work could potentially disrupt fish during sensitive periods including spawning and egg incubation.	• In water activity, including construction and removal of coffer dams or placement of rip rap below the high water mark will avoid spawning and incubation periods in spring (April1-June 15), summer (May 1-June 30), and fall (September 15 to April 30). • In water work will be conducted in isolation of flowing water to mitigate sediment transfer to downstream habitats.
			Sloping bedrock shorelines provide little buffer for spills increasing the risk of accidental spills entering the watercourse.	• Appropriate fueling/hazardous chemical buffers will be implemented.
			Mapleleaf mussel identified near the crossing; increased turbidity may smother mussel beds and reduced visibility may limit host fish-mussel interactions.	• In water work will be conducted in isolation of flowing water to mitigate sediment transfer to downstream habitats. • Appropriate erosion and sediment control measures will be implemented and monitored to mitigate impacts to water quality.
			Suitable Mapleleaf mussel habitat located immediately upstream and downstream of the crossing; placement of temporary instream structures over potential mussel habitat may disrupt mussel beds.	• Where possible, temporary structures will be placed away from mussel habitats. • Where potential mussel habitat is unavoidable, the area will be surveyed for Mapleleaf mussels. If conditions permit, mussel beds located within the footprint will be relocated following Mackie et al. (2008).
			Potential juvenile Lake Sturgeon habitat located near crossing; placement of temporary structures may disrupt these habitats.	• Temporary structures will be placed away from potential juvenile sturgeon habitat.

Table 7. Continued.

Crossing	Watercourse	Crossing Structure	Sensitivity/Concern	Mitigation
P4-X04	Etomami River	Multi span bridge	Spring and fall spawning fish species present; in water work could potentially disrupt fish during sensitive periods including spawning and egg incubation.	• In water construction will avoid spawning and incubation periods for spring (April 1-June 15) and fall spawning fish (September 15 to April 30). • In water work will be conducted in isolation of flowing water to mitigate sediment transfer to downstream habitats.
P4-X07	North Etomami River	Multi span bridge	Spring spawning fish species present; in water work could potentially disrupt fish during sensitive periods including spawning and egg incubation.	• In water construction will avoid spawning and incubation periods for spring spawning fish (April 1-June 15) • In water work will be conducted in isolation of flowing water to mitigate sediment transfer to downstream habitats.
P4-X22	Leaf River	Multi span Bridge	Spring spawning fish species present; in water work could potentially disrupt fish during sensitive periods, including spawning and egg incubation. Potential spawning area immediately downstream from the crossing; potential disruption of fish during spawning and incubation.	• In water activity will avoid spawning and incubation periods for spring (April 1-June 30). • Marshaling areas will be established well away from the watercourse. • If a temporary crossing is required, it will be placed upstream from the proposed bridge site.

Table 7. Continued.

Crossing	Watercourse	Crossing Structure	Sensitivity/Concern	Mitigation
P4-X30	Okeyakkoteinewin Creek	Culvert	Potential Northern Pike spawning habitat.	• In water construction will avoid spawning and incubation periods for spring spawning fish (April 15-June 30) • In water work will be conducted in isolation of flowing water to mitigate sediment transfer to downstream habitats.
			Soft floodplain prone to rutting and erosion by construction machinery and equipment.	• Construction will be conducted under frozen conditions to avoid damage to floodplain.

5.4 RESIDUAL EFFECTS

Following the application of proven mitigation measures (Section 5.3), the adverse residual effects from the Project are limited to fish habitat and include: the introduction of sediments to streams; the alteration and destruction of riparian habitats and; the destruction of instream habitat. A summary of the residual effects assessment is provided in Table 8.

Mitigation is expected to minimize the frequency, magnitude and extent of sediment introduction into the aquatic environment during the construction phase of the Project. However, in water construction activities, particularly during the installation and removal of coffer dams and silt curtains, may result in temporary, localized increases in total suspended solids. Additional sediment releases from RoW run-off may also occur during construction.

Unavoidable destruction and alteration of fish habitat will occur within the footprint of crossings and crossing approaches. Habitat loss will include approximately 218.68 m^2 of instream and 180 m or riparian habitat. An additional 192 m of riparian habitat within the cleared RoW will be altered from riparian forest to low growing vegetation.

Instream habitat losses will include the destruction of 5.84 m^2 of Lake Sturgeon habitat in the Berens River. This destruction includes the loss of moderate velocity habitat dominated by bedrock substrates. The impact is small in area and does not represent critical spawning or rearing habitat.

No adverse residual effects to Mapleleaf mussel and Lake Sturgeon are expected with the application of prescribed mitigation. Although short-term increases in suspended sediment are anticipated, the duration and magnitude of the increase is expected to have no effect on Mapleleaf mussel populations. The residual effects to fish habitat are not expected to impact Channel Catfish (the host of Mapleleaf mussel) or Lake Sturgeon populations in the Berens River.

Table 8. Summary of adverse residual effects for watercourse crossings on the Berens River First Nation to Poplar River First Nation All Season Road Project.

VEC	Potential Effect	Project Phase	Residual Effect	Assessment Criteria
Fish Habitat	Project will cause sedimentation of streams from disturbed banks, right-of-way runoff and instream works.	Construction	Temporary increase in TSS.	Magnitude: High Geographic Extent: Moderate Duration: Low Frequency: Low Permanency: Low Ecological Context: Low
Fish Habitat	Project will result in the alteration and destruction of riparian habitat.	Construction, Operation	Loss of riparian habitat and its contribution to fish habitat.	Magnitude: Moderate Geographic Extent: Low Duration: Moderate Frequency: Low Permanency: Moderate Ecological Context: Moderate
Fish Habitat	Project will result in the destruction of instream habitat.	Construction, Operation	Loss of instream fish habitat.	Magnitude: High Geographic Extent: Low Duration: Moderate Frequency: Low Permanency: Moderate Ecological Context: Moderate

6.0 INSPECTION AND MONITORING

The following sections outline inspection and monitoring programs related to the aquatic environment. Inspection and monitoring is described for each stage of construction (pre-construction, construction and post-construction) for activities conducted at or near watercourses.

6.1 INSPECTION

Regular site inspections are conducted to ensure that appropriate construction best management practices and mitigation measures are implemented, adequately maintained, and effective. Site observations and conditions are documented using pre-determined checklists and photographs. Where non-compliance is observed or new issues arise, recommendations for corrective actions are provided by the inspector. The following inspection recommendations were developed based on anticipated construction activities and site conditions.

6.1.1 Pre-Construction

Where appropriate, environmental protection measures should be in place prior to the start of construction. Table 9 provides a list of pre-construction inspection requirements.

6.1.2 Construction

To be effective, environmental protection measures must be adequately maintained throughout the construction phase. Protection measures must be regularly inspected to confirm that they continue to function as intended as construction progresses and site conditions change. Table 10 provides a list of items to be inspected throughout the construction phase at sites at or near watercourses. Inspections should be conducted on a weekly basis, with additional inspections for erosion and sediment control conducted during and/or immediately after significant rain events.

Table 9. Pre-construction inspection requirements for construction sites located at or near watercourses.

PRE-CONSTRUCTION INSPECTION LIST
Deleterious Substances Storage and Spill Prevention
• Spill clean-up kits are present on site.
• Storage and waste containers, including fuel, are located a minimum of 100 m from the high water mark.
• Storage and waste containers are intact/sealed and clearly labelled.
• Waste containers are of sufficient volume for materials requiring disposal.
• Secondary containment is present where necessary.
Construction Equipment and Machinery
• Designated vehicle/equipment maintenance and wash down areas are located a minimum of 100 m from the high water mark.
• Designated vehicle/equipment fuelling areas are located a minimum of 100 m from the high water mark.
• All construction vehicles and equipment are clean and free of leaks.
Erosion and Sediment Control (ESC)
• Appropriate ESC measures are in place prior to construction.
• Extra ESC materials are on site and available for immediate use (e.g., silt fencing, polyethylene sheeting)
Sensitive Areas
• Construction limits and/or any sensitive areas are clearly marked prior to construction
• Clearing limits are clearly marked prior to vegetation removal near watercourses

Table 10. Inspection requirements for construction sites located at or near watercourses.

CONSTRUCTION INSPECTION LIST
Deleterious Substances Storage and Spill Prevention
• Spill clean-up kits are present on site.
• Hazardous waste is being removed from the site regularly.
• All required signage/labels on storage and waste containers are clear and intact.
• Waste containers are intact/sealed.
• Secondary containment is functioning as intended.
• No visible signs of spills/leaks in or near watercourses.
Construction Equipment and Machinery
• Construction vehicles and equipment are free of leaks.
• Equipment and vehicles are being maintained and refuelled a minimum of 100 m from the high water mark.
Erosion and Sediment Control (ESC)
• Visible evidence of erosion (e.g., washouts, rilling, slumping).
• Visual inspection of water quality (turbidity) (e.g., sediment plume visible in nearby watercourses; site run off is visibly turbid)
• Existing drainage is adequately managing site run off (e.g., runoff is directed away from surfaces that are susceptible to erosion)
• Stockpiled materials (e.g., overburden, soil piles) are stored away from watercourses and adequately protected.
• ESC measures have been properly installed.
• ESC measures have been adequately maintained and functioning as intended (e.g., no excessive sediment accumulation behind silt fencing and or check dams; Interceptor/diversion ditches are intact with no visible signs of channel erosion)
Sensitive Areas
• Construction limits and any sensitive areas have been identified and are clearly marked (e.g., soft floodplains, unstable banks).
• Clearing limits are clearly marked prior to vegetation removal.
• Riparian clearing has been conducted within the designated area. No vegetation damage or removal outside clearing limits.
Working In/Near Watercourses
• All heavy equipment remains above the high water mark.
• During instream works downstream flows are maintained at all times.
• Pump intakes used in fish bearing water courses are adequately screened.
• Pumps are discharged onto a non-erodible surface, such as geotextile or rock apron.

6.1.3 Post-Construction

Post-Construction inspections are conducted to ensure that the site has been adequately restored and that the watercourse, including banks and approaches are physically stable. Table 11 provides a list of items to be inspected throughout the post-construction phase at sites at or near watercourses.

Table 11. Post-construction inspection requirements for sites located at or near watercourses.

POST CONSTRUCTION INSPECTION LIST
Deleterious Substances
• All waste (hazardous and non-hazardous) has been removed from site.
• No visible spills.
Construction vehicles, equipment and materials
• All construction equipment and materials have been removed
• All temporary stream crossings or diversions have been removed.
Remediation
• Disturbed areas and slopes have been adequately restored and stabilized (rip rap, seeding, plantings, etc.)
• Crossing sites are physically stable; no visible signs of channel or bank erosion, slumping, etc.[1]
• Vegetation growth/survival in seeded/planted areas

1 – physical stability assessments should be conducted following completion of site remediation, after first storm event, and after first spring freshet.

6.2 MONITORING

Monitoring will be conducted during each construction phase to ensure that environmental protection and mitigation measures are performing as intended and to identify where adaptive management is required.

6.2.1 Pre-construction

6.2.1.1 Water Quality

TSS and turbidity sampling will be conducted prior to construction to establish a TSS-turbidity relationship for the project area. This relationship will facilitate use of turbidity as a proxy for TSS allowing for rapid on-site assessment of potential water quality impacts during the construction phase of the Project.

6.2.2 Construction

A potential effect of ASR crossing construction is the degradation of water quality due to the introduction of sediment and other deleterious substances. These potential effects are of particular concern during instream construction activities. Water quality will be monitored during in water work that is conducted in streams that provide or are directly connected to fish habitat.

6.2.2.1 Turbidity Monitoring

The primary potential impacts from instream construction activities are sediment re-suspension and erosion in relation to the disturbance to the streambed and bank, and alterations to channel hydraulics. The primary indicator for these impacts is total suspended solids (TSS), with turbidity used as a surrogate for rapid on-site monitoring.

A turbidity monitoring program will be conducted during instream construction activities to document the spatial extent and magnitude of impacts to turbidity/TSS levels. Turbidity monitoring will use an upstream-downstream approach. Data collected at downstream sites will be compared to upstream reference sites (i.e., the background conditions) to quantify the effects of construction on TSS/turbidity and facilitate comparison of increases to MWQSOGs for the protection of aquatic life (MWS 2011).

Monitoring will consist of regular *in situ* turbidity measurements at transects and periodic measurements in the plume.

Transect Monitoring

Transect monitoring will be conducted before, during and after instream activities. A minimum of three transects will be established as follows:

- one transect upstream of the stream crossings (Transect 1), as close as feasible but distant enough so as to avoid any potential effects of construction (i.e., upstream of the cleared RoW);
- one transect downstream of the stream crossings (Transect 2), as close as practical considering safety and other considerations, such as construction activities (i.e., within the mixing zone to the extent possible); and
- one transect located at the end of the mixing zone (Transect 3), precise locations of transects will be subject to access and safety considerations.

Precise locations of transects will be determined based on site specific conditions at the time of instream construction (e.g., stream discharge, length of the mixing zone), but will cover a reach that is sufficiently large to determine the effects in the initial zone of dilution and downstream areas. Stream size may warrant establishment of additional transects located further downstream.

Depending on site conditions, turbidity loggers may be deployed in the streams during construction to assist in data collection (e.g., at locations that are not readily accessible).

The numbers of sampling sites on each transect will depend upon the wetted width at the time of monitoring, but typically three sites are established per transect: left quarter channel, mid-channel, and right quarter channel. If turbidity data indicate that MWQSOGs for the protection of aquatic life are being exceeded, corrective actions will be undertaken and plume monitoring will be initiated.

The frequency of transect monitoring will be adapted to reflect the duration and nature of instream activities, and will target collection of data during both periods of peak TSS levels as well as more typical conditions.

Plume Monitoring

Plume monitoring will be conducted to estimate the downstream extent and magnitude of any sediment plume. Approximately three transects (or less, depending on conditions), will be established within the mixing zone. The number and location of transects will be determined at the time of monitoring. Laboratory TSS samples and turbidity measurements will be collected across each transect.

The frequency of plume monitoring will be determined based on the duration and intensity of the plume and nature of instream activities.

TSS-Turbidity Relationship

TSS will be measured in the laboratory and turbidity will also be measured *in situ*. A relationship between TSS and turbidity will be developed to facilitate the use of more frequent *in situ* measurements of turbidity to estimate TSS concentrations.

6.2.2.2 Cofferdam Dewatering Monitoring

Dewatering of coffer dams can result in discharges of water with excessively high TSS (e.g., at culvert placements) or pH values (at pier placements due to contact with concrete). All water pumped from coffer dams will be monitoring to determine if it meets MWQSOGs. Should monitoring results indicate that guidelines are exceeded, appropriate mitigation measures will be implemented to treat the water before it re-enters the watercourse.

6.2.3 Post-Construction

If Mapleleaf mussel relocation is required during construction of the ASR, the relocated mussels will be monitored for growth and survival or as stipulated in the SARA Permit. Monitoring may include sampling one year following relocation, at water temperature greater than 16°C where a subset of marked mussels (marked at the time of relocation) will be sampled for survival, growth, and movement. Exact sample sizes will be determined by the total number of individuals and species relocated. Species survival will be determined by the proportion of marked empty (dead) valves to the total number of marked mussels originally relocated to each cell. Growth (change in length, width, and height) will be monitored in a subset of individuals and species. Migration will be monitored as the number of marked relocated mussels observed outside of the assigned relocation cell or entire grid.

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APPENDIX 1. WATER QUALITY PARAMETERS MEASURED IN SURFACE WATERS OF THE BERENS AND POPLAR RIVERS, MANITOBA (MCWS 2014).

			Nitrogen			Phosphorous			Carbon					
Sample Location	Site ID	Sample Date	Ammonia (mg N/L)	Nitrate/ Nitrite (mg N/L)	Total Kjeldahl N (mg N/L)	Dissolved P (mg/L)	Particulate P (mg/L)	Total P (mg/L)	Total Inorganic C (mg/L)	Total Organic C (mg/L)	Total C (mg/L)	Total Suspended Solids (mg/L)	Laboratory pH (pH units)	Laboratory Conductivity (µS/cm)
MWQSOGs[1]			*3.2-27.5* [2]	*2.93*	-	-	-	*0.025* [3]	-	-	-	-	*6.5-9.0*	-
Berens River	MB05RDS015	22-Jul-08	0.05	0.06	0.6	0.015	0.061	*0.076*	4.5	25	29	6	7.26	44
Poplar River	MB05RES006	31-Oct-01	<0.01	0.07	1.5	0.035		*0.067*	4.7		26		7.12	47

						Productivity			Total Metals and Major Ions									
Sample Location	Site ID	Sample Date	Dissolved Oxygen (mg/L)	Biochemical Oxygen Demand (mg/L)	*In situ* Temperature (°C)	Chlorophyll *a* (µg/L)	Pheophytin *a* (µg/L)	Secchi Disk Depth (m)	Aluminum (mg/L)	Antimony (mg/L)	Arsenic (mg/L)	Barium (mg/L)	Beryllium (mg/L)	Bismuth (mg/L)	Boron (mg/L)	Cadmium (mg/L)	Calcium (mg/L)	Cesium (mg/L)
MWQSOGs[1]			*6.0-6.5* [4]	-	-	-		-	*0.1*	-	*0.15*	-	-	-	*1.50*	*0.00004-0.00015* [5]	-	-
Berens River	MB05RDS015	22-Jul-08		<1	21.9	5.98	<0.5	1										
Poplar River	MB05RES006	31-Oct-01	8.6	1		1.4			*0.71*	0.0004	0.0008	0.011	<0.0002	<0.0002	<0.01	<0.00004	4.74	<0.0001

			Total Metals and Major Ions													
Sample Location	Site ID	Sample Date	Chromium (mg/L)	Cobalt (mg/L)	Copper (mg/L)	Iron (mg/L)	Lead (mg/L)	Lithium (mg/L)	Magnesium (mg/L)	Manganese (mg/L)	Molybdenum (mg/L)	Nickel (mg/L)	Phosphorus (mg/L)	Potassium (mg/L)	Rubidium (mg/L)	Selenium (mg/L)
MWQSOGs[1]			*0.0108-0.210* [5]	-	*0.00099-0.00119* [5]	*0.3*	*0.00011-0.00291* [5]	-	-	-	*0.073*	*0.00568-0.0511* [5]	-	-	-	*0.001*
Berens River	MB05RDS015	22-Jul-08														
Poplar River	MB05RES006	31-Oct-01	0.0017	0.0005	*0.0016*	*1.48*	*0.0008*	0.0022	2.54	0.047	0.0003	0.002	0.16	0.81	0.0031	<0.0004

			Total Metals and Major Ions												
Sample Location	Site ID	Sample Date	Silicon (mg/L)	Silver (mg/L)	Sodium (mg/L)	Strontium (mg/L)	Tellurium (mg/L)	Thallium (mg/L)	Thorium (mg/L)	Tin (mg/L)	Titanium (mg/L)	Uranium (mg/L)	Vanadium (mg/L)	Zinc (mg/L)	Zirconium (mg/L)
MWQSOGs[1]			-	*0.0001*	-	-	-	*0.0008*	-	-	-	*0.015*	-	*0.0130* [5]	-
Berens River	MB05RDS015	22-Jul-08													
Poplar River	MB05RES006	31-Oct-01	6.1	*0.00011*	1.55	0.019	0.0002	<0.00002	0.0003	<0.0002	0.031	0.0002	0.002	0.006	<0.002

1 – Manitoba Water Quality Standards, Objectives, and Guidelines.
2 - Site specific guideline
3 - Objective for tributaries where they enter a lake or pond.
4 - Open-water guidelines for dissolved oxygen for the protection of cool-water and cold-water species.
5 - Site specific guideline calculated using hardness of 7.28 mg/L (calculated)

APPENDIX 2. SUBSTRATE VERIFICATION DATA COLLECTED BY PONAR GRAPS DURING SIDE SCAN SONAR SURVEYS AT MAJOR WATERCOURSES CROSSED BY THE ASR ALIGNMENT

Table A2-1. Site P4-X01 – Berens River substrate verification data.

	UTM (Zone 14 U)		Substrate Type											
Ponar	Easting	Northing	Clay	Silt	Clay/ Silt	Sand	Gravel	Cobble	Cobble/ Boulder	Boulder	Boulder/ Bedrock	Bedrock	Organic	Comment
1	643657	5798314	60	10	-	20	10	-	-	-	-	-	-	
2	643606	5798328	-	100	-	-	-	-	-	-	-	-	-	
3	643723	5798362	-	100	-	-	-	-	-	-	-	-	-	macrophytes present
4	643666	5798369	5	10	-	-	85	-	-	-	-	-	-	
5	643588	5798428	-	-	-	-	-	-	-	-	-	-	-	No grab X 2
6	643590	5798423	-	-	-	-	-	-	-	-	-	-	-	No grab; hard compaction.
7	643525	5798452	-	-	-	-	100	-	-	-	-	-	-	
8	643655	5798494	90	5	-	-	-	-	-	-	-	-	5	organic = wood
9	643588	5798538	-	-	-	-	-	-	-	-	-	-	-	no grab x 2 (too much current)
10	643662	5798619	-	-	-	-	-	100	-	-	-	-	-	
11	643776	5798703	-	-	100	-	-	-	-	-	-	-	-	1 cm silt over clay
12	643706	5798736	-	100	-	-	-	-	-	-	-	-	-	
13	643650	5798805	-	-	-	25	25	50	-	-	-	-	-	
14	643641	5798860	-	-	-	-	-	-	-	-	-	-	-	No grab x 3
15	643585	5798919	-	95	-	-	4	-	-	-	-	-	1	
16	643570	5798998	-	-	-	-	-	-	-	-	-	-	-	No grab; hard compaction
17	643568	5799015	-	-	-	-	-	-	-	-	-	-	-	No grab; hard compaction
18	643627	5799069	-	80	-	10	5	-	-	-	-	-	5	
19	643618	5799012	-	60	-	40	10	-	-	-	-	-	-	

Table A2-1. Continued.

	UTM (Zone14 U)		SUBSTRATE TYPE											
Ponar	Easting	Northing	Clay	Silt	Clay/ Silt	Sand	Gravel	Cobble	Cobble/ Boulder	Boulder	Boulder/ Bedrock	Bedrock	Organic	Comment
20	643634	5798935	-	-	-	-	-	-	-	-	-	100	-	
21	643703	5798670	-	-	-	-	-	-	-	-	-	100	-	
22	643684	5798671	-	-	-	-	-	-	-	-	-	100	-	
23	643684	5798659	-	-	-	-	-	-	-	-	-	-	-	no grab x 2; compact
24	643666	5798659	-	-	-	-	-	100	-	-	-	-	-	
25	643657	5798661	-	-	-	-	-	-	-	-	-	-	-	no grab; compact
26	643690	5798625	-	-	-	-	-	-	-	-	-	-	-	no grab; compact
27	643684	5798641	-	-	-	-	-	-	-	-	-	-	-	hard substrate
28	643712	5798697	-	-	-	-	-	-	-	-	-	-	-	no grab x2; silt on outside of ponar
29	643686	5798702	-	-	-	-	-	-	-	-	-	-	-	no grab
30	643665	5798684	-	-	-	25	50	25	-	-	-	-	-	
31	643763	5798748	-	95	-	5	-	-	-	-	-	-	-	
32	643778	5798715	-	90	-	5	-	-	-	-	-	-	-	
33	643713	5798761	-	50	-	40	-	-	-	-	-	-	10	
34	643628	5798795	10	-	-	20	70	-	-	-	-	-	-	
35	643651	5798779		40	10	-	60	-	-	-	-	-	-	
36	643692	5798810	100	-	-	-	-	-	-	-	-	-	-	
37	643679	5798800	-	-	-	5	95	-	-	-	-	-	-	
38	643620	5798328	10	-	-	30	60	-	-	-	-	-	-	
39	643644	5798334	-	70	-	10	15	-	-	-	-	-	-	
40	643666	5798381	-	60	-	20	20	-	-	-	-	-	-	
41	643654	5798321	-	75	-	10	15	-	-	-	-	-	-	
42	643670	5798298	-	60	-	20	20	-	-	-	-	-	-	
43	643635	5798301	-	-	-	-	-	-	-	-	-	-	-	no grab; sand on ponar
44	643659	5798315	20	50	-	20	10	-	-	-	-	-	-	

Table A2-2. Site P4-X04 – Etomami River substrate verification data.

	UTM (Zone 14 U)		Substrate Type											
Ponar	Easting	Northing	Clay	Silt	Clay/ Silt	Sand	Gravel	Cobble	Cobble/ Boulder	Boulder	Boulder/ Bedrock	Bedrock	Organic	Comment
1	648579	5800323	80	20	-	-	-	-	-	-	-	-	-	
2	648530	5800298	80	19	-	-	-	-	-	-	-	-	1	
3	648531	5800276	80	19	-	-	-	-	-	-	-	-	1	
4	648485	5800276	80	19	-	-	-	-	-	-	-	-	1	
5	648445	5800228	80	19	-	-	-	-	-	-	-	-	1	
6	648390	5800230	80	19	-	-	-	-	-	-	-	-	1	
7	648303	5800219	90	10	-	-	-	-	-	-	-	-	-	
8	648236	5800258	80	19	-	-	-	-	-	-	-	-	1	
9	648200	5800250	-	30	-	-	-	-	-	-	-	-	70	
10	648186	5800268	80	19	-	-	-	-	-	-	-	-	1	
11	648150	5800297	80	19	-	-	-	-	-	-	-	-	1	
12	648085	5800313	-	-	100	-	-	-	-	-	-	-	-	
13	647992	5800350	-	75	-	-	-	-	-	-	-	-	25	
14	658204	5798561	30	50	-	-	-	-	-	-	-	-	20	
15	647898	5800318	80	19	-	-	-	-	-	-	-	-	1	
16	647865	5800319	80	19	-	-	-	-	-	-	-	-	1	
17	647835	5800312	-	-	100	-	-	-	-	-	-	-	-	
18	647824	5800288	-	10	90	-	-	-	-	-	-	-	<1	
19	647796	5800274	23	75	-	-	-	-	-	-	-	-	2	
20	647786	5800289	80	20	-	-	-	-	-	-	-	-	-	
21	648196	5800266	80	20	-	-	-	-	-	-	-	-	-	
22	648182	5800251	80	20	-	-	-	-	-	-	-	-	-	
23	648191	5800260	90	20	-	-	-	-	-	-	-	-	-	
24	648202	5800246	70	30	-	-	-	-	-	-	-	-	-	
25	648196	5800267	-	-	100	-	-	-	-	-	-	-	-	

Table A2-3. Site P4-X07 – North Etomami River substrate verification data.

	UTM (Zone 14 U)		Substrate Type											
Ponar	Easting	Northing	Clay	Silt	Clay/ Silt	Sand	Gravel	Cobble	Cobble/ Boulder	Boulder	Boulder/ Bedrock	Bedrock	Organic	Comment
1	648758	5809040	-	-	-	-	80	-	-	-	-	-	20	
2	648753	5809012	-	70	-	10	-	-	-	-	-	-	20	
3	648738	5808988	90	thin top layer	-	-	-	-	-	-	-	-	10	1/2 cm silt over clay and organics
4	648712	5809059	90	thin top layer	-	-	-	-	-	-	-	-	10	thin layer of silt over clay and organics
5	648647	5809031	-	-	-	-	-	-	-	-	-	100	-	
6	648597	5809036	60	thin top layer	-	10	30	-	-	-	-	-	-	thin layer of silt over clay, gravel and sand
7	648778	5809101	-	-	-	-	-	-	-	-	-	100	-	
8	648801	5809167	95	thin top layer	-	-	5	-	-	-	-	-	-	thin layer silt of clay and gravel
9	648897	5809202	25	-	25	25	25	-	-	-	-	-	-	
10	648924	5809203	-	20	-	40	40	-	-	-	-	-	-	
11	648976	5809212	-	-	100	-	-	-	-	-	-	-	-	thin layer silt over hard clay
12	649012	5809198	-	-	100	-	-	-	-	-	-	-	-	silt over soft clay
13	649073	5809176	100	-	-	-	-	-	-	-	-	-	-	compact clay
14	649100	5809259	60	thin top layer	-	10	30	-	-	-	-	-	-	thin layer silt over clay, gravel and sand
15	649096	5809343	-	-	-	-	-	-	-	-	-	100	-	
16	649064	5809399	-	-	-	-	-	-	-	-	-	-	-	hard; rock
17	649097	5809459	-	-	-	-	-	-	-	-	-	100	-	
18	649106	5809492	-	-	-	-	-	-	-	-	-	100	-	
19	649120	5809553	50	40	-	-	-	-	-	-	-	-	10	
20	649153	5809570	50	40	-	-	-	-	-	-	-	-	10	
21	648950	5809206	80	thin top layer	-	-	15	-	-	-	-	-	5	thin layer silt over clay, gravel and organics
22	648927	5809206	-	50	-	25	-	-	-	-	-	-	25	

Table A2-3. Continued.

	UTM (Zone 14 U)		Substrate Type											
Ponar	Easting	Northing	Clay	Silt	Clay/ Silt	Sand	Gravel	Cobble	Cobble/ Boulder	Boulder	Boulder/ Bedrock	Bedrock	Organic	Comment
23	648921	5809201	25	-	-	25	25	-	-	-	-	-	25	
24	648909	5809197	-	-	-	-	-	-	-	-	-	-	-	hard; rock
25	648900	5809202	-	-	-	-	-	-	-	-	-	-	-	no grab; compact; not rocky
26	648883	5809202	90	thin top layer	-	10	-	-	-	-	-	-	-	thin layer silt over clay and sand
27	648941	5809196	90	thin top layer	-	-	-	-	-	-	-	-	10	thin layer silt over clay and organics
28	648960	5809198	98	-	-	2	-	-	-	-	-	-	-	
29	648935	5809208	95	thin top layer	-	-	-	-	-	-	-	-	5	thin layer silt over clay and organics
30	648914	5809199	-	-	-	-	-	-	-	-	-	-	-	no grab
31	648900	5809197	-	-	-	-	-	-	-	-	-	-	-	hard
32	649074	5809428	-	-	-	-	-	-	-	-	-	-	-	Hard
33	649113	5809292	-	-	-	-	-	-	-	-	-	-	-	Sticks and silt
34	649028	5809200	90	-	-	-	10	-	-	-	-	-	-	
35	648632	5809037	90	-	-	10	-	-	-	-	-	-	-	
36	648713	5809058	90	-	-	10	-	-	-	-	-	-	-	
37	648762	5809015	90	-	-	10	-	-	-	-	-	-	-	
38	648845	5809188	90	-	-	-	10	-	-	-	-	-	-	

Table A2-4. Site P4-X22 – Leaf River substrate verification data.

	UTM (Zone 14 U)		Substrate Type											
Ponar	**Easting**	**Northing**	**Clay**	**Silt**	**Clay/ Silt**	**Sand**	**Gravel**	**Cobble**	**Cobble/ Boulder**	**Boulder**	**Boulder/ Bedrock**	**Bedrock**	**Organic**	**Comment**
1	647631	5827163	-	25	-	25	50	-	-	-	-	-	-	
2	647629	5827177	60	40	-	-	-	-	-	-	-	-	-	
3	647605	5827182	-	20	-	70	10	-	-	-	-	-	-	
4	647576	5827188	-	20	-	70	10	-	-	-	-	-	-	
5	647541	5827226	40	10	-	40	10	-	-	-	-	-	-	
6	647481	5827272	50	<1	-	50	-	-	-	-	-	-	-	
7	647431	5827259	40	5	-	45	10	-	-	-	-	-	-	
8	647373	5827275	-	-	100	-	-	-	-	-	-	-	-	
9	647316	5827294	40	25	-	5	-	-	-	-	-	-	30	
10	647300	5827332	-	-	-	-	-	-	-	-	-	100	-	
11	647619	5827155	-	-	-	-	-	-	-	-	-	100	-	
12	647631	5827153	-	-	-	-	-	-	-	-	-	-	-	compact; no grab
13	647636	5827153	-	-	-	-	-	100	-	-	-	-	-	
14	647637	5827169	-	-	100	-	-	-	-	-	-	-	-	
15	647670	5827131	-	-	100	-	-	-	-	-	-	-	-	
16	647676	5827140	5	-	-	-	-	95	-	-	-	-	-	
17	647696	5827135	70	-	-	15	15	-	-	-	-	-	-	
18	647729	5827152	-	-	100	-	-	-	-	-	-	-	-	
19	647743	5827131	-	-	100	-	-	-	-	-	-	-	-	
20	647770	5827111	40	20		-	-	40	-	-	-	-	-	cobble embedded
21	647761	5827074	-	-	100	-	-	-	-	-	-	-	<1	
22	647777	5827014	-	-	-	-	-	-	-	-	-	100	-	
23	647822	5826995	-	-	100	-	-	-	-	-	-	-	-	
24	647874	5826998	-	20	80	-	-	-	-	-	-	-	-	
25	647918	5827021	-	-	100	-	-	-	-	-	-	-	-	
26	647658	5827125	-	-	-	-	10	-	-	90	-	-	-	

APPENDIX 3. SIZE AND ABUNDANCE DATA FOR FISH CAPTURED DURING THE STREAM CROSSING ASSESSMENT SURVEYS, JULY 2014.

Site	Watercourse	Sample Date	Gear Type[1]	Species	n[2]	Fork Length (mm)
P4-X01	Berens River	16-Jul-14	GN	Walleye	1	312
P4-X01	Berens River	16-Jul-14	GN	Walleye	1	311
P4-X01	Berens River	16-Jul-14	GN	Walleye	1	410
P4-X01	Berens River	16-Jul-14	GN	Walleye	1	327
P4-X01	Berens River	16-Jul-14	GN	Walleye	1	346
P4-X01	Berens River	16-Jul-14	GN	Walleye	1	223
P4-X01	Berens River	16-Jul-14	GN	Shorthead Redhorse	1	429
P4-X01	Berens River	16-Jul-14	GN	Rock Bass	1	213
P4-X01	Berens River	16-Jul-14	GN	Channel Catfish	1	372
P4-X01	Berens River	16-Jul-14	GN	Channel Catfish	1	390
P4-X01	Berens River	16-Jul-14	GN	Channel Catfish	1	392
P4-X01	Berens River	16-Jul-14	GN	Channel Catfish	1	473
P4-X04	Etomami River	18-Jul-14	GN	Cisco	1	286
P4-X04	Etomami River	18-Jul-14	GN	Walleye	1	336
P4-X04	Etomami River	18-Jul-14	GN	Walleye	1	193
P4-X04	Etomami River	18-Jul-14	SN	Troutperch	1	-
P4-X04	Etomami River	18-Jul-14	SN	Emerald Shiner	2	-
P4-X07	North Etomami River	19-Jul-14	GN	Walleye	1	331
P4-X07	North Etomami River	19-Jul-14	GN	Walleye	1	338
P4-X07	North Etomami River	19-Jul-14	GN	Walleye	1	493
P4-X07	North Etomami River	19-Jul-14	GN	White Sucker	1	246
P4-X07	North Etomami River	19-Jul-14	GN	White Sucker	1	221
P4-X07	North Etomami River	19-Jul-14	GN	White Sucker	1	391

1 – EF = backpack electrofisher; GN = gill net; SN = small mesh gill net
2 = n = # of fish captured.

Appendix 3. Continued.

Site	Watercourse	Sample Date	Gear Type[1]	Species	n[2]	Fork Length (mm)
P4-X07	North Etomami River	19-Jul-14	GN	White Sucker	1	428
P4-X07	North Etomami River	19-Jul-14	SN	Walleye	1	149
P4-X07	North Etomami River	19-Jul-14	SN	Troutperch	1	-
P4-X07	North Etomami River	19-Jul-14	SN	Emerald Shiner	1	-
P4-X07	North Etomami River	19-Jul-14	SN	Spottail Shiner	1	-
P4-X22	Leaf River	20-Jul-14	GN	White Sucker	1	230
P4-X22	Leaf River	20-Jul-14	GN	Walleye	1	295
P4-X22	Leaf River	20-Jul-14	GN	Walleye	1	272
P4-X22	Leaf River	20-Jul-14	SN	Walleye	1	349
P4-X22	Leaf River	20-Jul-14	SN	Walleye	1	341
P4-X22	Leaf River	20-Jul-14	SN	Walleye	1	213
P4-X22	Leaf River	20-Jul-14	SN	Spottail Shiner	1	-
P4-X29	Unnamed Okeyakkoteinwewin Creek Tributary	21-Jul-14	EF	Brook Stickleback	1	-

1 – EF = backpack electrofisher; GN = gill net; SN = small mesh gill net
2 = n = # of fish captured.

APPENDIX 4. MUSSEL SPECIES CAPTURED DURING STREAM CROSSING ASSESSMENT SURVEYS, JULY 2014.

Site	Watercourse	Sample Date	Gear Type[1]	Species	n[2]	State
P4-X01	Berens River	15-Jul-14	PG	Wabash Pigtoe	1	live
P4-X01	Berens River	15-Jul-14	PG	Fat Mucket	2	empty valves
P4-X01	Berens River	16-Jul-14	PG	Threeridge	1	empty valve
P4-X01	Berens River	16-Jul-14	PG	Mapleleaf	1	live
P4-X01	Berens River	16-Jul-14	GN	Threeridge	1	empty valve
P4-X01	Berens River	16-Jul-14	GN	Fat Mucket	1	live
P4-X01	Berens River	16-Jul-14	GN	Wabash Pigtoe	2	live

1 – PG = ponar grab; GN = gill net
2 = n = # of mussels captured.

APPENDIX 5. SUMMARY OF STREAM CROSSING SITES ASSESSED AS NO FISH HABITAT.

Watercourse		Representative Photograph
Site: Location: CANVEC: Connectivity: Description:	P4-X02 - Unnamed Drainage 14U 644288/5798617 Yes No No defined channel at the crossing site.	
Site: Location: CANVEC: Connectivity: Description:	P4-X06 – Unnamed Drainage 14U 648929/5808634 No No small wetland channel with poor connectivity (absence of well-defined channel connection) to Site P4-X05 drainage.	
Site: Location: CANVEC: Connectivity: Description:	P4-X08 – Unnamed Drainage 14U 648712/5815230 No No Impounded water (beaver dam) within a broad boreal wetland. No defined connection to overwintering habitats.	

Appendix 5. Continued.

Watercourse	Representative Photograph
Site: P4-X09 – Unnamed Drainage Location: 14U 648495/5815629 CANVEC: No Connectivity: No Description: Small discontinuous channel within broad wetland. No defined connection to overwintering habitats.	
Site: P4-X10 – Unnamed Drainage Location: 14U 648272/5815981 CANVEC: No Connectivity: No Description: Impounded water (beaver dam) within a broad boreal wetland. No defined connection to overwintering habitats. Located on same drainage as and adjacent to Site P4-X11.	
Site: P4-X11 – Unnamed Drainage Location: 14U 648235/5816070 CANVEC: No Connectivity: No Description: Impounded water (beaver dam) within a broad boreal wetland. No defined connection to overwintering habitats. Located on the same drainage as and adjacent to Site P4-X10.	

Appendix 5. Continued.

Site: P4-X12 – Unnamed Drainage
Location: 14U 647869/5817308
CANVEC: Yes
Connectivity: No
Description: CANVEC mapped as a small, isolated waterbody. Impounded water (beaver dam) within a broad boreal wetland. No defined connection to overwintering habitats.

Site: P4-X13 – Unnamed Drainage
Location: 14U 647782/5817516
CANVEC: No
Connectivity: No
Description: Small intermittent channel within boreal wetland; flows to Site P4-X12 impoundment; no downstream connection.

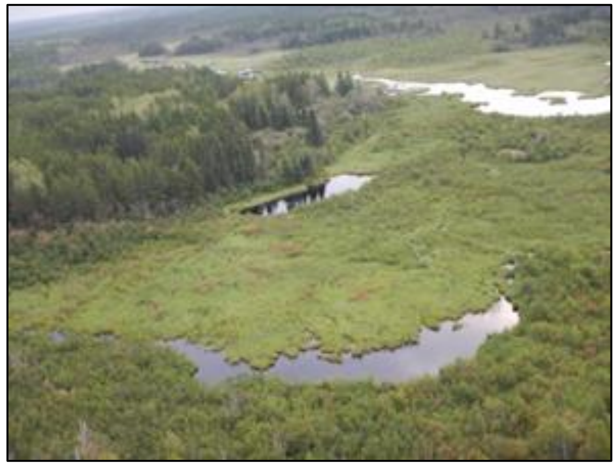
Site: P4-X14 – Unnamed Drainage
Location: 14U 647730/5817642
CANVEC: No
Connectivity: No
Description: Small intermittent channel within boreal wetland; no downstream connection; Located adjacent to and on the same drainage as Site P4-X15.

Site: P4-X15 – Unnamed Drainage
Location: 14U 647718/5817671
CANVEC: No
Connectivity: No
Description: Small intermittent channel within boreal wetland; no downstream connection. Located on the same drainage as Site P4-X14.

Appendix 5. Continued.

Watercourse		Representative Photograph
Site: Location: CANVEC: Connectivity: Description:	P4-X16 – Unnamed Drainage 14U 647690/5817756 No No Small intermittent channel within boreal wetland; no downstream connection.	
Site: Location: CANVEC: Connectivity: Description:	P4-X17 – Unnamed Drainage 14U 647281/5819729 Yes No CANVEC mapped as a small, isolated waterbody. Boreal wetland area with no defined channel. Series of beaver dams and impoundments located downstream but no defined channel connection to overwintering habitats.	

Appendix 5. Continued.

Watercourse	Representative Photograph
Site: P4-X18 – Unnamed Drainage Location: 14U 647170/5820298 CANVEC: No Connectivity: No Description: Impounded water (beaver dam) within a broad boreal wetland. No defined connection to overwintering habitats. Sites P4-X18 and P4-X19 are located on the same impoundment.	
Site: P4-X19 – Unnamed Drainage Location: 14U 647167/5820337 CANVEC: No Connectivity: No Description: Impounded water (beaver dam) within a broad boreal wetland. No defined connection to overwintering habitats. Sites P4-X18 and P4-X19 are located on the same impoundment.	
Site: P4-X20 – Unnamed Drainage Location: 14U 647184/5821742 CANVEC: No Connectivity: No Description: Impounded water (beaver dam) within a broad boreal wetland. No defined channel downstream from impoundment. No connection to overwintering habitats. Located on the same impoundment as Site P4-X21.	
Site: P4-X21 – Unnamed Drainage Location: 14U 647191/5821786 CANVEC: No Connectivity: No Description: Impounded water (beaver dam) within a broad boreal wetland. No defined channel downstream from impoundment. No connection to overwintering habitats. Located on the same drainage as Site P4-X 20.	

Appendix 5. Continued.

Watercourse		Representative Photograph
Site: Location: CANVEC: Connectivity: Description:	P4-X23 – Unnamed Drainage 14U 648249/538188 No No No defined channel at crossing site.	
Site: Location: CANVEC: Connectivity: Description:	P4-X25 – Unnamed Drainage 14U 647835/5840254 No No Small wetland channel. Beaver dam and impoundment downstream from crossing. No defined channel downstream of dam. No connection to overwintering habitats. Located adjacent to and within the same wetland as Site P4-X26.	
Site: Location: CANVEC: Connectivity: Description:	P4-X26 – Unnamed Drainage 14U 647804/5840294 No No Small wetland channel. Beaver dam and impoundment downstream from crossing. No defined channel downstream of dam. No connection to overwintering habitats. Located adjacent to and within the same wetland as Site P4-X25.	

Appendix 5. Continued.

Watercourse	Representative Photograph
Site: P4-X27 – Unnamed Creek Location: 14U 641366/587454 CANVEC: Yes Connectivity: No Description: Broad wetland adjacent to a small, isolated lake; no visible channel at the crossing or defined connection to lake.	
Site: P4-X28 – Unnamed Creek Location: 14U 640598/5849291 CANVEC: Yes Connectivity: No Description: Impounded water (beaver dam) at crossing; no defined connection to downstream receiving tributary.	
Site: P4-X32 – Unnamed Drainage Location: 14U 624506/5862152 CANVEC: Not at crossing, but further downstream Connectivity: No Description: Broad wetland; no defined channel at crossing site.	

Appendix 5. Continued.

Watercourse		Representative Photograph
Site:	P4-X33 – Unnamed	
Location:	14U 620897/ 5864651	
CANVEC:	Yes	
Connectivity:	No	
Description:	No defined channel at crossing site.	

APPENDIX 6. STREAM CROSSING ASSESSMENT SUMMARIES

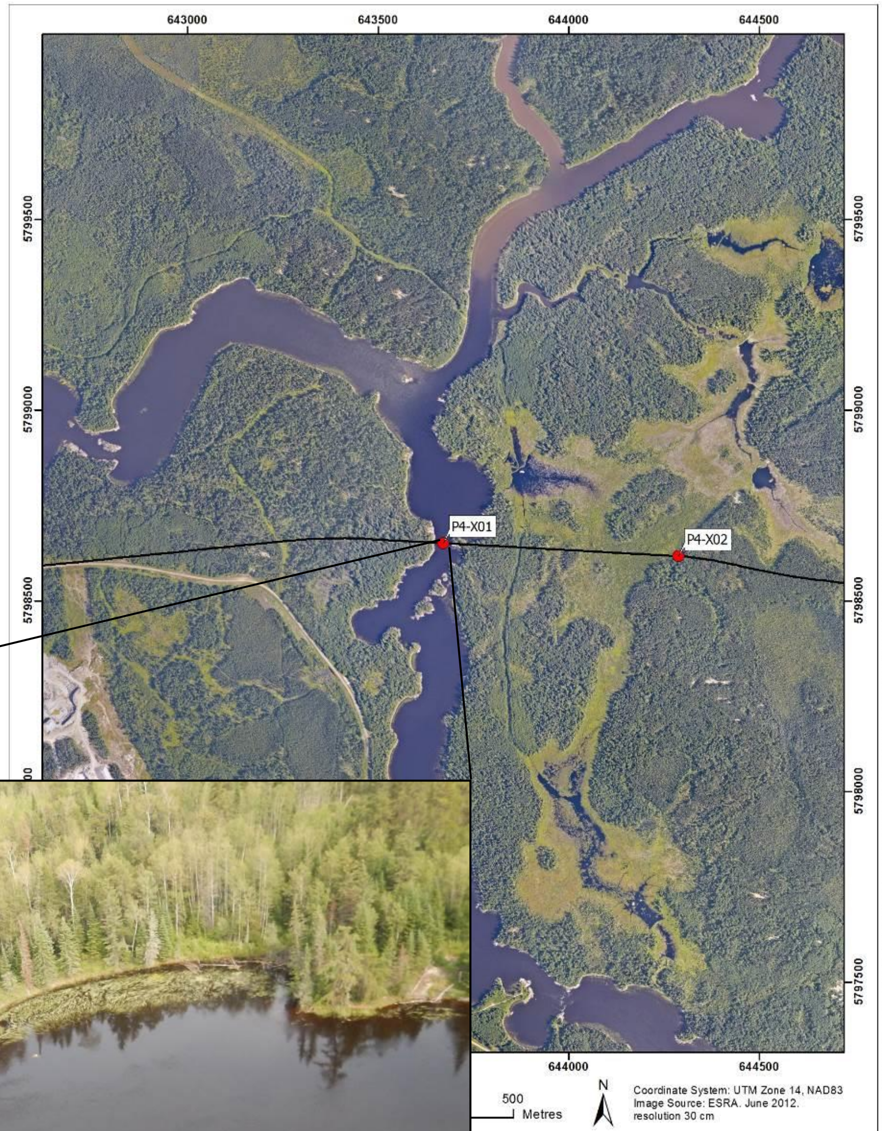
P4-X01 Berens River

Location

Datum:	NAD 83
UTM:	14U 643706 5798650

General Morphology

Type:	River
Pattern:	Straight
Channel Profile:	U-shape
Sinuosity:	1.13
Confinement:	Frequently Confined
Flow Regime:	Perennial



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Site Conditions

Survey Date:	July 16, 2014
Discharge (m^3/s):	-
Stage:	High

+ Physical Channel Data

Transect	**1**	**2**	**3**	**4**	**5**
Distance from Crossing[a] (m)	0	30 US	40 DS	-	-
Channel and Flow					
Channel Width (m)	63	85	137	-	-
Wetted Width (m)	60	84	136	-	-
Depth at 25% (m)	-	-	-	-	-
Depth at 50% (m)	-	-	-	-	-
Depth at 75% (m)	-	-	-	-	-
Maximum Depth (m)	-	-	-	-	-
Gradient (%)	**-**	**-**	**-**	**-**	**-**
Banks					
Left Bank Height (m)	1.6	0.44	1.7	-	-
Right Bank Height (m)	~5	~3	0.97	-	-
Left Bank Shape	sloping	sloping	vertical	-	-
Right Bank Shape	sloping	vertical	sloping	-	-
Left Bank Materials	bedrock	organic	organic/mineral	-	-
Right Bank Materials	bedrock	bedrock	bedrock	-	
Left Bank Stability	high	high	high	-	-
Right Bank Stability	high	high	high	-	-
Substrate Type and Distribution (%)					
Fines	-	-	-	-	-
Small Gravel	-	-	-	-	-
Large Gravel	-	-	-	-	-
Cobble	-	-	-	-	-
Boulder	-	-	-	-	-
Bedrock	-	-	-	-	-

a – US = upstream from crossing; DS = downstream from crossing.

Site Conditions Continued

+ Riparian Area/Floodplain

Transect	1	2	3	4	5
Floodplain Distance (m)					
Left Bank	-	-	-	-	-
Right Bank	0	0	0	-	-
Riparian Distance (m)					
Left Bank	0	24.4	-	-	-
Right Bank	0	0	0	-	-
Riparian Vegetation Type[a]	-	MIX	MIX	-	-
Canopy Cover (%)	0	0	0	-	-

a – GRA = grass; SHR = Shrub; DEC = deciduous; CON = coniferous; MIX = mixed

+ Habitat Type

Transect	1	2	3	4	5
Flat	-	-	-	-	-
Pool	10	5	-	-	-
Rapid	-	-	-	-	-
Riffle	-	-	-	-	-
Run	90	80	60	-	-
Backwater	-	15	40	-	-

+ Water Quality Data

Sample Date:	July 22, 2014
Habitat:	Run
Temperature (°C):	20.8
pH:	5.97
Turbidity (NTU):	4.7
Specific Conductance (µS/cm):	49.0
DO (mg/L):	8.32

Cross channel (west) view of the crossing site.

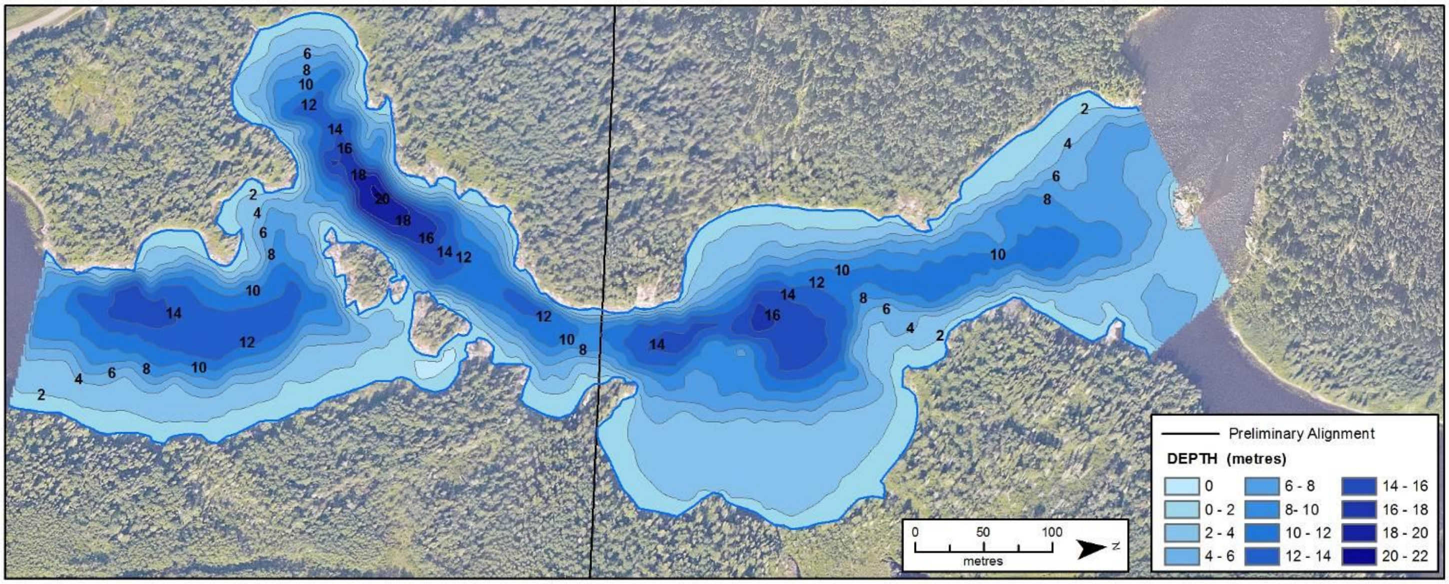
East bank at the crossing site.

Upstream view from the crossing site.

Cross channel (east) view of the crossing site.

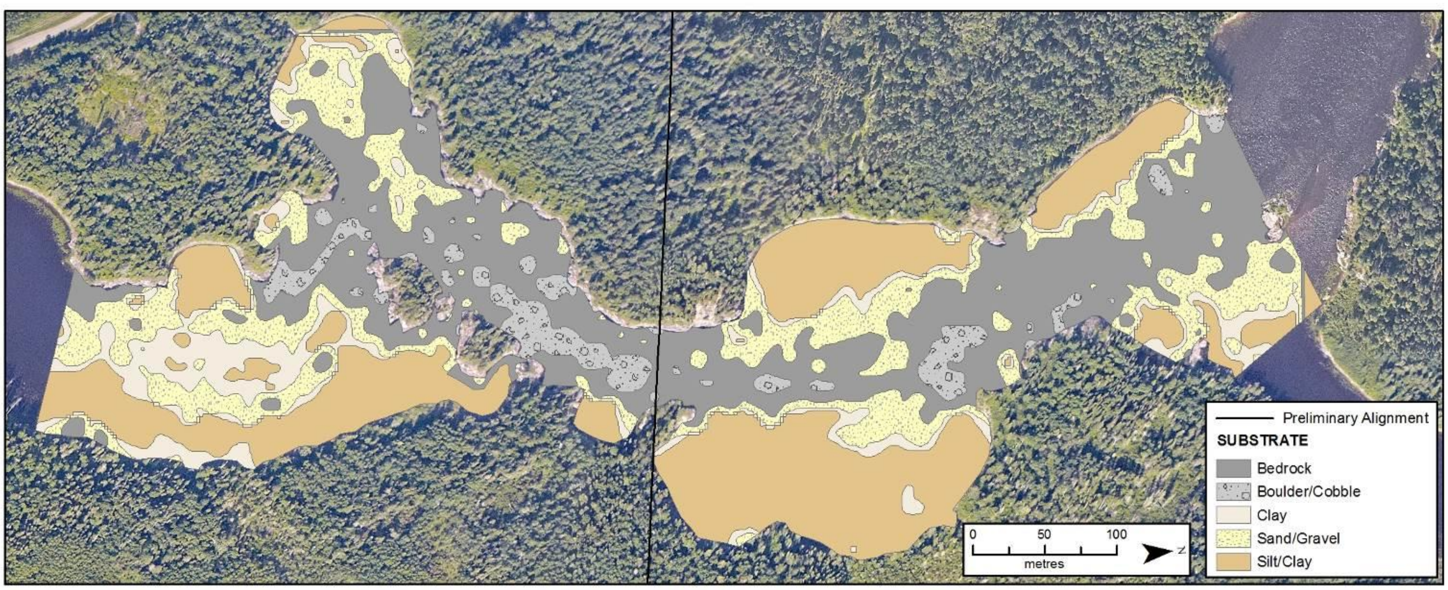
Site Conditions Continued

+ Bathymetric Map



Note: This map is intended for fish habitat assessments. It should not be used for navigation or design purposes.

+ Substrate Map



Note: This is a generalized substrate map, intended for fish habitat assessment. It should not be used for navigation or design purposes.

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Site Conditions Continued

+ Cover

	US	DS
Total Cover Available (%)	10	10
Cover Composition (% of Total)		
Large Woody Debris	-	-
Overhanging Vegetation	-	-
Instream Vegetation	90	95
Pool	-	-
Boulder	10	5
Undercut Bank	-	-
Surface Turbulence	-	-
Turbidity	-	-

Fish Presence

+ Fish Habitat Potential

Forage Fish	**US**	**DS**
Spawning	High	High
Rearing	High `	High
Overwinter	High	High
Migration	High	High
Large Bodied Fish		
Spawning	High	High
Rearing	High	High
Overwinter	High	High
Migration	High	High

Comments

The Berens River is a major perennial watercourse that provides important fish habitat for a diverse fish community. The study reach provides a variety of habitat types including: run habitat with bedrock and boulder/cobble substrates; shallow bays with soft substrates; and deep water habitats (14-20 m) with sand/gravel substrates. Macrophyte beds in the shallow, off-current bays may be suitable for spawning and rearing by Northern Pike and forage fish species. Deepwater areas provide overwintering habitats for a variety of large bodied fish. Deeper habitats (>10 m) provide potential habitat for juvenile Lake Sturgeon.

+ Fish Sampling Data

Methods: gillnetting

Fish Species Captured: Channel Catfish, Rock Bass, Shorthead Redhorse, Walleye

Existing Information: Bulloch et al. (2002), COSEWIC (2006), North/South Consultants (2010, 2014), and/or Stewart and Watkinson (2004) reported: Black Crappie, Blacknose Shiner, Black Bullhead, Brook Stickleback, Brown Bullhead, Carp, Channel Catfish, Cisco, Emerald Shiner, Fathead Minnow, Freshwater Drum, Golden Shiner, Johnny Darter, Lake Sturgeon, Lake Whitefish, Longnose Dace, Mimic Shiner, Mooneye, Ninespine Stickleback, Northern Pike, River Darter, Rock Bass, Sauger, Silver Redhorse, Shorthead Redhorse, Spottail Shiner, Tadpole Madtom, Troutperch, Walleye, Weed Shiner, White Bass, White Sucker, and Yellow Perch.

Mussel Presence

+ Mussel Sampling Data

Methods: ponar, gill net

Mussel Species Captured: Mapleleaf, Fat Mucket, Three Ridge, Wabash Pigtoe

Existing Information: North/South Consultants (2014) reported: Fatmucket

Regional Context

+ Habitat

Upstream Drainage Area (km^2):	1,195
Distance to Major DS Waterbody (km):	10.8 (Lake Winnipeg)
Connectivity:	Yes

Comments
The immediate crossing area consists of run habitat with dominated by a bedrock substrate. This type of habitat is typical of larger rivers in the area and is not unique. The habitat is not considered critical or limiting to CRA fishery species.

+ Fishery

Fishery Area: Berens River, Lake Winnipeg

Fishery Users:

Commercial	Lake Winnipeg[a]
Recreational	Yes
Aboriginal	Berens River First Nation[b]

Comments
The Berens River supports both a recreational and Aboriginal fishery, including Walleye and Northern Pike. The crossing area contributes to these fisheries by providing potential feeding, spawning and overwintering habitat, but is not considered critical.

Information Sources:

a – Manitoba Conservation (2014)
b – ESRA (2009)

Crossing Information

+ Proposed Crossing

Type	Two-span bridge[a]
Diameter (mm)	-
Length (m)	TBD
Number of Barrels	-
Provision of Fish Passage	Yes

Information Sources:

a – pers. comm. ESRA

Risk Assessment

+ Preliminary Considerations

Attribute	Rating	Comments
Supports a CRA Fishery	Yes	The habitat in the immediate crossing area provides suitable habitat for CRA fishery species; the habitat up- and downstream of the proposed right-of-way may support a variety of life requisites for several CRA fishery species (e.g. Walleye, Northern Pike, Lake Sturgeon)
Species at Risk Present	Yes	Mapleleaf Mussel, Lake Sturgeon

+ Impacts to Fish and Fish Habitat

Type	Multi-span bridge construction and operation
Minor Impact List	No
Residual Impact	Channel infilling from a single instream pier Habitat alteration from rip rap placement at base of the pier

Attribute	Rating	Comment
Extent of Impact	Low	Infilling and rip rap placement will be limited to the footprint and immediate base of the pier.
Duration of Impact	High	The infill and rip rap will be in place for approximately 50 years.
Availability & Condition	Low	The affected habitat is common and widespread within moderate to large river systems in the region. The east side Lake Winnipeg area is largely undeveloped and the habitat within the Berens River remains intact.
Impact on Relevant Fish	Low	The affected habitat at the crossing site is not considered to be critical or limiting as similar habitat is plentiful in the region. Negative impacts to fish populations from rip rap placement are unlikely as it provides additional coarse substrate to an already diverse mosaic of habitats within the study reach. Current status of Lake Sturgeon population is unknown. Sturgeon population is listed as cautious in Ontario portion of the river. Other CRA fishery species which may use the area are abundant and widespread. Habitat impacts are expected to result in no measureable effect to local fish populations.

+ Risk of Serious Harm to Fish

Risk Rating: LOW

Qualification: Based on the small area of impact, abundance of similar habitat within the system, and absence of critical or limiting habitat, bridge construction is expected to have minimal impact on the productivity of local fish populations.

Net Habitat Change

Habitat Change				
Type of Structure: Two-span Bridge				
Effect	**Pathway of Effect**	**Proposed Area Affected**	**Existing Area Affected**	**Loss/Gain**
Instream Alteration	None[1]	161.5 m^2	0 m^2	161.5 m^2
Instream Destruction	Footprint[2]	5.84 m^2	0 m^2	-5.84 m^2

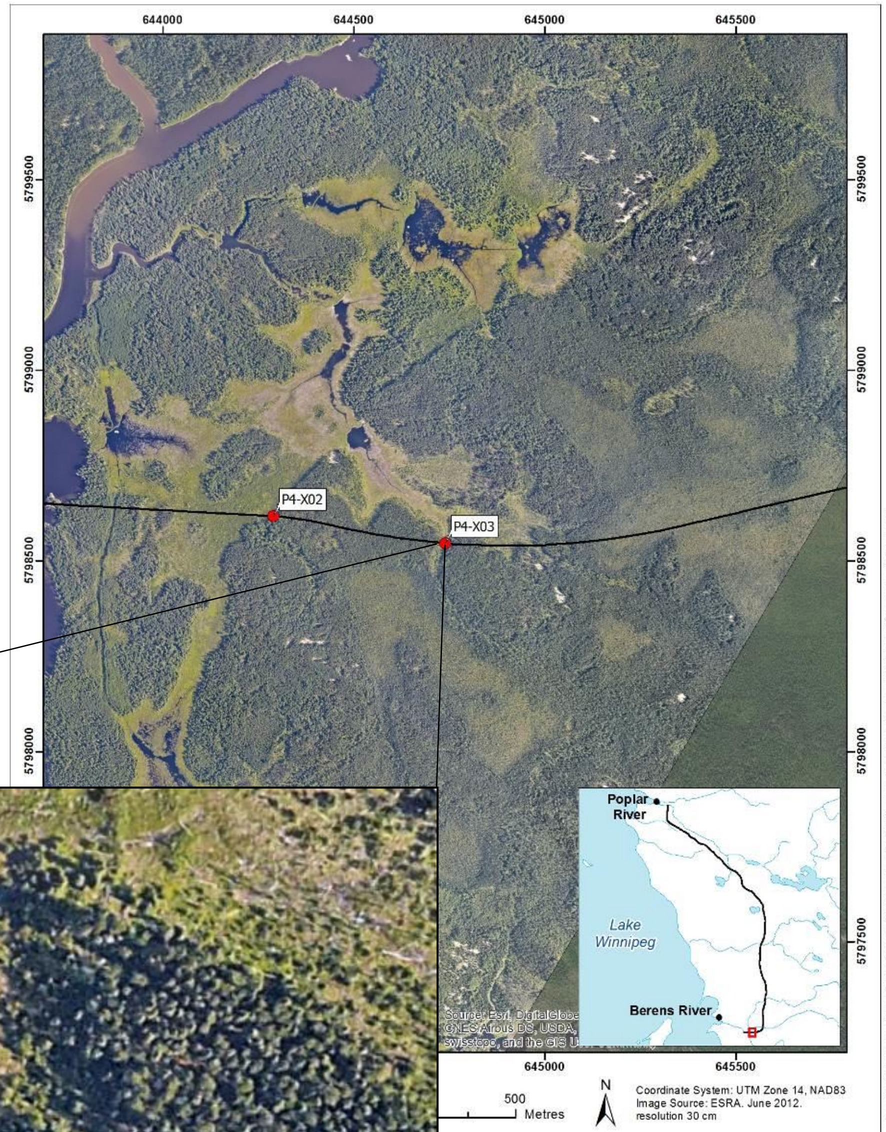
1 – Bridge design was unavailable at the time of assessment. Area calculated as the area rip rap armouring around a single pier and was estimated based on AECOM design drawings provided in Plans PR 304 to Berens River All Season Road Alignment Tender No. B5 Pigeon River Bridge, issued October 3, 2013.

2 – Bridge design was unavailable at the time of assessment. Habitat loss is estimated using the area of a single pier from the Pigeon River bridge design (based on AECOM design drawings provided in Plans PR 304 to Berens River All Season Road Alignment Tender No. B5 Pigeon River Bridge, issued October 03, 2013).

P4-X03 Unnamed Etomami River Tributary

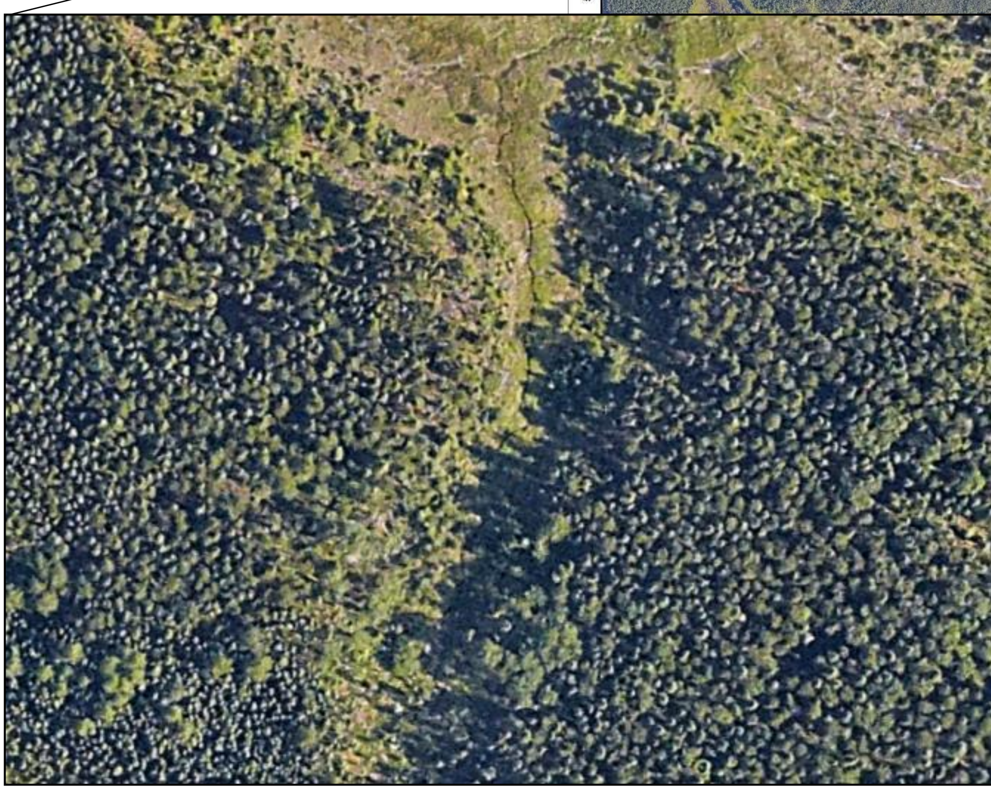
Location

Datum:	NAD 83
UTM:	14U 644741 5798546



General Morphology

Type:	Creek
Pattern:	-
Channel Profile:	Notched
Sinuosity:	-
Confinement:	Unconfined
Flow Regime:	Perennial



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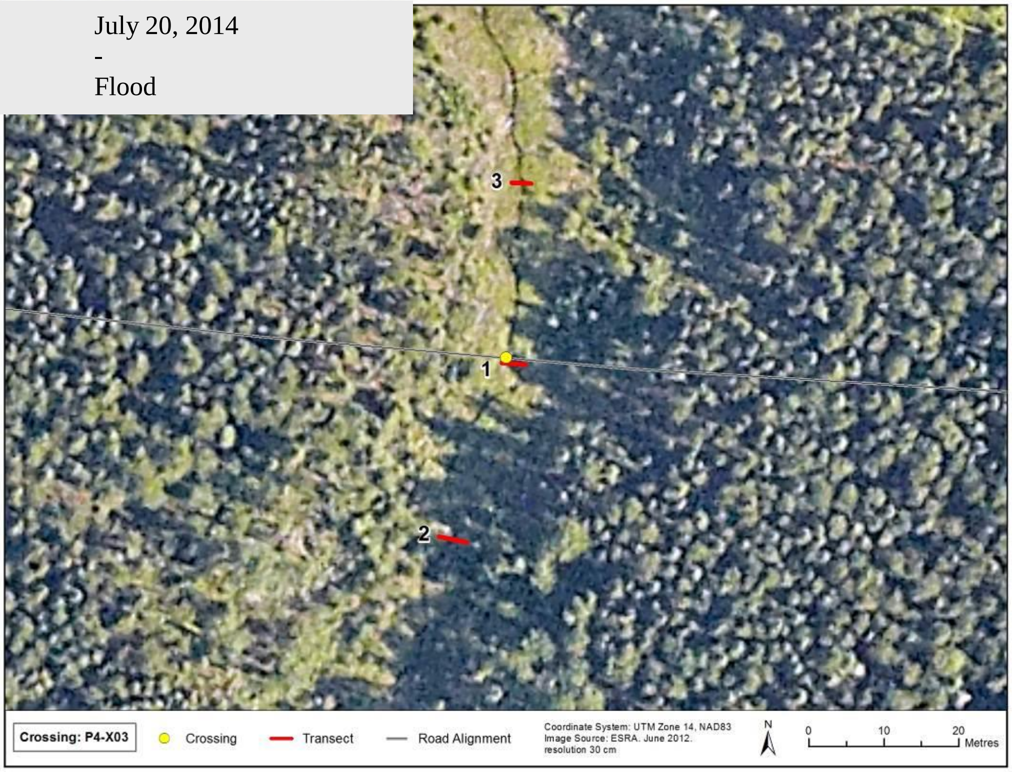
Aquatic Environment Specialists

Site Conditions

Survey Date:	July 20, 2014
Discharge (m^3/s):	-
Stage:	Flood



+ Physical Channel Data

Transect	**1**	**2**	**3**	**4**	**5**
Distance from Crossing[a] (m)	0	25 US	25 DS	-	-
Channel and Flow					
Channel Width (m)	0.71	1.15	1.0	-	-
Wetted Width (m)	10.6	8.5	10.7	-	-
Depth at 25% (m)	0.66	0.60	0.84	-	-
Depth at 50% (m)	0.64	0.58	0.80	-	-
Depth at 75% (m)	0.62	0.66	0.80	-	-
Maximum Depth (m)	0.7	0.66	0.84	-	-
Gradient (%)	0.25	-	-	-	-
Banks					
Left Bank Height (m)	flooded	flooded	flooded	-	-
Right Bank Height (m)	flooded	flooded	flooded	-	-
Left Bank Shape	vertical	vertical	vertical	-	-
Right Bank Shape	vertical	vertical	vertical	-	-
Left Bank Materials	organic	organic	organic	-	-
Right Bank Materials	organic	organic	organic	-	-
Left Bank Stability	high	high	high	-	-
Right Bank Stability	high	high	high	-	-
Substrate Type and Distribution (%)					
Fines	100	100	100	-	-
Small Gravel	-	-	-	-	-
Large Gravel	-	-	-	-	-
Cobble	-	-	-	-	-
Boulder	-	-	-	-	-
Bedrock	-	-	-	-	-

a – US = upstream from crossing; DS = downstream from crossing

Site Conditions Continued

+ Riparian Area/Floodplain

Transect	1	2	3	4	5
Floodplain Distance (m)					
Left Bank	19.5	NM	6.7	-	-
Right Bank	8.0	6.4	5.7	-	-
Riparian Distance (m)					
Left Bank	19.5	6.2	10	-	-
Right Bank	9.5	6.4	5.7	-	-
Riparian Vegetation Type[a]					
	GRA	GRA	GRA	-	-
Canopy Cover (%)					
	0	0	0	0	-

a – GRA = grass; SHR = Shrub; DEC = deciduous; CON = coniferous; MIX = mixed

+ Habitat Type

Transect	1	2	3	4	5
Flat	100	100	100	-	-
Pool	-	-	-	-	-
Rapid	-	-	-	-	-
Riffle	-	-	-	-	-
Run	-	-	-	-	-
Impoundment	-	-	-	-	-

+ Water Quality Data

Sample Date:	-
Habitat:	-
Temperature (°C):	-
pH:	-
Turbidity (NTU):	-
Specific Conductance (µS/cm):	-
DO (mg/L):	-

Crossing site.

Upstream view of the crossing site (right) and small tributary stream (left).

Upstream view of impoundment located downstream from crossing.

Downstream from the crossing, the channel is heavily impacted by beaver dams.

Site Conditions Continued

+ Cover

	US	DS
Total Cover Available (%)	35	-
Cover Composition (% of Total)		
Large Woody Debris	25	-
Overhanging Vegetation	50	-
Instream Vegetation	25	-
Pool	-	-
Boulder	-	-
Undercut Bank	-	-
Surface Turbulence	-	-
Turbidity	-	-

Fish Presence

+ Fish Habitat Potential

Forage Fish	**US**	**DS**
Spawning	Low	Moderate
Rearing	Low	Moderate
Overwinter	None	Moderate
Migration	None	Low
Large Bodied Fish		
Spawning	None	None
Rearing	None	None
Overwinter	None	None
Migration	None	None

Comments
The crossing is located on a small first order stream, heavily impacted by beaver activity. No significant headwaters were identified; the upstream area consists of a low area with small, isolated pools. A defined continuous channel begins approximately 120 m upstream from the crossing site, within a forested area. At the crossing, the habitat consists of small, open canopy channel with flat habitat and fine substrate. The channel and floodplain are inundated due to backwatering from a beaver dam located approximately 390 m downstream. The impoundment is greater than 1 m depth and may overwinter forage fish species. At least six dams were identified downstream from the crossing likely restricting fish passage to the crossing site. Based on poor connectivity and low flows due to a small upstream drainage area, the crossing site is not expected to support large-bodied fish. Fish use is limited to forage fish species, tolerant of low dissolved oxygen levels.

+ Fish Sampling Data

Methods: electrofishing

Fish Species Captured: none

Existing Information: none

Mussel Presence

+ Mussel Sampling Data

Methods: Not sampled; unsuitable habitat.

Mussel Species Captured: -

Existing Information: -

Regional Context

+ Habitat

Upstream Drainage Area (km^2):	0.29
Distance to Major DS Waterbody (km):	1.6 (Etomami River)
Connectivity:	Yes - Unlikely

Comments

The crossing is located on the upper reach of a small tributary stream of the Etomami River. The habitat is flat with fine substrates and is heavily impacted by beaver dams. This type of small stream habitat is common within the area.

+ Fishery

Fishery Area: Etomami River, Berens River, Lake Winnipeg

Fishery Users:

Commercial	Yes - Lake Winnipeg[a]
Recreational	Yes
Aboriginal	Yes - Berens River First Nation

Comments

The unnamed watercourse is a tributary of the Etomami River and has downstream connectivity to Lake Winnipeg via the Berens River. The importance of the habitat to these fisheries is considered low; habitat at the culvert site is considered marginal habitat for forage fish and does not provide direct habitat for CRA species.

Information Sources:

a – Manitoba Conservation (2014)

Crossing Information

+ Proposed Crossing

Type	Culvert[a]
Diameter (mm)	TBD
Length (m)	TBD
Number of Barrels	TBD
Provision of Fish Passage	Yes

Information Sources:

a – pers. comm. ESRA.

Risk Assessment

+ Preliminary Considerations

Attribute	Rating	Comments
Supports a CRA Fishery	No	The habitat does not directly support CRA fish species or key prey species of CRA fish species.
Supports Species at Risk	No	No known species at risk.

+ Impacts to Fish and Fish Habitat

Type	Culvert construction and operation
Minor Impact List	No
Residual Impact	Channel infilling within footprint of the culvert. Habitat alteration from rip rap placement at culvert inlet and outlet

Attribute	Rating	Comment
Extent of Impact	Low	The infill of the stream bed and rip rap placement is restricted to the culvert site.
Duration of Impact	High	The infill and rip rap will be in place for approximately 50 years.
Availability & Condition	Low	The affected habitat is common and widespread within boreal streams in the region. The east-side Lake Winnipeg area is relatively undeveloped and small stream habitats remain largely intact.
Impact on Relevant Fish	Low	The habitat at the crossing site is expected to support only forage fish species. Numerous ephemeral barriers to fish passage downstream of the crossing preclude migrations of CRA fishery species from the downstream fish bearing waterbody. A small upstream drainage area limits flows. Habitat impacts are expected to result in no measureable effect to downstream fisheries.

+ Risk of Serious Harm to Fish

Risk Rating: LOW

Qualification: Based on the small area of impact, abundance of similar habitat within the system, and absence of direct habitat for CRA fishery species within the project footprint, culvert construction and operation is expected to have no measureable impact on the productivity of local fish populations.

Net Habitat Change

Type of Structure: Culvert				
Effect	**Pathway of Effect**	**Proposed Area Affected**	**Existing Area Affected**	**Loss/Gain**
Instream Alteration	None[1]	0 m^2	0 m^2	0 m^2
Instream Destruction	Footprint[2]	21.3 m^2	0 m^2	-21.3 m^2

1 – Any habitat alterations due to rip rap included in footprint (i.e., destruction)

2 – Culvert design unavailable at the time of assessment. Area estimated based on the length of culvert crossings constructed as part of the Provincial Road 304 to Berens River All Season Road Project (30 m) and the channel width at the crossing (0.71 m).