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Fish Habitat Assessment at select Watercourse Crossings along the Inuvik to Tuktoyaktuk Highway

REPORT

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Executive Summary

There has been interest in building an all-weather access road between the Town of Inuvik and the Hamlet of Tuktoyaktuk in the Inuvialuit Settlement Area (ISR) of the Northwest Territories (NWT) since the 1960s. Tuktoyaktuk is currently only accessible by aircraft year-round, by boat during the brief ice-free summer season, and by ice-road for several months during the winter season. The construction of an all-weather road, called the Inuvik to Tuktoyaktuk Highway (the Highway), would provide a year-round link from the community to the rest of the North American road network. The connection to Inuvik and other southern locations could provide Tuktoyaktuk residents with benefits such as decreased transportation costs to bring food and goods to the community, increased tourism potential, increased access to services such as health care and education, and provide business expansion opportunities (Kiggiak-EBA Consulting [Kiggiak-EBA] 2010a; Kiggiak-EBA 2010b).

In the fall of 2009 the Government of Canada, through the Canadian Adjustment Fund as part of Canada's Economic Action Plan, allocated funding for planning (i.e., preparing plans undertaking environmental studies, and stakeholder consultations and assessing route alternatives) the road to link Inuvik and Tuktoyaktuk (Government of Canada 2009).

Sections of the proposed Highway were surveyed during the past years: IMG-Golder Corp. (IMG-Golder) assessed the watercourse crossings on the northern stretch of the Highway (the "Tuktoyaktuk to Source 177 Road") in 2009 and Kiggiak EBA investigated portions of the Highway in 2010. The objective of this current 2011 Fish Habitat Assessment was to assess the remaining watercourse locations that have not been previously surveyed.

Site assessments on the proposed watercourse crossings were conducted from September 8th to September 20th, 2011. A total of 36 watercourses were assessed. Fourteen of the crossings were located on the "Alternate Routes"; however, one of these (crossing A 14) could not be located.

A total of 11 watercourses were assessed as being ephemeral with no defined channel, 10 were classified as intermittent and 15 were classed as perennial.

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1.0 INTRODUCTION

1.1 Background

There has been interest in building an all-weather access road between the Town of Inuvik and the Hamlet of Tuktoyaktuk in the Inuvialuit Settlement Area (ISR) of the Northwest Territories (NWT) since the 1960s. Tuktoyaktuk is currently only accessible by aircraft year-round, by boat during the brief ice-free summer season, and by ice-road for several months during the winter season. The construction of an all-weather road, called the Inuvik to Tuktoyaktuk Highway (referred to hereafter as the Highway), would provide a year-round link from the community to the rest of the North American road network. The connection to Inuvik and other southern locations could provide Tuktoyaktuk residents with benefits such as decreased transportation costs to bring food and goods to the community, increased tourism potential, increased access to services such as health care and education, and provide business expansion opportunities (Kiggiak-EBA Consulting [Kiggiak-EBA] 2010a; Kiggiak-EBA 2010b).

In fall 2009 the Government of Canada, through the Canadian Adjustment Fund as part of Canada's Economic Action Plan, allocated funding for planning (i.e., preparing plans undertaking environmental studies, and stakeholder consultations and assessing route alternatives) the road to link Inuvik and Tuktoyaktuk (Government of Canada 2009).

The 19 kilometre (km) all-weather access road extending from Tuktoyaktuk south to the gravel source known as Granular Source 177 (referred to hereafter as the Tuk to 177 Road) constructed in 2009 / 2010 by the Hamlet of Tuktoyaktuk, in partnership with the Government of the Northwest Territories (GNWT) Department of Transportation (DOT) and the Inuvialuit Regional Corporation (IRC), represents the northernmost portion of the Highway.

With the Tuk to 177 Road already completed, the focus is now on completing assessments for the remainder of the Highway route between Inuvik (i.e., the northern end of the community's Old Navy Road) and Granular Source 177. Several routing options are being analyzed for the Highway, as shown in Figure 1.

This report, along with others listed in Section 1.2, constitutes a component of the planning phase for the Highway through the completion of an assessment of fish habitat and fish resources present or likely to be present within the watercourse crossed by the Highway.

1.2 Previous Assessments

The following aquatic field assessments have been conducted over the past years:

- Summer 1998: Rescan Environmental Services Ltd. (Rescan) conducted a field survey to complete an environmental baseline study of the Highway corridor (Rescan 1999).
- Summer 2009: IMG-Golder Corporation (IMG-Golder) carried out an archaeological and fisheries assessment of the Tuktoyaktuk to Source 177 access road. The Fisheries assessment involved aerial identification of watercourse crossings, habitat assessments and fisheries assessments including electrofishing along the Tuk to 177 Road (IMG-Golder 2009).

- Fall 2009: Kiggiak-EBA conducted and aerial reconnaissance (identification of watercourse crossings as ephemeral or permanent along entire Inuvik to Tuktoyaktuk Highway route(Kiggiak-EBA 2010a).
- Summer 2010: Kiggiak-EBA completed and aquatic field program (water crossing studies in two general areas: Inuvik to 25 km north of Inuvik; and, Granular Source 177 to 25 km south of Granular Source 177; aerial reconnaissance of watercourse crossings, habitat and fisheries assessments including electrofishing; Kiggiak-EBA 2010a).
- Fall 2010: Indian and Northern Affairs Canada [INAC] (now Aboriginal and Northern Development Canada [AANDC]) carried out water quality sampling program at select water course crossings (water quality samples sent to laboratory for analysis and compared to Canadian Council of Ministers of the Environment [CCME] guidelines; Kiggiak-EBA 2011).

1.3 Highway Corridor Description

The Highway runs north from Inuvik to Tuktoyaktuk. It is located on Inuvialuit-owned lands, designated as 7(1)a and 7(1)b lands in the *Inuvialuit Final Agreement* (IFA), as well as Crown Land (Appendix I, Figure 1). Several routing options for the Highway are being considered as shown on Figure 1. The Highway routes include the Primary Route as identified in 2009, Alternative 1 (a minor realignment identified in 2009), Alternative 2 (an upland route) and Alternative 3 (a minor realignment identified in 2010). For the purpose of this report, the 15 km buffer encompassing, the primary Highway option, its alternative routes, and the lands and waters in proximity to those routes, encompassed, is referred to as the Highway Corridor. The Highway Corridor coincides with the Study Area identified in the 2011 report, *Environmental Impact Statement for Construction of the Inuvik to Tuktoyaktuk Highway, NWT* (Kiggiak-EBA 2011).

The Highway is located primarily within the Southern Arctic Ecozone, with the portion closest to Inuvik (i.e., 2.5 km of the road) being located within the boundaries of the Taiga Plains Ecozone. The Southern Arctic Ecozone extends across much of the northern coast of Northern Canada. It ends where the treeline begins to the south (and the Taiga Plains Ecozone begins along the Highway). The Southern Arctic Ecozone has short cool summers averaging 5°C and long cold winters averaging -28°C in the Highway area. Precipitation in the Highway Corridor area of the ecozone averages 150 mm per year (Bernhardt 2011). The Taiga Plains Ecozone, bordered to the north by the treeless Southern Arctic Ecozone, has short cool summers averaging 7°C and long cold winters averaging -26°C in the Highway Corridor area of the ecozone. Precipitation averages 200-500 mm a year (Bernhardt 2011).

Details on the biophysical characteristics of these ecozones (e.g., climate, terrain, geology, soils, permafrost, vegetation, hydrology and water quality) can be found in Kiggiak-EBA's *Environmental Impact Statement for Construction of the Inuvik to Tuktoyaktuk Highway, NWT* (EIS; 2011) along with a description of how these ecozones relate to the NWT's specific classification of ecological land units (i.e., integrating the Canadian ecozone classification with the Ecological Regions of North America). This report concentrates on fish habitat and fish resources present or likely to be present in watercourses within the Highway Corridor.

1.4 Relevant Terminology

Relevant terms are described below to provide explanations for the wording used in this report.

The federal *Fisheries Act* (1985) defines the following terms (Canadian Legal Information Institute 2011a):

- "Fish" – *Includes (a) parts of fish; (b) shellfish, crustaceans, marine animals and any parts of shellfish, crustaceans or marine animals; and (c) the eggs, sperm, spawn, larvae, spat and juvenile stages of fish, shellfish, crustaceans and marine animals*;
- "Fishery" - *Includes the area, locality, place or station in or on which a pound, seine, net, weir or other fishing appliance is used, set, placed or located, and the area, tract or stretch of water in or from which fish may be taken by the said pound, seine, net, weir or other fishing appliance, and also the pound, seine, net, weir, or other fishing appliance used in connection therewith*; and
- "Fish habitat" - *Means spawning grounds and nursery, rearing, food supply and migration areas on which fish depend directly or indirectly in order to carry out their life processes* (*Fisheries Act* 1985).

Fisheries and Oceans Canada (DFO) Pacific Region also provides the following definitions which provide additional clarification of the terms used in this report (DFO 2010a):

- "Anadromous" - *Refers to fish that spend most of their life in saltwater but migrate to freshwater to spawn. Salmon, trout and Arctic char that live in the ocean are prime examples of anadromous species*;
- "Critical Habitat" - *The habitat that is necessary for the survival or recovery of a listed wildlife species and that is identified as the species' critical habitat in the recovery strategy or in an action plan for the species*;
- "Migration" - *The spatial and temporal movement between spawning, feeding, and refuge habitats in response to genetic or environmental stimuli*;
- "Riparian Areas" - *Vegetated areas adjacent to a watercourse or water body that directly contribute to fish habitat by providing shade, cover and food production areas. Riparian areas are important because they stabilize stream banks and shorelines. To minimize disturbance to fish habitat and prevent bank erosion, it is important to retain as much riparian vegetation as possible, especially the vegetation directly adjacent to the watercourse or water body*;
- "Substrate" - *Refers to the bed of a water body or watercourse. The substrate of a water body or watercourse may be bedrock, boulder, cobble, gravel, sand, silt, clay, mud, vegetative matter, etc.*;
- "Watercourse" - *General term that refers to riverine systems such as creeks, brooks, streams, rivers, etc.*; and
- "Water Body" - *General term that refers to ponds, bays, lakes, estuaries, marine areas, etc*.

1.5 Watercourse Crossings Overview

Table 1 provides an overview of the watercourse crossings that intersect the Highway's primary and alternative routes. It includes the crossing identifier, crossing location in the Universal Transverse Mercator (UTM) system (NAD 83), the name of the consulting firm that conducted the crossing assessment, the known or assumed fish

habitat, and crossing type. Note that even though habitat might be characterized as unknown by the assessors (i.e., labelled with the designation UK in Table 1), it is still assumed to be fish habitat.

Results from the 2009 assessment (IMG-Golder 2009), Kiggiak EBA's 2010 assessment (Kiggiak EBA 2010 a) and results from the current 2011 fish habitat assessment completed by IMG-Golder are also included. Details on the IMG-Golder 2011 watercourse crossings are provided in subsequent sections of this report. Note that there were differences in the calculation of Kilometre Markers between Kiggiak EBA (2010a) and IMG-Golder starting at Watercourse Crossing 6. For clarity, Kiggiak EBA's Kilometre Markers (where available) are provided in parentheses (Table 1).

Table 1: Watercourse Crossing Locations on the Highway including Brief Descriptions

Watercourse Crossing	*Km Marker (Kiggiak EBA)* [a]	*UTM East Zone 8 NAD 83*	*UTM North Zone 8 NAD 83*	*Assessment Completed*	*Stream Type*	*Fish Habitat* [b]	*Crossing Type* [c]
1	1.3	550651.906	7591440.899	Kiggiak-EBA in 2010 / IMG-Golder in 2011	Ephemeral	UK	Culvert
2	1.7	550676.184	7591876.476	Kiggiak-EBA in 2010	Ephemera	UK	Culvert
3	2.3	550701.098	7592438.556	Kiggiak-EBA in 2010	Perennial	F	Culvert
4	3.2	550737.758	7593313.897	Kiggiak-EBA in 2010	Perennial	F	Culvert
5	3.9	550773.520	7594072.451	Kiggiak-EBA in 2010	Perennial	F	Culvert
6	5.9 (4.1)	550843.132	7595986.508	Kiggiak-EBA in 2010	Ephemeral	UK	Culvert
7	6.9 (7.0)	550461.106	7596943.679	Kiggiak-EBA in 2010	Ephemeral	UK	Culvert
8	7.0 (7.8)	550600.000	7597000.000	Kiggiak-EBA in 2010	Perennial	F	Culvert
9	8.2 (8.4)	550528.110	7598257.717	Kiggiak-EBA in 2010 / IMG-Golder in 2011	Ephemeral	UK	Culvert
10	8.9 (9.1)	550432.381	7598916.091	Kiggiak-EBA in 2010	Ephemeral	UK	Culvert
11	9.3 (9.4)	550485.901	7599284.722	Kiggiak-EBA in 2010	Ephemeral	UK	Culvert
12	10.9 (11.1)	550300.455	7600886.706	Kiggiak-EBA in 2010	Perennial	F	Culvert
13	13.0 (13.3)	550415.804	7603031.166	Kiggiak-EBA in 2010	Ephemeral	UK	Culvert
13a	16.7 (17.0)	551298.553	7606550.279	Kiggiak-EBA in 2010	Perennial	F	Bridge (15m)
14	18.6 (19.1)	552193.999	7608091.180	Kiggiak-EBA in 2010	Ephemeral	F	Culvert
15	21.6 (22.0)	553225.000	7610775.000	Kiggiak-EBA in 2010	Ephemeral	UK	Culvert
16	22.5 (23.0)	553243.573	7611734.645	Kiggiak-EBA in 2010	Ephemeral	F	Culvert
17	22.9 (23.4)	553384.867	7612049.583	Kiggiak-EBA in 2010	Ephemeral-	UK	Culvert
18	25.1 (26.1)	554803.545	7613971.447	Kiggiak-EBA in 2010	Perennial	F	Bridge (20m)
19	25.8	555438.454	7614239.192	IMG-Golder in 2011	Ephemeral	UK	Culvert
20	26.5	556043.372	7614500.579	IMG-Golder in 2011	Intermittent	UK	Culvert
21a	28.9	557679.409	7616108.457	IMG-Golder in 2011	Ephemeral	UK	Culvert
22a	31.1	558041.881	7618195.273	IMG-Golder in 2011	Perennial	F	Culvert
23a	39.4	559226.897	7626137.370	IMG-Golder in 2011	Perennial	F	Bridge (20m)
24a	41.4	559011.889	7628013.584	IMG-Golder in 2011	Perennial	F	Culvert

Watercourse Crossing	Km Marker (Kiggiak EBA) [a]	UTM East Zone 8 NAD 83	UTM North Zone 8 NAD 83	Assessment Completed	Stream Type	Fish Habitat [b]	Crossing Type [c]
25	42.5	559107.389	7629151.034	IMG-Golder in 2011	Perennial	F	Culvert
26	43.9	558700.421	7630515.327	IMG-Golder in 2011	Ephemeral	UK	Culvert
27a	45.5	559102.643	7632056.447	IMG-Golder in 2011	Intermittent	UK	Culvert
27b	46.8	558945.761	7633282.726	IMG-Golder in 2011	Ephemeral	UK	Culvert
28a	52.4	558393.923	7638036.696	IMG-Golder in 2011	Perennial	F	Culvert
29	52.8	558280.812	7638458.961	IMG-Golder in 2011	Ephemeral	UK	Culvert
29a	54.1	558210.692	7639744.181	IMG-Golder in 2011	Perennial	F	Bridge (20m)
30a	54.9	558736.305	7640377.967	IMG-Golder in 2011	Perennial	F	Bridge (25m)
31	66.1	563402.892	7648602.442	IMG-Golder in 2011	Perennial	F	Bridge (25m)
33a	76.0	567384.611	7656681.816	IMG-Golder in 2011	Intermittent	F	Culvert
33b	76.3	567667.025	7656751.512	IMG-Golder in 2011	Intermittent	F	Culvert
34a	78.7	569614.712	7657867.327	IMG-Golder in 2011	Ephemeral	UK	Culvert
34b	82.7	572161.178	7660491.938	IMG-Golder in 2011	Intermittent	F	Culvert
34e	85.6	573750.780	7662855.894	IMG-Golder in 2011	Intermittent	F	Culvert
35a	88.2	575422.172	7664333.159	IMG-Golder in 2011	Perennial	F	Bridge (10m)
36a	92.5 (94.1)	578796	7665217	Kiggiak-EBA in 2010	Ephemeral	UK	Culvert
37	93.4 (95.0)	579578.567	7665694.644	Kiggiak-EBA in 2010	Ephemeral	UK	Culvert
37a	94.5 (96.3)	580529.271	7666601.261	Kiggiak-EBA in 2010	Ephemeral	UK	Culvert
38a	101.0 (102.8)	582061.956	7672454.257	Kiggiak-EBA in 2010	Perennial	F	Culvert
39	106.8 (108.7)	583809.332	7676964.744	Kiggiak-EBA in 2010	Perennial	F	Bridge (10m)
39a	107.9 (109.8)	583407.042	7677970.136	Kiggiak-EBA in 2010	Perennial	F	Culvert
39b	113.3 (115.1)	582872.646	7683007.102	Kiggiak-EBA in 2010	Ephemeral	UK	Culvert
39c	113.9 (115.8)	582798.580	7683621.645	Kiggiak-EBA in 2010	Ephemeral	UK	Culvert
A 1 *	A1-112.3 / A3-106.2	582840	7677885	IMG-Golder in 2011	Perennial	F	Culvert
A 2	A1-108 / A3-101.9	579011	7676323	IMG-Golder in 2011	Intermittent	F	Culvert
A 3	A1-105.5 / A3-99.4	577863	7674377	IMG-Golder in 2011	Perennial	F	Culvert
A 4	A1-101.9	579458	7671953	IMG-Golder in 2011	Perennial	F	Culvert
A 5	A1-100	581333	7671439	IMG-Golder in 2011	Perennial	F	Culvert
A 6	A3-96.4a	577977	7671432	IMG-Golder in 2011	Intermittent	F	Culvert
A 7	A3-96.6	577770	7671724	IMG-Golder in 2011	Ephemeral	UK	Culvert
A 8	A3-96.4b	577954	7671470	IMG-Golder in 2011	Ephemeral	UK	Culvert
A 9	A3-94.7	577748	7669874	IMG-Golder in 2011	Perennial	F	Culvert

Watercourse Crossing	Km Marker (Kiggiak EBA) [a]	UTM East Zone 8 NAD 83	UTM North Zone 8 NAD 83	Assessment Completed	Stream Type	Fish Habitat [b]	Crossing Type [c]
A 10	A3-92.8	576532	7668536	IMG-Golder in 2011	Intermittent	UK	Culvert
A 11	A3-92.4	576435	7668140	IMG-Golder in 2011	Ephemeral	UK	Culvert
A 12	A3-91.9	576315	7667618	IMG-Golder in 2011	Perennial	F	Culvert
A 13	A3-88.9	575975	7664634	IMG-Golder in 2011	Intermittent	UK	Culvert
Tuk 1**	118.4	582491	7687628	IMG-Golder in 2009	Ephemeral	UK	Culvert
Tuk 2	120.2	581290	7688591	IMG-Golder in 2009	Ephemeral	UK	Culvert
Tuk 3	120.3	581158	7688888	IMG-Golder in 2009	Ephemeral	UK	Culvert
Tuk 4	122.5	579313	7690396	IMG-Golder in 2009	Perennial	F	Culvert
Tuk 5	126.4	577660	7693145	IMG-Golder in 2009	Perennial	F	Culvert
Tuk 6	127.5	577475	7694082	IMG-Golder in 2009	Perennial	F	Culvert
Tuk 7	128.0	577385	7694422	IMG-Golder in 2009	Ephemeral	UK	Culvert
Tuk 7b	129.7	577025	7696021	IMG-Golder in 2009	Intermittent	CH	Culvert
Tuk 8	133.9	577431	7699375	IMG-Golder in 2009	Ephemeral	UK	Culvert

a – Kilometre Marker as measured from the northern end of Old Navy Road, Inuvik.

b - F = known or assumed fish habitat
CH = contributing to fish habitat downstream
UK = unknown

c – bridge locations identified by EBA 2010b (Table 2.5-2)

* A, A1, A3 = Crossings located on Alternates 1 and 3.

** Tuk = Crossings located on the Tuk to Source 177 Road.

2.0 FISH HABITAT AND FISH RESOURCES OVERVIEW

2.1 Fish Habitat

The typical types of watercourses and drainages along the proposed Highway corridor vary from dry, ephemeral drainages to larger more permanent (perennial) watercourses.

Ephemeral/dry drainages are typically vegetated waterways, depressions or swales that are generally dry for most of the year and only flow during spring runoff or after major rain events (Bain and Stevenson 1999). Ephemeral drainages have no defined bed and banks or evidence of annual sediment transport. They are areas of dispersed overland flow, i.e. wetland drainages, which have shallow flow through terrestrial vegetation (shrubs and trees). These types of drainages tend to dry up during late summer and winter. Ephemeral streams can provide spawning habitat for spring spawning fish species such as Northern Pike and Arctic Grayling.

Intermittent watercourses tend to only flow at certain times of the year when groundwater levels are at their highest. As the groundwater levels drop, the flows in these types of streams also decrease, usually leaving isolated pockets of water in the channel (Bain and Stevenson 1999). Intermittent streams tend to have defined bed and banks and evidence of annual sediment transport. They are typically frozen to the substrate or are dry below the ice during winter months. Intermittent streams can provide rearing, feeding and spawning habitat but are not able provide overwintering habitat.

Permanent (perennial) watercourses flow throughout the year. They have defined bed and banks, including fines and organic materials. They can be partially frozen to the substrate during winter depending on water depths. Perennial streams are most likely to provide overwintering habitat (Bain and Stevenson 1999).

According to the watercourse crossing assessments completed to date, the majority of the watercourses that the Highway will cross are small, ephemeral streams. These generally drain surrounding upland areas or small, shallow lakes or ponds which are unlikely to provide year round habitat for large bodied fish species (Kiggiak-EBA 2011; Kiggiak-EBA 2010b).

2.1.1 Water Quality in the Highway Corridor

Studies on waters of the Lower Mackenzie sub-basin of the Mackenzie River basin (through which the Highway runs) have shown total metal concentrations (including aluminum, iron and cadmium) to be typically lower than Canadian Council of Minister of Environment (CCME) guideline levels for aquatic life and drinking water. However, seasonally high background levels and exceedances that may be correlated with increased discharge and suspended sediment loads (Kiggiak-EBA 2011) may occur.

During spring runoff events, water quality sampling around the Highway Corridor has revealed elevated concentrations of metals such as aluminum, iron and magnesium, as well as elevated levels of nutrients such as total phosphorus. This is expected to be the result of increased suspended solids during the freshet period (Kiggiak-EBA 2011).

Particulate-bound contaminants in natural waters have low bioavailability (the degree and rate at which a substance is absorbed into a living system; Merriam-Webster 2011) and may therefore not be harmful, so guideline levels established for the protection of aquatic life may be misleading (Kiggiak-EBA 2011).

In the Husky Lakes system, mean copper, lead and zinc concentrations have been found to be typically less than CCME guideline values, although cadmium concentrations in certain basins have exceeded those values (Kiggiak-EBA 2011).

The inorganic nitrogen (i.e., nitrite, nitrate, ammonia) concentrations have been found to be low or below the detection limit in the lakes of the Highway Corridor (Kiggiak-EBA 2011).

In places like the Highway Corridor where the catchments of lakes have bogs or peatlands, levels of iron are typically high (Kiggiak-EBA 2011).

INAC conducted water quality assessments at certain crossing locations in late September of 2010 and compared laboratory analytical results to CCME's *Water Quality Guidelines for the Protection of Freshwater Aquatic Life* (Kiggiak-EBA 2011). Water quality samples were tested for concentrations of aluminum, cadmium, copper, iron, lead, mercury and zinc. Table 2 shows those results in milligrams per litre (mg/L). Cells that are bolded indicate exceedances of the relative CCME guideline values which, as discussed above, may be considered to be natural (and likely season) in nature.

Table 2: Metals Concentrations in Select Watercourse Crossings

Crossing	*Aluminum (mg/L)*	*Cadmium (mg/L)*	*Copper (mg/L)*	*Iron (mg/L)*	*Lead (mg/L)*	*Mercury (mg/L)*	*Zinc (mg/L)*

Crossing	Aluminum (mg/L)	Cadmium (mg/L)	Copper (mg/L)	Iron (mg/L)	Lead (mg/L)	Mercury (mg/L)	Zinc (mg/L)
13A	0.021	<0.0001	0.0009	0.252	<0.0001	<0.0001	<0.005
18	0.0097	0.00026	0.0006	0.18	<0.0001	<0.0001	0.0012
23A	0.0103	<0.00005	<0.0002	0.09	<0.0001	<0.0001	<0.0004
29A	0.014	<0.0001	0.0006	0.228	0.0003	<0.0001	<0.005
30A	0.049	<0.0001	0.0015	0.908	0.0002	<0.0001	<0.005
35A	0.291	<0.0001	0.0015	2.2	0.0001	<0.0001	0.022
39	0.066	<0.0001	0.0017	1.42	0.0001	<0.0001	<0.005

Assessment completed September 2010 by INAC.

2.2 Fish Resources

2.2.1 Special Management Areas with Respect to Fish

Certain tracts of land and water within the ISR have been identified as having important wildlife habitat and/or harvesting areas and management plans include the provision of recommended land use practices. Inuvialuit communities have allocated priority land uses and activities and also identified ecologically and culturally significant areas.

The Inuvik and Tuktoyaktuk Community Conservation Plans (CCPs), which classify the lands and waters that the Highway crosses as categories B, C and E (Community of Inuvik *et al.* 2008; Community of Tuktoyaktuk *et al.* 2008):

- Category A – no known significant / sensitive cultural or renewable resources; managed according to current regulatory practices;
- Category B – cultural or renewable resources of some significance / sensitivity exist; terms and conditions of permits / leases provide conservation measures;
- Category C – cultural or renewable resources have particular seasonal significance / sensitivity; managed to minimize / eliminate potential damage and disruption;
- Category D – cultural or renewable resources have particular year-round significance / sensitivity; managed to minimize / eliminate potential damage and disruption; and
- Category E – cultural or renewable resources of extreme significance exist; no development; managed to minimize / eliminate potential damage and disruption; highest degree of protection in TCCP.

The Highway route crosses or is adjacent to spring, summer, fall and winter fish harvesting areas near Husky Lakes, sites 305C, 307C, 310C and 316C, part of the Fish Lakes and Rivers management area, site 704C (Kiggiak-EBA 2011). It is also close to the Husky Lakes and Rivers management area (Community of Inuvik *et al.* 2008; Community of Tuktoyaktuk *et al.* 2008). Table 3 provides further details on these areas.

Table 3: Inuvik and Tuktoyaktuk CCP Designations Pertaining to Fish and Fish Habitat*

Area Name	*Zone Title*	*Category*	*Locations which Highway Crosses Through*	*Significance*
Spring Fish Harvesting	305C	C	- Tuktoyaktuk / adjacent to - Husky Lakes area - Noel Lake area	Key subsistence fishing area during spring
Summer Fish Harvesting	307C	C	- Tuktoyaktuk / area to south - Husky Lakes area	Key subsistence fishing area during summer
Fall Fish Harvesting	310C	C	- Tuktoyaktuk / area to south - Husky Lakes area	Key subsistence fishing area during fall
Winter Fish Harvesting	316C	C	- Husky Lakes area - Jimmy Lake area - Noel Lake area	Key subsistence fishing area during winter
Fish Lakes and Rivers	704C	C	- Tuktoyaktuk / area to south - Husky Lakes / area to west - Jimmy Lake area - Noel Lake area (includes rivers / lakes along shoreline west of Tuktoyaktuk, inland to their headwaters, including Parsons and Yaya Lakes)	Important fish habitat, historic / present subsistence harvest area for Inuvik and Tuktoyaktuk residents
Husky Lakes	705E	E	- Husky Lakes (south and east of Tuktoyaktuk, Highway is adjacent but does not cross this zone; Alternatives 1 and 3 have been designed to respect the 1 km Husky Lakes setback)	Past / present use by Inuvialuit for year-round subsistence fishing; approximately 25 cabins throughout the area; Important spawning area for Pacific herring, lake trout and beluga

* Source: Community of Inuvik *et al.* 2008; Community of Tuktoyaktuk *et al.* 2008

The CCPs overlay the designations identified in the plan to determine “all site designations” for the area. The most northern portion of the proposed Highway route (i.e., the length which has already been constructed to Source 177 – the Tuk to Source 177 Road) is located on lands identified as Management Category B and waters identified as Management Category C. The overall “all site designation” for the remaining area south to Inuvik through which the Highway would pass is identified as Management Category E (Community of Inuvik *et al.* 2008; Community of Tuktoyaktuk *et al.* 2008).

2.2.2 Fish Species in the ISR

The two CCPs provide a list of fish species that have been identified within the ISR and are presented in the following list (Community of Inuvik *et al.* 2008; Community of Tuktoyaktuk *et al.* 2008):

Marine Species

- Arctic Cod (*Boreogadus saida*);
- Blue Herring (*Clupea pallasi*);
- Capelin (*Mallotus villosus*);

- Fourhorn Sculpin, Deepwater Sculpin or Devil Fish (*Myoxocephalus quadricornis*);*
- Greenland Cod (*Gadus ogac*);
- Saffron Cod (*Elegiums navaga*);
- Sand Lance (*Amodytes* sp.);
- Starry Flounder (*Platichthys stellatus*);
- Tom Cod (*Microgadus proximus*);

* Although this species is listed as a marine species only, freshwater forms are found in Canada and are therefore considered in this report.

Anadromous Species

- Chum Salmon (*Oncorhynchus keta*);
- Pink Salmon (*Onchorhynchus gorbuscha*);
- Arctic Char (*Salvelinus alpinus*; land locked);
- Least Cisco (*Coregonus sardinella*);
- Dolly Varden (*Salvelinus malma*);

Freshwater Species

- Arctic Cisco (*Coregonus autumnalis*);
- Arctic Grayling; Bluefish (*Thymallus arcticus*);
- Broad Whitefish (*Coregonus nasus*);
- Burbot (*Lota lota*);
- Finescale Dace (*Phoxinus neogaeus*);
- Flathead Chub (*Platygobio gracilis*);
- Inconnu; Coney (*Stenodus leucichthys*);
- Lake Chub (*Couesius plumbeus*);
- Lake Trout (*Salvelinus namaycush*);
- Lake Whitefish; Crooked Back (*Coregonus clupeaformis*);
- Longnose Dace (*Rhinichthys cataractae*);
- Longnose Sucker (*Catostomus catostomus*);
- Nine-spine Stickleback (*Pungitius pungitius*);

- Northern Pike; Jackfish (*Esox lucius*);
- Pond Smelt (*Hypomesus olidus*);
- Rainbow Smelt (*Osmerus mordax*);
- Round Whitefish (*Prosopium cylindraceum*);
- Slimy Sculpin (*Cottus cognatus*);
- Spoonhead Sculpin (*Cottus ricei*);
- Trout Perch (*Percopsis omiscomaycus*);
- Walleye; Pickerel (*Stizostedion vitreum*); and
- White Sucker (*Catostomus commersoni*).

For the purposes of this report, only anadromous and strictly freshwater species are considered as fish resources because they are considered the species that will be potentially affected by the Highway.

2.2.3 Subsistence Harvest and Valued Species in the ISR

The Highway Corridor provides important fish resources for subsistence harvests for the people of Inuvik and Tuktoyaktuk. Exclusive harvesting rights were not granted under the *Inuvialuit Final Agreement* but Inuvialuit have been granted the preferential right within the ISR to harvest fish for subsistence uses (Kiggiak-EBA 2011).

The most important harvest species include Broad Whitefish, Lake Whitefish, Inconnu and Northern Pike (Kiggiak-EBA 2011; Community of Inuvik *et al.* 2008; Community of Tuktoyaktuk *et al.* 2008).

Of the anadromous and freshwater species listed in Section 2.3.2, Arctic Grayling are considered to be of particular importance; Arctic Grayling were referred to as a valued species in the EIS for the Highway (Kiggiak-EBA 2010b). Arctic Grayling could be the species most affected by the construction of the Highway and stream crossings because the fish depend on stream habitats with clean, well-oxygenated water and gravel-cobble substrates for spawning, juvenile rearing and adult life stages. The species productivity within a system is considered highly sensitive to disturbances or alterations to their migration routes or to habitat quality (Kiggiak-EBA 2010b).

Additionally, Lake Trout are considered a valuable species in the ISR (A. Joynt, DFO, pers. comm. 2011) and there are several large lakes close to the Highway corridor known to have viable stocks (Webb and MacDougall 1996).

2.2.4 Fish Species Described for the Highway Corridor

Previous field studies at the watercourse crossings of the Highway have reported that Lake Whitefish, Round Whitefish, Inconnu, Northern Pike, Arctic Grayling, Lake Trout, Burbot, Least Cisco, Ninespine Stickleback,

Sculpin spp. and potentially Broad Whitefish and Arctic Cisco have been identified (Kiggiak-EBA 2011; IMG-Golder 2009).

However, there is the possibility that any of the anadromous or freshwater species listed as occurring within the ISR could be encountered along the Highway corridor.

Table 4 presents the common and Inuvialuit names, a description of each species' known distribution including any known occurrences at watercourses that are crossed by the Highway, details on typical habitat, spawning characteristics, diet as well as population characteristics as identified in the CCPs (Community of Inuvik *et al* 2008; Community of Tuktoyaktuk *et al.* 2008).

More details on each fish species mentioned in Table 4 are provided in Appendix II.

Table 4: Description of Fish Species in the ISR

Common Name / Inuvialuit Name [a]	*Scientific Name*	*Distribution in the ISR / Known Location Along Highway* [a]	*Habitat / Spawning Characteristics*	*Diet*	*Population Status* [b] */ Known Management Plans in ISR*
Anadromous Species					
Chum Salmon Dog salmon	*Oncorhynchus keta*	- Beaufort Sea; into the Mackenzie and Peel river systems to spawn	- Marine dwelling but enter freshwater systems briefly to spawn, use rivers and lakes for migration routes - Spawning in rivers in fall (Slave River in NWT) in streams with groundwater input or upwellings, over gravel substrate	- Insects and marine invertebrates while in rivers, consists of copepods, molluscs, squid, tunicates and other fish while at sea	- Undetermined - None
Pink Salmon Humpback Salmon	*Onchorhynchus gorbuscha*	Beaufort Sea; Mackenzie River system	- Marine dwelling but enter freshwater systems to spawn (not known to spawn in NWT) - (Alaska) spawn August / September on clean coarse gravel substrate in riffles or pools	- Zooplankton (especially krill)	- Vagrant / Accidental - None
Arctic Char	*Salvelinus alpinus*	- Beaufort Sea offshore; east of the Mackenzie River inland	- Anadromous adults enter freshwater rivers only to spawn; land-locked adults remain in freshwater lakes and rivers - Spawning in September / October over rocky shoals in lakes and rivers with gravel substrate	- Freshwater shrimp and insect larvae (young), small fish, snails, clams and insect larvae (adults)	- Secure - None
Dolly Varden	*Salvelinus malma*	- Mackenzie River and Mackenzie Delta, typically to the west of the Mackenzie River	- Anadromous and freshwater stocks; freshwater overwintering in areas where groundwater discharge prevents freezing - Spawning August to November in mountain streams fed by groundwater over gravel substrate	- Insect larvae and gastropods but primarily other fish	- Sensitive - Rat River Charr Fishing Plan and the intended West Side Charr Fishing / Management Plan (for the Aklavik area - Integrated Fisheries Management Plan for Dolly Varden (Salvelinus malma malma) of the Gwich'in Settlement Area and Inuvialuit Settlement Region Northwest Territories and Yukon North Slope 2011 – 2015
Least Cisco Least Whitefish Big-eyed Herring Qaluhaq	* *Coregonus sardinella*	- Beaufort Sea; lower Mackenzie Delta in lakes and rivers	- Lakes and rivers - Migrate upstream to spawn in October; clear streams over gravel substrate	- Crustaceans, fish	- Secure - None

Common Name / Inuvialuit Name [a]	Scientific Name	Distribution in the ISR / Known Location Along Highway [a]	Habitat / Spawning Characteristics	Diet	Population Status [b] / Known Management Plans in ISR
Freshwater Species					
Arctic Cisco	* *Coregonus autumnalis*	- Beaufort sea; Mackenzie Delta system, including inland lakes	- Mackenzie River system (summer / spawning); offshore (overwintering / nursery) - Spawning in fall likely in fast-moving water (rapids) over gravel substrate	- Small fish, crustaceans	- Sensitive - None
Arctic Grayling Hulukpaugaq	* *Thymallus arcticus*	- Rivers to the east of the Mackenzie River - Watercourse 39[d] - Watercourse 39a[d]	- Clear water of small shallow streams / medium rivers; can be highly migratory with different streams for different life stages, or may spend life in small lake or stream section; overwinter in lakes or river pools - Spawn in spring during ice break up over gravel substrate in running water	- Terrestrial / aquatic insects, crustaceans, small fish, fish eggs	- Sensitive - None
Broad Whitefish Anaakiq	*Coregonus nasus*	- Coastal and inland areas of NWT including the East Channel of the Mackenzie River - Watercourse 6[e]	- Fresh and brackish waters; anadromous and non-migratory lake stocks known in Mackenzie Basin; more encountered in rivers than lakes; typically larger moderately turbid river systems, delta lakes and brackish estuaries - Spawns in rivers October / November under ice over gravel substrate	- Aquatic insects and larvae, small molluscs, crustaceans	- Secure - Considered for an Integrated Fisheries Management Plan
Burbot Loche Tittaaliq	* *Lota lota*	- Common in rivers / large lakes of NWT; common in outflows of small streams in Mackenzie Delta during early winter	- Fresh and brackish waters; migrate into tributary rivers late winter / early spring, then deep water summer - Spawns Jan / March under ice over sand / gravel substrate in shallow bays or on gravel shoals, usually in lakes, sometimes rivers	- Aquatic insects (young), other fish (adults)	- Secure - None
Finescale Dace	*Phoxinus neogaeus*	- Mackenzie River and Mackenzie Delta, Arctic Red River	- Clear, acidic, stained boggy water in bog ponds, streams and large lakes; often in creek pools - Spawning spring / midsummer under cover of trees, bush and logs over mud or gravel substrate	- Insects, crustaceans and plankon	- Secure - None
Flathead Chub	*Platygobio*	- Mackenzie River and	- Swift, turbid muddy water and slow-	- Insect larvae, berries,	- Secure

Common Name / Inuvialuit Name [a]	Scientific Name	Distribution in the ISR / Known Location Along Highway [a]	Habitat / Spawning Characteristics	Diet	Population Status [b] / Known Management Plans in ISR
	gracilis	Mackenzie Delta, Great Slave Lake, Great Bear River	moving creeks; typically in rivers, rarely in lakes / ponds - Spawning in June through August in small streams	seeds and other fish	- None
Fourhorn Sculpin	*Myoxocephalus quadricornis*	- Marine and freshwater forms in NWT	- Ocean, estuary and river habitats; prefer cold nearshore areas in shallow water - Spawn in December / January presumably; freshwater form presumably in lakes on ceilings of small cavities over gravel or rock substrate	- Invertebrates and fish	- Undetermined - None
Inconnu Coney Higaq	* *Stenodus leucichthys*	- Mackenzie River system including Mackenzie Delta	- Sometimes anadromous with long migrations to upstream spawning sites; other times lake dwelling - Spawn September / October in areas of fast currents over gravel substrates	- Plankton (fry), insect larvae / small fish (young), fish (year two and older)	- Sensitive - *Integrated Fisheries Management Plan for Coney (*Stenodus leuchicthys*) in the Gwich'in Settlement Area, Inuvialuit Settlement Region, and the Sahtu Settlement Area, Northwest Territories 2000-2005*
Lake Chub	*Couesius plumbeus*	- Mackenzie River system	- Lakes and rivers, also streams; warm or cool water; clear or muddy water - Spawning along shores of lakes or tributary streams in August shallow slow-flowing water over silt, gravel or leaf substrate	- Aquatic / terrestrial insects, algae, zooplankton and small fish	- Secure - None
Lake Trout Iqaluakpak	* *Salvelinus namaycush*	- Across mainland NWT including Husky Lakes	- Mostly in large deep lakes, sometimes in large rivers or brackish water - Spawn in September, usually over shoals of lakes or along shores of islands; spawning over clean rocky lake bottoms	- Usually cisco, smelt, sticklebacks, sculpins; in some lakes diet mostly plankton and crustaceans; also insects and bottom organisms	- Secure - HTC Bylaw minimum 11 cm net mesh size; commercial minimum 14 cm net mesh size
Lake Whitefish Crooked back Humpback Whitefish Pikuktuq Qalupiaq	* *Coregonus clupeaformis*	- Across NWT including Mackenzie Delta lakes and rivers	- Lake dwelling and anadromous stock; marine, brackish and freshwater habitats; may overwinter in ocean or spend winter in deep lakes - Spawn in September / October in shallow water over cobble and gravel or sometimes sand substrate	- Aquatic insects, molluscs, amphipods, small fish and fish eggs	- Secure - None
Longnose Dace	*Rhinichthys*	- Across the NWT including the Mackenzie	- Cool clear streams with swift flow and gravel or boulders on bottom; also clear	- Insect larvae, worms and	- Secure

Common Name / Inuvialuit Name [a]	Scientific Name	Distribution in the ISR / Known Location Along Highway [a]	Habitat / Spawning Characteristics	Diet	Population Status [b] / Known Management Plans in ISR
	cataractae	River system	river pools and nearshore lake areas - Spawning in riffle areas of streams or rivers over gravel substrate	algae	- None
Longnose Sucker	*Catostomus catostomus*	- Across NWT	- Rivers, lakes and streams with clear or turbid, warm or cold water - Spawning in May / June in rivers or lake shallows over large rock or sand and gravel substrate	- Insect larvae, amphipods, algae, crustaceans and snails	- Secure -
Ninespine Stickleback	*pungitius*	- Across NWT including Mackenzie River system and Mackenzie Delta - Watercourse 13a[d] - Watercourse 4[e] - Watercourse 5[e] - Watercourse 6[e]	- Typically freshwater but can tolerate salinity and may live in marine habitats; lives in shallows - Spawning in summer in weeds / vegetation in freshwater creeks	- Diet includes aquatic insects, crustaceans, young fish and fish eggs	- Secure - None
Northern Pike Jackfish Saulik	* *Esox lucius*	- Across NWT - Watercourse 6[e]	- Typically non-migratory, but sometimes move long distances; lakes and warm, clear channels of rivers / slack waters - Spawn on aquatic vegetation early spring	- Diet of opportunistic feeders, mostly fish but also muskrats and ducklings	- Secure - None
Pond Smelt	*Hypomesus olidus*	- Lower Mackenzie and Peel river systems including Mackenzie Delta; also around Tuktoyaktuk	- Rivers, streams and lakes but may live in marine, brackish or freshwater habitats - Spawn in spring / early summer along shores of shallow rivers with slow currents or lakes over gravel and sand substrate	- Zooplankton, insects, algae and crustaceans	- Undetermined - None
Rainbow Smelt	*Osmerus mordax*	- Mackenzie Delta and coastal areas	- Marine, brackish and freshwater habitats; inland lakes and streams - Spawn in spring in streams or gravelly lake shores over gravel substrate	- Crustaceans, worms, squid, aquatic and terrestrial insects and small fish	- Undetermined - None
Round Whitefish	*Prosopium cylindraceum*	- Across NWT mainland, Mackenzie Delta, along Beaufort coast	- Freshwater / sometimes brackish waters; typically in shallows of lakes / clear streams, also swift rivers with gravel bottoms - Spawns in shallows of lakes, river mouths, or in rivers over gravel substrate	- Invertebrates, fish and fish eggs	- Secure - None
Slimy Sculpin	*Cottus cognatus*	- Across NWT	- Sometimes lakes, typically cool, clear or muddy rivers, streams and creeks	- Insect larvae, other invertebrates, fish eggs	- Undetermined - None

Common Name / Inuvialuit Name [a]	Scientific Name	Distribution in the ISR / Known Location Along Highway [a]	Habitat / Spawning Characteristics	Diet	Population Status [b] / Known Management Plans in ISR
			- Spawn in a nest under a rock, ledge or submerged tree root; eggs may be laid on underside		
Spoonhead Sculpin	*Cottus ricei*	- Mackenzie River, Great Slave Lake, Rabbitskin River, Thelon River system	- Freshwater and brackish habitats; typically swift streams, large turbid rivers, shallows and deeper waters in lakes - Spawning likely in fall on the underside of a rock	- Aquatic insects and crustaceans	- Undetermined -
Trout Perch	*Percopsis omiscomaycus*	- Throughout Mackenzie River basin including Mackenzie Delta; also on Tuktoyaktuk Peninsula	- Lakes and sometimes slow-moving areas of streams and rivers - Spawning in shallow streams or sometimes shallow lake margins over rocky substrates	- Insects and other invertebrates	- Undetermined - None
Walleye Pickerel	*Stizostedion vitreum*	- Mackenzie River basin including Mackenzie Delta	- Large shallow turbid lakes but variable habitats also including large, turbid or clear rivers and streams, sometimes clear lakes - Spawn in May over rock, sand, gravel, rubble or gravel substrate, sometimes over sand or silt	- Primarily other fish	- Sensitive - None
White Sucker	*Catostomus commersoni*	- Mackenzie River system south of the treeline; potentially Mackenzie Delta	- Rivers, streams and lakes, preferring warm shallow water - Spawn in May sometimes in rivers and along lake shores, but prefer to spawn in swift streams over rubble or gravel substrate	- Aquatic insect larvae, small molluscs, crustaceans and terrestrial worms	- Secure - None

Refer to descriptions of fish species in Appendix II for references.

a – From capture and observation data collected during surveys by IMG-Golder (2009) and Kiggiak-EBA (2010b).

b – Based on GNWT, ENR General Status Ranking Program (GNWT, ENR 2011c).

* Fish considered important in the CCPs (Community of Inuvik *et al.* 2008; Community of Tuktoyaktuk *et al.* 2008) and summarized in its Species Conservation Summaries.

Table 5 provides an overview of the species caught (through electrofishing) or directly observed in the fisheries assessments carried out in 2009 and 2010 (IMG-Golder 2009; Kiggiak-EBA 2010a). Rescan 1999 data are not included as this assessment was conducted on a different road alignment and consequently investigated different watercourse crossings that those reported by Rescan (1999).

Table 5: Fish Species Observed or Captured along Highway

Watercourse Crossing	*Fish Species*	*Estimated Captured or Observed*	*Assessment*
Tuk 4	Ninespine Stickleback	2 captured / 2 observed	IMG-Golder 2009
Tuk 5	Ninespine Stickleback	15 captured / 20 observed	IMG-Golder 2009
Tuk 6	Ninespine Stickleback	1 observed	IMG-Golder 2009
	Northern Pike	2 captured / 3 observed	IMG-Golder 2009
	Broad Whitefish	3 observed	IMG-Golder 2009
	Cisco spp.	1 observed	IMG-Golder 2009
13a	Ninespine Stickleback	1 captured	Kiggiak-EBA 2010a
39	Arctic Grayling	1 captured / 9 observed	Kiggiak-EBA 2010a
39a	Arctic Grayling	5 observed	Kiggiak-EBA 2010a

2.2.5 Fish Species with Special Conservation Status

For the purpose of this document, species with special conservation status will be considered those that do not have a secure status as a species within the NWT or Canada. Three classification systems for ranking these species will be considered.

Species may be ranked under the Government of Canada's *Species at Risk Act* (SARA), first legislated in 2003 (SARA 2011). SARA designates a national classification for species that have been assessed by the Committee on the Status of Endangered Wildlife in Canada (COSEWIC). These include species designations as Special Concern (may become Threatened or Endangered from combination of biological characteristics and identified threats), Threatened (may become Endangered if not protected from factors leading to extirpation or extinction), Endangered (facing extirpation or extinction), Extirpated (no longer existing in Canada but does elsewhere in the world), and Extinct (no longer existing anywhere; SARA 2011). If a species becomes listed as “extirpated”, Endangered or Threatened, people are legally prohibited from killing, harming, harassing or capturing species individuals, nor can they damage or destroy their habitat (SARA 2011).

In addition, there are three schedules that species can be listed under. Species listed under Schedule 1 of the *Species at Risk Act* include those species officially listed by SARA. Species that had been listed by COSEWIC prior to October 1999, but have not been officially protected yet under SARA, are listed under Schedules 2 and 3 (SARA 2011). The species listed under Schedules 2 and 3 are required to be assessed within a certain timeframe.

COSEWIC was created in 1977 to provide a sound assessment of Canadian species and develop a national classification for wildlife species at risk. In 2003, it was established under SARA's mandate to act as its advisory body, and it continues to provide ongoing evaluations of the status of Canadian species. The committee uses

the same designations as SARA does for species classifications, but these rankings are not necessarily accepted by SARA (COSEWIC 2011).

The Government of the Northwest Territories' (GNWT) Department of Environment and Natural Resources (ENR) has established an assessment program for species found within the NWT (GNWT, ENR 2011c). Since 1999, the GNWT has been collecting information on species and has developed the NWT General Status Ranking Program to be used as a tool for conservation management. Under this program, species ranks must be reviewed every five years. Species may be ranked as At Risk (have been assessed in detail or ranked by COSEWIC as Threatened or Endangered), May be at Risk (may be at risk of extinction or extirpation; the highest rank for species under GNWT General Status Ranking system), Sensitive (may require protection to keep from becoming at risk), Secure (not at risk or sensitive), Undetermined (insufficient information to determine status), Not assessed (not assessed under program), Alien (introduced through human activities), Extirpated / Extinct (no longer found in the NWT / world), Vagrant (infrequent and / or unpredictable occurrences, outside normal distribution range) and Presence Expected (species not yet recorded but expected to occur in the NWT).

In 2009, the GNWT passed the *Species at Risk (NWT) Act* to fulfill the NWT's commitment to effective legal protection of the territory's flora and fauna (GNWT, ENR 2010). It also describes the processes to assess, list, protect and recover species at risk specifically for the NWT. The *Species at Risk (NWT) Act* applies to any wild animal or plant species managed by the GNWT on public and private lands, including private lands owned under a land claims agreement. The act was designed to complement SARA and other legislation and assessments follow the same procedure as described above for SARA (GNWT, ENR 2010). Species occurring in the NWT listed under SARA and / or COSEWIC are considered as well in the *Species at Risk (NWT) Act.*

Table 6 summarizes those fish species (excluding strictly marine species) that could potentially occur in the watercourse crossings of the Highway that have a special conservation status (i.e., the table does not present species that are considered Secure, Not at Risk, Not Assessed, Undetermined, etc.)

Table 6: Fish Species with Special Conservation Status potentially occurring in the Highway Corridor

Species	***SARA*** [a]	***COSEWIC*** [b]	***GNWT*** [c]
Arctic Cisco	-	-	Sensitive
Arctic Grayling	-	-	Sensitive
Bull Trout	-	-	May be at Risk
Dolly Varden	-	Special Concern	Sensitive
Fourhorn Sculpin	(Freshwater form); Special Concern, Schedule 3	-	-
Inconnu	-	-	(Lower Mackenzie River stock); Sensitive
Walleye	-	-	Sensitive

a – SARA 2011.

b – COSEWIC 2011.

c – GNWT ENR 2011c.

2.2.6 Fish Health and Condition

Research has indicated that there is no information available suggesting that the fish species found in the Highway corridor have shown signs of health issues or degraded conditions. It has been noted that Broad Whitefish are preferable to Lake Whitefish as a harvest species because Lake Whitefish are more likely to have cysts (Kiggiak-EBA 2011; Community of Inuvik *et al.* 2008; Community of Tuktoyaktuk *et al.* 2008).

Water quality parameters found to have concentrations exceeding levels established by the Canadian Council of the Ministers of Environment (CCME) for the protection of aquatic life may be seasonal in nature and potentially not bioavailable to fish, suggesting a minimized or negligible negative affect on the health and condition of fish populations in the area (Section 2.1.1). The lack of human activities in this remote northern area (excluding the Tuk to 177 Road stretch of the Highway) supports the suggestion that fish species in the Highway Corridor's waterbodies have not been exposed to adverse contaminant concentrations (Kiggiak-EBA 2011). Big Lake (also know as "Ilkaasuat" or "fishing area") was identified as a popular fishing area for Lake trout and Pike during community consultations. Residents stated that a road would allow easier access to this fishing area (Kiggiak-EBA 2011). It was however stated that people do not fish along the proposed Highway route, but further to the east, so the Highway corridor would not affect their fishing areas trough increased access.

Additionally, research has indicated that there is no evidence of non-native fish species invading the area and posing a threat to local native fish populations in the Highway Corridor (Kiggiak-EBA 2011).

3.0 METHODS

The detailed field fish habitat assessments for the Highway were conducted from September 7 to 20 for the 36 proposed watercourse crossings. Field investigations were completed by a three person crew: one fisheries biologist, one field technician and one Inuvialuit Wildlife Monitor.

3.1 Aerial Reconnaissance Flight

An aerial reconnaissance flight was conducted to confirm the location of each of the 36 proposed highway crossings with a Global Positioning System (GPS). Photographs were taken at an altitude sufficient to provide an overall view of the watercourse upstream and downstream and yet low enough to show the habitat features in sufficient detail should unforeseen circumstance prevent conducting detailed surveys. The photographs included any features that could affect fish habitat (e.g., obstruction to fish passage, woody debris etc.)

3.2 Watercourse Habitat Mapping

Watercourse habitat mapping was conducted in accordance with Golder's Technical Procedure 8.5-1: "Stream Habitat Mapping and Classification System". The stream habitat mapping system includes recording the presence and location of individual channel units (i.e., pool/riffle/run) in combination with depth, velocity, substrate characteristics and instream and overhead cover. This habitat information was used to provide a qualitative rating for each channel unit in relation to the habitat requirements of fish at their various life history stages (i.e., spawning, rearing, feeding and overwintering). Representative photographs were taken at the crossing location and throughout the surveyed sections of the watercourse to document habitat conditions (provided in Appendix III).

3.3 Stream Discharge Measurement

Water velocity measurements were collected using a Marsh-McBirney digital velocity meter in the vicinity of the proposed crossing location. The measurements were collected as outlined in Golder's Technical Procedure 8.24-0: "Discharge Measurement Methods".

3.4 In-situ Water Quality

Water quality parameters were in accordance with Golder's Technical Procedure 8.3-1: "Surface Water Sampling Methods". Data collected included pH (± 0.2 units), specific conductivity (µS/cm, ± 0.5% of reading), water temperature (± 0.15°C) and dissolved oxygen (± 0.2 mg/L) using a YSI 556 Multimeter.

3.5 Habitat Evaluation Parameters

At each watercourse crossing site, a Pipeline Crossing Habitat Evaluation Parameters (PCHEP) form was completed. This form assists in defining the physical characteristics of the stream and in evaluating fish habitat parameters that are specific to the road crossing location. To ensure consistent evaluations, the protocols used to complete the PCHEP form followed Golder's Technical Procedure 8.14-1: "Pipeline Crossing Habitat Evaluation Parameters". Although the PCHEP form was originally developed for evaluating fish habitat at pipeline crossing it is also applicable to other linear development projects such as highways.

The PCHEP assessment consists of the documentation of the following parameters:

- General watercourse characteristics (e.g., stream pattern, confinement, gradient);
- Photographs of the proposed crossing point;
- Channel characteristics (e.g., wetted width, cross-sectional depth, velocity profile, depth of pools/riffles/runs);
- In-situ water quality;
- Streambed and bank material;
- Erosion potential;
- Other pertinent habitat features (e.g., fish habitat potential, barriers to fish movement, macrophytic growth); and
- A qualitative rating of the suitability of the habitat for the various life history functions of non-sport fish, sport fish and forage fish species.

When assigning qualitative ratings of habitat suitability for large-bodied fish, the following parameters were used:

- Watercourses with maximum depths less than 1.5 m were considered to have limited overwintering potential; and
- Dissolved oxygen levels below 5.6 mg/L were considered to be sub-optimal for large bodied fish species such as northern pike (CCME 1999; Ford *et al.* 1995).

Watercourses crossed by the proposed Highway were classified in three categories: ephemeral, intermittent and perennial streams (Section 2.1).

4.0 DESCRIPTION OF EXISTING FISH AND FISH HABITAT

Results of the fish habitat assessments of the 36 watercourse crossed by the proposed Highway are presented in the following sections and summarized in Tables 6 and 7. The assessment focused on suitability of the habitat (overwintering, spawning, rearing and feeding) for Northern Pike and Arctic Grayling as these were the large bodied fish species that would most likely be present in the watercourses and were most often observed in the streams by the field crew. Suitability of the habitat at the watercourse crossings for use by other large bodied

such as Burbot or Coregonid species (i.e., Lake Whitefish, Round Whitefish, Inconnu, Least Cisco, and Broad Whitefish) was also considered for watercourses where these species could potentially be present.

Small-bodied forage fish species, e.g., minnows, Sculpin spp. and Stickleback spp, found in most watercourses were consider ubiquitous. These species and their life stages are found in a wide range of habitats (Evans et. al. 2002). It was assumed that all streams classes (i.e., perennial, intermittent and ephemeral) provided suitable habitat for all of these species at times when they were flowing.

A summary of the stream characteristics is provided in Table 6. The existing habitat conditions and habitat suitability for the proposed watercourse crossings is provided in Table 7. Photographs illustrating the habitat features of each watercourse at or near the crossing locations are provided in Appendix III. Watercourse crossings are named according to Kilometre Marker starting from 0, at the northern end of Navy Road in Inuvik and moving northwards. Watercourse crossings on Alternate routes are labelled with A1 and preceding the respective kilometre Marker. Some watercourse crossings are located on both routes Alternate 1 and Alternate 3 (Figure 2). These crossings are labelled with both names. Kilometre Markers on Alternate routes were established the same way as the main route: starting with km 0 at the northern end of Navy Road in Inuvik. Despite several attempts, watercourse crossing A14 (on Alternate 3) could not be located and was excluded from the following sections.

4.1 Watercourse Crossing A1-112.3 / A3-106.2 (Unnamed Watercourse)

A site assessment was conducted at crossing location A1-112.3 / A3-106.2 on September 13, 2011. This crossing is located on both routes Alternate 1 and Alternate 3. The site is located in open tundra with terrestrial vegetation consisting of dwarf shrubs, sedges, grasses, mosses and lichens.

The watercourse was a straight channel that was occasionally confined. The channel features consisted entirely of shallow run habitat. The mean water depth at the time of the survey was 0.31 m with a maximum water depth of 0.50 m. Discharge was not measured. Point velocities collected at the site ranged from 0.00 to 0.07 m/s, the average velocity measured at the crossing location was 0.03 m/s.

Bankfull width at the crossing location was 6.8 m, with a wetted width of 4.0 m. The substrate throughout the surveyed section was comprised of unconsolidated organic material. Both banks throughout the surveyed reach were comprised of organic material and were well vegetated. The banks were stable. Approach slopes within the floodplain were flat and stable.

Overhanging grass, shrubs and undercut banks provided overhead cover. Instream cover was provided by instream vegetation and large organic debris and small woody debris.

The water temperature at the time of the crossing assessment was 7.7°C, dissolved oxygen concentration was 9.8 mg/L and conductivity was 139 µS/cm.

The watercourse at the crossing location had the physical characteristics required to provide suitable rearing, feeding and spawning habitat for small bodied forage fish species. The presence of instream vegetation will provide limited rearing, feeding and spawning habitat for large bodied fish species such as Northern Pike and Burbot. However the high amount of organic substrate and the lack of gravel resulted in low habitat suitability for

Arctic Grayling and Coregonid spawning and rearing. The shallow water depths at or near the crossing location made the watercourse unsuitable for use as overwintering habitat as the watercourse is likely to freeze to the bed in winter.

4.2 Watercourse Crossing A1-108 / A3-101.9 (Unnamed Watercourse)

A site assessment was conducted at crossing location A1-108 / A3-101.9 on September 8, 2011. This site is located on both alternate routes between two unnamed waterbodies. The watercourse had intermittent flows and consisted of dry sections interspersed with isolated pockets of standing water. The site was located within open tundra with terrestrial vegetation consisting of dwarf shrubs, sedges, grasses, mosses and lichens.

The channel at the crossing location was a meandering pattern that was unconfined. The mean water depth of standing water was 0. 29 m with a maximum water depth of 0.50 m. No measureable flows were observed at the site. The average bankfull width at the survey location was 2.1 m, with an average wetted width of 0.9 m. The substrate throughout the surveyed section was comprised of unconsolidated organic material. Both banks throughout the surveyed reach were comprised of organic material and were well vegetated. The banks had a high stability. Approach slopes within the floodplain were flat and stable.

The watercourse had the physical characteristics, such as sufficient water depths and overhead cover, required to provide suitable rearing, feeding and spawning habitat for small bodied forage fish species during the open water season. The shallow water depth and lack of overhead cover make long term use of the habitat at the crossing location by adult large bodied fish unlikely. Intermittent flow and presence of dewatered sections in the channel prevent year round upstream and downstream movement of fish. Use of the channel by fish is limited to periods in spring, early summer and fall when flowing water is present and therefore any crossing structure installed should allow for migratory fish movements. The lack of instream vegetation will limit rearing, feeding and spawning habitat for large bodied fish species such as Northern Pike and Burbot and resulted in a nil to low habitat suitability for large bodied fish species. The high amount of organic substrate and the lack of gravel resulted in low habitat suitability for Arctic Grayling and Coregonid spawning and rearing. The shallow water depths at or near the crossing location made the watercourse unsuitable for use as overwintering habitat as the watercourse is likely to freeze to the bed in winter.

4.3 Watercourse Crossing A1-105.5 / A3-99.4 (Unnamed Watercourse)

A site assessment was conducted at crossing location A1-105.5 / A3-99.4 on September 8, 2011. The site is located on both alternate routes between two waterbodies. It is located in open tundra with terrestrial vegetation consisting of dwarf shrubs, sedges, grasses, mosses and lichens. The channel was a meandering pattern that was unconfined. The habitat features consisted entirely of shallow flat habitat. The mean water depth at the time of the survey was 0.17 m with a maximum water depth of 0.45 m. Discharge was not measured due to the amount of instream vegetation preventing an accurate measurement. Point velocities collected at the site ranged from 0.00 to 0.14 m/s, the average velocity measured at the crossing location was 0.04 m/s.

Bankfull width at the crossing location was 13.5 m, with a wetted width of 4.3 m. The substrate throughout the surveyed section was comprised of unconsolidated organic material. Both banks throughout the surveyed reach

were vegetated and comprised of unconsolidated organic material, with high stability. Approach slopes within the floodplain were flat and considered stable.

Overhanging grass, shrubs, large organic debris and undercut banks provided overhead cover. Instream cover was provided by instream vegetation and large organic debris.

The water temperature at the time of the crossing assessment was 9.4°C, the pH was 7.7, dissolved oxygen concentration was 10.6 mg/L and conductivity was 121 µS/cm.

The watercourse had sufficient depth and abundant instream and overhead cover to provide suitable rearing, feeding and spawning habitat for small bodied forage fish species and large bodied fish species such as Northern Pike and Burbot during the open water season. However the high amount of organic substrate and the lack of gravel resulted in low habitat suitability for Arctic Grayling and Coregonid spawning and rearing.

The shallow water depths at or near the crossing location made the watercourse unsuitable for use as overwintering habitat as the watercourse is likely to freeze to the bed in winter.

4.4 Watercourse Crossing A1-101.9 (Unnamed Watercourse)

A site assessment was conducted at crossing location A1-101.9 on September 13, 2011. The site is located in open tundra with terrestrial vegetation consisting of dwarf shrubs, sedges, grasses, mosses and lichens. The channel was straight and considered unconfined. The features consisted entirely of shallow run habitat. The mean water depth at the time of the survey was 0.21 m with a maximum water depth of 0.45 m. Discharge was not measured. Point velocities collected at the site ranged from 0.00 to 0.18 m/s, the average velocity measured at the crossing location was 0.05 m/s.

Bankfull width at the crossing location was 8.5 m, with a wetted width of 5.2 m. The substrate throughout the surveyed section was comprised of unconsolidated organic material. Both banks throughout the surveyed reach were vegetated and comprised of unconsolidated organic material, with moderate stability. Approach slopes within the floodplain were flat and considered stable.

Overhanging grass and shrubs provided overhead cover. Instream cover was provided by instream vegetation and large organic debris.

The water temperature at the time of the crossing assessment was 7.6°C, dissolved oxygen concentration was 10.7 mg/L and conductivity was 140 µS/cm.

Field crew observed three juvenile Northern Pike and numerous Ninespine Stickleback during the site assessment.

The water depth, abundant overhead and instream woody debris provided suitable habitat for small bodied forage fish and large bodied fish species. However the suitability of the habitat for use by Arctic Grayling and Coregonid spawning and rearing was considered to be low due to the high amount of organic substrate and the lack of coarse substrate material.

The shallow water depths at or near the crossing location made the watercourse unsuitable for use as overwintering habitat as the watercourse is likely to freeze to the bed in winter.

4.5 Watercourse Crossing A1-100 (Unnamed Watercourse)

A site assessment was conducted at crossing location A1-100 on September 8, 2011. This site is located between two unnamed waterbodies. The site is located in open tundra with terrestrial vegetation consisting of dwarf shrubs, sedges, grasses, mosses and lichens.

The watercourse was an irregular meandering pattern that was frequently confined. The features consisted entirely of shallow run habitat. The mean water depth at the time of the survey was 0.26 m with a maximum water depth of 0.39 m. Discharge was not measured due to the presence of instream vegetation and narrow wetted width. Point velocities collected at the site ranged from 0.05 to 0.15 m/s, the average velocity measured at the crossing location was 0.09 m/s.

Bankfull width at the crossing location was 6.8 m, with a wetted width of 1.1 m. The substrate throughout the surveyed section was comprised of unconsolidated organic material. Both banks throughout the surveyed reach were vegetated and comprised of unconsolidated organic material, with high stability. Approach slopes within the floodplain were flat and considered stable.

Overhanging grass, shrubs, large organic debris and undercut banks provided overhead cover. Instream cover was provided by instream vegetation and depth and turbulence.

The water temperature at the time of the crossing assessment was 9.3°C, the pH was 8.2, dissolved oxygen concentration was 12.4 mg/L and conductivity was 145 µS/cm.

The field crew observed numerous Ninespine Stickleback during the field investigation.

The watercourse has the physical characteristics required to provide suitable rearing, feeding and spawning habitat for small bodied forage fish species and large bodied fish species such as Northern Pike and Burbot during the open water season. The overhanging vegetation and instream aquatic vegetation provided suitable cover for small bodied forage fish and large bodied fish species and could be used for spawning and rearing habitat by Northern Pike. However the suitability of the habitat for use by Arctic Grayling and Coregonid spawning and rearing was considered to be low due to the lack of coarse substrate material.

The shallow water depths at or near the crossing location made the watercourse unsuitable for use as overwintering habitat as the watercourse is likely to freeze to the bed in winter.

4.6 Watercourse Crossing A3-96.4a (Unnamed Watercourse)

A site assessment was conducted at crossing location A3-96.4a on September 8, 2011. The watercourse had intermittent flows and consisted of dry sections interspersed with isolated pockets of standing water. The site was located within open tundra with terrestrial vegetation consisting of dwarf shrubs, sedges, grasses, mosses and lichens.

The water depth of the standing water was 0. 10 m. No measureable flows were observed at the site.

Bankfull width at the proposed crossing location was 6.4 m, with a wetted width of 2.3 m. The substrate throughout the surveyed section was comprised of unconsolidated organic material. Both banks throughout the surveyed reach were comprised of organic material and were well vegetated. The banks had a high stability. Approach slopes within the floodplain were flat and stable,

The watercourse has the physical characteristics required to provide suitable rearing, feeding and spawning habitat for small bodied forage fish species. However, the watercourse was considered unlikely to provide similar habitat for large bodied species such as Northern Pike, Arctic Grayling, Burbot or Coregonid species due to shallow water depths, low flow and lack of suitable substrate. Intermittent flow and presence of dewatered sections in the channel prevent year round upstream and downstream movement of fish. Use of the channel by fish is limited to periods in spring, early summer and fall when flowing water is present and therefore any crossing structure installed should allow for migratory fish movements.

The shallow water depths at or near the crossing location made the watercourse unsuitable for use as overwintering habitat as the watercourse is likely to freeze to the bed in winter.

4.7 Watercourse Crossing A3-96.6 (Unnamed Watercourse)

A site assessment was conducted at crossing location A3-96.6 on September 11, 2011. The watercourse at the crossing location had no defined channel with defined bed or banks. The site was located within open tundra with terrestrial vegetation consisting of dwarf shrubs, sedges, grasses, mosses and lichens.

4.8 Watercourse Crossing A3-96.4b (Unnamed Watercourse)

A site assessment was conducted at crossing location A6-96.4b on September 11, 2011. The crossing is in close proximity to A3-96.4a. The watercourse had intermittent flows and consisted of dry sections interspersed with isolated pockets of standing water with no defined bed and banks.

The site was located within open tundra with terrestrial vegetation consisting of dwarf shrubs, sedges, grasses, mosses and lichens. .

4.9 Watercourse Crossing A3-94.7 (Unnamed Watercourse)

A site assessment was conducted at crossing location A3-94.7 on September 11, 2011. The watercourse at the crossing location had no defined channel bed or banks. The site is located in open tundra with terrestrial vegetation consisting of dwarf shrubs, sedges, grasses, mosses and lichens.

The watercourse had an irregular meandering channel that was occasionally confined. The features consisted entirely of shallow run habitat. The mean water depth at the time of the survey was 0.14 m with a maximum water depth of 0.23 m. Discharge was not measured at the crossing location due to insufficient flow.

Bankfull width at the crossing location was 7.3 m, with a wetted width of 4.8 m. The substrate throughout the surveyed section was comprised of unconsolidated organic material. Both banks throughout the surveyed reach

were vegetated and comprised of unconsolidated organic material, with high stability. Approach slopes within the floodplain were flat and considered stable.

Overhanging grass, shrubs and undercut banks provided overhead cover. Instream cover was provided by instream vegetation.

The water temperature at the time of the crossing assessment was 7.8°C, the pH was 9.1, dissolved oxygen concentration was 10.3 mg/L and conductivity was 186 µS/cm.

The watercourse has the physical characteristics required to provide suitable rearing, feeding and spawning habitat for small bodied forage fish species and large bodied fish species including, Northern Pike, Arctic Grayling, Burbot or Coregonid species during the open water season. The overhanging vegetation and instream aquatic vegetation provided suitable cover for small bodied forage fish species as well as large bodied fish species and could be used as spawning and rearing habitat by Northern Pike. However the suitability of the habitat for use by Arctic Grayling and Coregonids for spawning and rearing was considered to be low due to the lack of coarse substrate material.

The shallow depths at the crossing location make that habitat unsuitable for overwintering by small bodied forage fish and large bodied fish species. The watercourse at the crossing location is likely be frozen to the bed in winter

4.10 Watercourse Crossing A3-92.8 (Unnamed Watercourse)

A site assessment was conducted at crossing location A3-92.8 on September 11, 2011. The watercourse at the crossing location was an intermittent channel with no defined bed and banks and isolated pockets of standing water. The site was located within open tundra with terrestrial vegetation consisting of dwarf shrubs mosses and lichens.

4.11 Watercourse Crossing A3-92.4 (Unnamed Watercourse)

A site assessment was conducted at crossing location A3-92.4 on September 12, 2011. The watercourse at the crossing location had no defined channel bed or banks. The site was located within open tundra with terrestrial vegetation consisting of dwarf shrubs, sedges, grasses, mosses and lichens.

4.12 Watercourse Crossing A3-91.9 (Unnamed Watercourse)

A site assessment was conducted at crossing location A3-91.9 on September 12, 2011. The site was located in open tundra with terrestrial vegetation consisting of dwarf shrubs, sedges, grasses, mosses and lichens.

The watercourse had an irregular meandering channel that was occasionally confined. The features consisted entirely of shallow run habitat. The mean water depth at the time of the survey was 0.19 m with a maximum water depth of 0.26 m. Discharge was not measured due to the high amount of instream vegetation. Point velocities collected at the crossing location was 0.01 m/s.

Bankfull width at the crossing location was 22.0 m, with a wetted width of 2.2 m. The substrate throughout the surveyed section was comprised of unconsolidated organic material. Both banks throughout the surveyed reach were vegetated and comprised of unconsolidated organic material, with high stability. Approach slopes within the floodplain were flat and considered stable.

Overhanging grass, shrubs and large organic debris provided overhead cover. Instream cover was provided by instream vegetation.

The water temperature at the time of the crossing assessment was 7.3°C, dissolved oxygen concentration was 8.1 mg/L and conductivity was 197 µS/cm.

The watercourse has the physical characteristics required to provide suitable rearing, feeding and spawning habitat for small bodied forage fish species. The overhanging vegetation and instream aquatic vegetation provided suitable cover for small bodied forage fish and large bodied fish species and could be used for spawning and rearing habitat by Northern Pike. However the suitability of the habitat for use by Arctic Grayling and Coregonid species as spawning and rearing was considered to be low due to the lack of coarse substrate. Small bodied forage fish were observed in the watercourse; however water depths were too shallow to support adult large bodied fish species. The shallow depths at the crossing location make that habitat unsuitable for overwintering by small bodied forage fish and large bodied fish species. The watercourse at the crossing location is likely to be frozen to the bed in winter.

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4.13 Watercourse Crossing A3-88.9 (Unnamed Watercourse)

A site assessment was conducted at crossing location A3-88.9 on September 12, 2011. The watercourse had intermittent flow with isolated pockets of standing water. The site was located within open tundra with terrestrial vegetation consisting of dwarf shrubs, sedges, grasses, mosses and lichens.

The watercourse was an irregular meandering pattern that was unconfined. The mean standing water depth was 0. 18 m with a maximum water depth of 0.23 m. No measureable flows were observed at the site.

Bankfull width at the survey location was 7.2 m, with a wetted width of 5.5 m. The substrate throughout the surveyed section was comprised of unconsolidated organic material. Both banks throughout the surveyed reach were comprised of organic material and were well vegetated. The banks had a high stability. Approach slopes within the floodplain were flat and stable.

The watercourse did not provide sufficient water depth and overhead cover, for use as rearing, feeding and spawning habitat for forage fish. The shallow water depth and lack of overhead cover make long term use of the habitat at the crossing location by adult large bodied fish (i.e., Northern Pike, Arctic Grayling, Burbot or Coregonid species) unlikely. Intermittent flow and presence of dewatered sections in the channel prevent year round upstream and downstream movement of fish. Use of the channel by fish is limited to periods in spring, early summer and fall when flowing water is present and therefore any crossing structure installed should allow for migratory fish movements. The shallow water depths at or near the crossing location made the watercourse unsuitable for use as overwintering habitat.

The suitability of the habitat to provide overwintering habitat was considered nil to low for small bodied forage fish for large bodied fish species due to the shallow water depth, which would likely cause the watercourse to freeze to the bed in winter. The intermittent flows and dry sections create a barrier to fish passage to all fish species.

4.14 Watercourse Crossing 1.3 (Unnamed Watercourse)

A site assessment was conducted at crossing location 1.3 on September 9, 2011. The watercourse at the crossing location had no defined channel bed or banks. The site was located within open tundra with terrestrial vegetation consisting of dwarf shrubs, sedges, grasses, mosses and lichens. This site was visited because it previously assessed from the air by Kiggiak EBA (2010a).

4.15 Watercourse Crossing 8.2 (Unnamed Watercourse)

This site was visited because it was previously assessed from the air by Kiggiak EBA (2010a). An aerial visual assessment was conducted from the helicopter at the crossing location 9 on September 20, 2011. The site could not be accessed by ground as there was not a safe location to land the helicopter near the crossing due to the thick and tall vegetation. Aerial observations for the watercourse showed no defined channel bed or banks. The site was covered with terrestrial vegetation consisting of dwarf shrubs, sedges, grasses, mosses and lichens. The watercourse was an irregularly meandering channel pattern and was not confined within the flood plain. Water was flowing through vegetation at the time of the survey.

4.16 Watercourse Crossing 25.8 (Unnamed Watercourse)

A site assessment was conducted at crossing location 25.8 on September 9, 2011. The watercourse at the crossing location had no defined channel bed or banks. The site was located within open tundra with terrestrial vegetation consisting of dwarf shrubs, sedges, grasses, mosses and lichens.

4.17 Watercourse Crossing 26.5 (Unnamed Tributary to Jimmy Lake)

A site assessment was conducted at crossing location 26.5 on September 9, 2011. The watercourse at the crossing location is an intermittent channel with isolated pockets of standing water. The site was located within open tundra with terrestrial vegetation consisting of dwarf shrubs, sedges, grasses, mosses and lichens.

The watercourse had an irregular meandering channel that was occasionally confined. The channel features consisted entirely of isolated pockets of water. The mean water depth at the time of the survey was 0.04 m with a maximum water depth of 0.15 m. Discharge was not measured at the crossing location due to insufficient flow.

Bankfull width at the crossing location was 2.5 m, with a wetted width of 1.8 m. The substrate throughout the surveyed section was comprised of unconsolidated organic material and fines. Both banks throughout the surveyed reach were vegetated and comprised of unconsolidated organic material and fines, with high stability. Approach slopes within the floodplain were flat and considered stable.

The watercourse lacks the physical characteristics required to provide suitable rearing, feeding, spawning and overwintering habitat for small bodied forage fish species or large bodied fish species such as Northern Pike, Arctic Grayling, Burbot and Coregonid species. The shallow water depth makes long term use of the habitat at the crossing location by adult large bodied fish unlikely. Intermittent flow and presence of dewatered sections in the channel prevent year round upstream and downstream movement of fish. Use of the channel by fish is limited to periods in spring, early summer and fall when flowing water is present and therefore any crossing structure installed should allow for migratory fish movements. The shallow water depths at or near the crossing location made the watercourse unsuitable for use as overwintering habitat as the watercourse is likely to freeze to the bed in winter.

4.18 Watercourse Crossing 28.9 (Unnamed Watercourse)

A site assessment was conducted at crossing location 28.9 on September 10, 2011. The watercourse at the crossing location had no defined channel bed or banks.

The site was located within open tundra with terrestrial vegetation consisting of dwarf shrubs, sedges, grasses, mosses and lichens.

4.19 Watercourse Crossing 31.1 (Unnamed Watercourse)

A site assessment was conducted at crossing location 31.1 on September 10, 2011. The site was located in open tundra with terrestrial vegetation consisting of dwarf shrubs, sedges, grasses, mosses and lichens.

The watercourse had an irregular meandering channel that was occasionally confined. The channel features consisted entirely of shallow flat habitat. The mean water depth at the time of the survey was 0.21 m with a maximum water depth of 0.35 m. Discharge was not measured at the crossing location due to insufficient flow.

Bankfull width at the crossing location was 15.4 m, with a wetted width of 10.5 m. The substrate throughout the surveyed section was comprised of unconsolidated organic material. Both banks throughout the surveyed reach were comprised of organic material and were well vegetated. The banks were stable with flat and stable floodplain approach slopes.

Overhanging grass, shrubs and large organic debris provided overhead cover. Instream cover was provided by instream vegetation, large organic debris and surface turbulence.

The water temperature at the time of the crossing assessment was 4.5°C, the pH was neutral (7.0), dissolved oxygen concentration was 6.3 mg/L and conductivity was 122 µS/cm.

The watercourse has the physical characteristics required to provide suitable rearing, feeding and spawning habitat for small bodied forage fish species. The shallow water depth and lack of instream cover make long term use of the habitat at the crossing location by adult large bodied fish such as Arctic Grayling, Northern Pike, Burbot and Coregonid species unlikely. The suitability of the habitat for use by Arctic Grayling and Coregonid species for spawning was considered to be low due to the high amount of organic substrate and the lack of coarse substrate material.

The shallow water depths at or near the crossing location made the watercourse unsuitable for use as overwintering habitat as the watercourse is likely to freeze to the bed in winter.

4.20 Watercourse Crossing 39.4 (Trail Valley Creek)

A site assessment was conducted at crossing location 39.4 on September 10, 2011. The site was located in open tundra with terrestrial vegetation consisting of dwarf shrubs, sedges, grasses, mosses and lichens.

The watercourse had a winding channel pattern and was confined. The channel features consisted entirely of shallow run habitat. The mean water depth at the time of the survey was 0.57 m with a maximum water depth of 0.97 m. Discharge was not measured. Point velocities collected at the site ranged from 0.04 to 0.87 m/s, the average velocity measured at the crossing location was 0.42 m/s.

Bankfull width at the crossing location was 2.4 m, with a wetted width of 2.0 m. The substrate throughout the surveyed section was comprised of unconsolidated organic material. Both banks throughout the surveyed reach were comprised of organic material and were well vegetated. The banks were stable with flat and stable floodplain approach slopes.

Overhanging grass, shrubs and undercut banks provided overhead cover. Instream cover was provided by instream vegetation and turbidity.

The water temperature at the time of the crossing assessment was 5.0°C, the pH was 6.5, dissolved oxygen concentration was 11.7 mg/L and conductivity was 70 µS/cm.

The watercourse has the physical characteristics required to provide suitable rearing, feeding and spawning habitat for small bodied forage fish species and Northern Pike. Sufficient water depth and instream vegetation provide suitable cover for adult small bodied forage fish and Northern Pike. However, due to the lack of instream woody debris, overhead cover suitably sized substrate the suitability of the habitat for use by Arctic Grayling was considered to be low.

The shallow water depths at or near the crossing location made the watercourse unsuitable for use as overwintering habitat as the watercourse is likely to freeze to the bed in winter.

4.21 Watercourse Crossing 41.4 (Unnamed Watercourse)

A site assessment was conducted at crossing location 41.4 on September 10, 2011. The site was located in open tundra with terrestrial vegetation consisting of dwarf shrubs, sedges, grasses, mosses and lichens.

The watercourse had an irregular meandering channel that was unconfined. The channel features consisted entirely of shallow flat habitat. The mean water depth at the time of the survey was 0.14 m with a maximum water depth of 0.22 m. Discharge was not measured at the crossing location due to insufficient flow.

Bankfull width at the crossing location was 17.9 m, with a wetted width of 15.0 m.

The substrate throughout the surveyed section was comprised of unconsolidated organic material. Both banks throughout the surveyed reach were comprised of organic material and were well vegetated. The banks were stable with flat approach slopes

Overhanging grass, shrubs and large organic debris provided overhead cover. Instream cover was provided by instream vegetation and large organic debris.

The water temperature at the time of the crossing assessment was 4.7°C, the pH was 6.6, dissolved oxygen concentration was 8.7 mg/L and conductivity was 60 µS/cm.

The water depth and abundant instream vegetation at the watercourse has provided the physical characteristics required for suitable rearing, feeding and spawning habitat for small bodied forage fish species and Northern Pike. However the suitability of the habitat for use by Arctic Grayling and Coregonid species for spawning and rearing was considered to be low due to the lack of coarse substrate material

The shallow water depths at or near the crossing location made the watercourse unsuitable for use as overwintering habitat as the watercourse is likely to freeze to the bed in winter.

4.22 Watercourse Crossing 42.5 (Unnamed Watercourse)

A site assessment was conducted at crossing location 42.5 on September 10, 2011. The site was located in open tundra with terrestrial vegetation consisting of dwarf shrubs, sedges, grasses, mosses and lichens.

The watercourse had an irregular meandering channel that was unconfined. The channel features consisted entirely of shallow run habitat. The mean water depth at the time of the survey was 0.09 m with a maximum water depth of 0.14 m. Discharge was not measured at the crossing location due to insufficient flow.

Bankfull width at the crossing location was 4.2 m, with a wetted width of 2.3 m. The substrate throughout the surveyed section was comprised of unconsolidated organic material. Both banks throughout the surveyed reach were comprised of organic material and were well vegetated. The banks were stable with flat and stable floodplain approach slopes. Overhanging grass and shrubs provided overhead cover. Instream cover was provided by instream vegetation.

The water temperature at the time of the crossing assessment was 5.0°C, the pH was 6.5, dissolved oxygen concentration was 11.7 mg/L and conductivity was 70 µS/cm.

The watercourse does not have the physical characteristics required to provide suitable rearing, feeding and spawning for small bodied forage fish and large bodied fish species. The shallow water depth and lack of instream and overhead cover create low habitat suitability for all fish species. The shallow water depths at or

near the crossing location made the watercourse unsuitable for use as overwintering habitat as the watercourse is likely to freeze to the bed in winter.

4.23 Watercourse Crossing 43.9 (Unnamed Watercourse)

A site assessment was conducted at crossing location 43.9 on September 11, 2011. The watercourse at the crossing location had no defined channel bed or banks. The site was located within open tundra with terrestrial vegetation consisting of dwarf shrubs, sedges, grasses, mosses and lichens.

4.24 Watercourse Crossing 45.5 (Unnamed Watercourse)

A site assessment was conducted at crossing location 45.5 on September 11, 2011. The watercourse had intermittent flows and consisted of dry sections interspersed with isolated pockets of standing water. The site was located within open tundra inundated with terrestrial vegetation.

The watercourse had an irregular meandering channel that was occasionally confined. The mean water depth of the standing water at the time of the survey was 0.07 m with a maximum water depth of 0.11 m. Discharge was not measured at the crossing location due to insufficient flow.

Bankfull width at the crossing location was 2.3 m, with a wetted width of 2.0 m. The substrate throughout the surveyed section was comprised of unconsolidated organic material. Both banks throughout the surveyed reach were comprised of organic material and were well vegetated. The banks were stable with flat and stable floodplain approach slopes. Overhanging grass, shrubs and large organic debris provided overhead cover. Instream cover was provided by instream vegetation and large organic debris.

The water temperature at the time of the crossing assessment was 3.4°C, the pH was 7.8, dissolved oxygen concentration was 3.9 mg/L and conductivity was 72 µS/cm.

The watercourse at the crossing location did not have the physical characteristics required to provide suitable rearing, feeding and spawning habitat for small bodied forage fish species and large bodied fish species. The shallow water depth and lack of overhead cover make long term use of the habitat at the crossing location by adult large bodied fish unlikely. Intermittent flow and presence of dewatered sections in the channel prevent year round upstream and downstream movement of fish. Use of the channel by all fish species is limited to periods in spring, early summer and fall when flowing water is present and therefore any crossing structure installed should allow for migratory fish movements. The shallow water depths at or near the crossing location made the watercourse unsuitable for use as overwintering habitat as the watercourse is likely to freeze to the bed in winter.

4.25 Watercourse Crossing 46.8 (Unnamed Watercourse)

A site assessment was conducted at crossing location 46.8 on September 19, 2011. The watercourse at the crossing location had no defined channel bed or banks. The site was located within open tundra.

4.26 Watercourse Crossing 52.4 (Unnamed Watercourse)

A site assessment was conducted at crossing location 52.4 on September 18, 2011. The site was located in open tundra with terrestrial vegetation consisting of dwarf shrubs, sedges, grasses, mosses and lichens.

The watercourse had a meandering channel that was occasionally confined. The channel features consisted entirely of shallow run habitat. The mean water depth at the time of the survey was 0.23 m with a maximum water depth of 0.50 m. Discharge was not measured due to the shallow depths and instream vegetation. Point velocities collected at the site ranged from 0.00 to 0.01 m/s.

Bankfull width at the crossing location was 13.0 m, with a wetted width of 9.8 m. The substrate throughout the surveyed section was comprised of unconsolidated organic material. Both banks throughout the surveyed reach were comprised of organic material and were well vegetated. The banks were stable with flat and stable floodplain approach slopes. Overhanging grass, shrubs and undercut banks provided overhead cover. Instream cover was provided by large organic debris.

The water temperature at the time of the crossing assessment was 6.8°C, the pH was 7.3, dissolved oxygen concentration was 8.1 mg/L and conductivity was 70 µS/cm.

The watercourse at the crossing location has the physical characteristics required to provide suitable rearing, feeding and spawning habitat for small bodied forage fish species and large bodied fish species that spawn on vegetation such as Northern Pike. The high amount of unconsolidated organic material and the lack of gravel make the habitat unsuitable for Arctic Grayling and Coregonid spawning and use by other life stages. The shallow water depth, intermittent flow and presence of dewatered sections prevent year round upstream and downstream movement of fish. Use of the channel by fish is limited to periods in spring, early summer and fall when flowing water is present and therefore any crossing structure installed should allow for migratory fish movements. The shallow water depths at or near the crossing location made the watercourse unsuitable for use as overwintering habitat as the watercourse is likely to freeze to the bed in winter.

4.27 Watercourse Crossing 52.8 (Unnamed Watercourse)

A site assessment was conducted at crossing location 52.8 on September 18, 2011. The watercourse at the crossing location had no defined channel bed or banks. The site was located within open tundra.

4.28 Watercourse Crossing 54.1 (Unnamed Watercourse)

A site assessment was conducted at crossing location 54.1 on September 18, 2011. The site was located in open tundra with terrestrial vegetation consisting of dwarf shrubs, sedges, grasses, mosses and lichens.

The watercourse had an irregular meandering channel that was occasionally confined. The channel features consisted entirely of shallow flat habitat. The mean water depth at the time of the survey was 0.13 m with a maximum water depth of 0.40 m. Discharge was not measured due to the shallow water depths. Point velocities collected at the site ranged from 0.00 to 0.08 m/s, the average velocity measured at the crossing location was 0.02 m/s.

Bankfull width at the crossing location was 21.0 m, with a wetted width of 17.0 m. The substrate throughout the surveyed section was comprised of unconsolidated organic material. Both banks throughout the surveyed reach were comprised of organic material and were well vegetated. The banks were stable with flat and stable floodplain approach slopes.

Overhanging grass, shrubs and undercut banks provided overhead cover. Instream cover was provided by limited amounts of instream vegetation and large organic debris.

The watercourse at the crossing location did not have the physical characteristics required to provide suitable rearing, feeding and spawning habitat for small bodied forage fish or large bodied fish species. The lack of instream vegetation and course substrate limits the habitat suitability for small bodied forage fish and large bodied fish species. The shallow water depths at or near the crossing location made the watercourse unsuitable for use as overwintering habitat as the watercourse is likely to freeze to the bed in winter.

4.29 Watercourse Crossing 54.9 (Hans Creek)

A site assessment was conducted at crossing location 54.9 on September 19, 2011. The site was located in open tundra with terrestrial vegetation consisting of dwarf shrubs, sedges, grasses, mosses and lichens.

The watercourse had an irregular meandering channel that was occasionally confined. The channel features consisted of run and riffle habitat. The mean water depth at the time of the survey was 0.75 m with a maximum water depth of 1.10 m for the run habitat. Discharge measured at the crossing location was 0.09 m^3/s.

Bankfull width at the crossing location was 13.7 m, with a wetted width of 7.2 m. The substrate throughout the surveyed section was comprised of approximately 60% cobble, 20% gravels and 20% fines. Both banks throughout the surveyed reach were vegetated and comprised of unconsolidated organic material, with moderate stability. Approach slopes within the floodplain were flat and considered stable.

Overhanging grass, shrubs, undercut banks and large organic debris provided overhead cover. Instream cover was provided by large organic debris.

The water temperature at the time of the crossing assessment was 5.7°C, the pH was 8.5, dissolved oxygen concentration was 9.1 mg/L and conductivity was 162 µS/cm.

Field crew observed one juvenile Arctic Grayling during the site assessment.

The watercourse at the crossing location had the physical characteristics required to provide suitable rearing, feeding and spawning habitat for small bodied forage fish species, Northern Pike, Arctic Grayling and other large bodied fish species including Coregonid species and Burbot. Although, instream and overhead cover was limited, the coarse substrate and deep run habitat provide moderate to high habitat suitability for both small bodied forage fish species and large bodied fish species. The presence of juvenile Arctic Grayling suggests that this watercourse provides potential spawning and rearing habitat for Arctic Grayling.

The shallow water depths at or near the crossing location made the watercourse unsuitable for use as overwintering habitat as it is likely to freeze to the bed in winter.

4.30 Watercourse Crossing 66.1 (Zed Creek)

A site assessment was conducted at crossing location 66.1 on September 19, 2011. The site is located in open tundra with terrestrial vegetation consisting of dwarf shrubs, sedges, grasses, mosses and lichens.

The watercourse had an irregular meandering channel that was occasionally confined. The channel features consisted entirely of shallow run habitat. The mean water depth at the time of the survey was 0.23 m with a maximum water depth of 0.52 m. Discharge measured at the crossing location was 1.89 m^3/s.

Bankfull width at the crossing location was 11.7 m, with a wetted width of 6.7 m. The substrate throughout the surveyed section was comprised of approximately 60% gravel, 30% cobble and 10% fines. Both banks throughout the surveyed reach were comprised of organic material and were well vegetated. The banks were stable with flat and stable floodplain approach slopes. Overhanging grass, shrubs and undercut banks provided overhead cover. Instream cover was provided by depth/turbulence and instream vegetation.

The water temperature at the time of the crossing assessment was 7.4°C, dissolved oxygen concentration was 12.3 mg/L and conductivity was 72 µS/cm.

The watercourse at the crossing location has the physical characteristics required to provide suitable rearing, feeding and spawning habitat for small bodied forage fish species, Northern Pike, Arctic Grayling or other large bodied fish species, including Coregonid species and Burbot. The watercourse had suitable water depth and coarse substrate required for Arctic Grayling spawning.

The shallow water depths at or near the crossing location made the watercourse unsuitable for use as overwintering habitat as it is likely to freeze to the bed during winter.

4.31 Watercourse Crossing 76.0 (Unnamed Watercourse)

A site assessment was conducted at crossing location 76.0 on September 20, 2011. The watercourse at the crossing location had intermittent flow and consisted of dry sections interspersed with isolated pockets of standing water. The site was located within open tundra with terrestrial vegetation consisting of dwarf shrubs, sedges, grasses, mosses and lichens.

The channel at the crossing location was straight and unconfined. The mean water depth of the standing water was 0. 06 m with a maximum water depth of 0.12 m. No measureable flows were observed at the site.

Bankfull width at the crossing location was 18.0 m, with a wetted width of 15.0 m. The substrate throughout the surveyed section was comprised of unconsolidated organic material. Both banks throughout the surveyed reach were comprised of organic material and were well vegetated. The banks were stable with flat and stable floodplain approach slopes.

The watercourse at the crossing location does not have the physical characteristics required to provide suitable rearing, feeding and spawning habitat for small bodied forage fish species or large bodied fish species. Intermittent flow and presence of dewatered sections in the channel prevent year round upstream and downstream movement of fish. Use of the channel by fish is limited to periods in spring, early summer and fall when flowing water is present and therefore any crossing structure installed should allow for migratory fish movements. The shallow water depths at or near the crossing location made the watercourse unsuitable for use as overwintering habitat as it is likely to freeze to the bed during winter.

4.32 Watercourse Crossing 76.3 (Unnamed Watercourse)

A site assessment was conducted at crossing location 76.3 on September 20, 2011. The watercourse at the crossing location had intermittent flow and consisted of dry sections interspersed with isolated pockets of standing water. The crossing is located between two unnamed waterbodies. The downstream waterbody is connected to Husky Lakes. The site was located within open tundra inundated with vegetation consisting of dwarf shrubs, sedges, grasses, mosses and lichens.

The channel at the crossing location was straight and unconfined. The mean water depth of the standing water was 0.09 m with a maximum water depth of 0.20 m. No measureable flows were observed at the site.

Bankfull width at the crossing location was 10.0 m, with a wetted width of 5.4 m. The substrate throughout the surveyed section was comprised of unconsolidated organic material. Both banks throughout the surveyed reach were comprised of organic material and were well vegetated. The banks had a high stability. Approach slopes within the floodplain were flat and stable.

The watercourse at the crossing location does not have the physical characteristics required to provide suitable rearing, feeding and spawning habitat for small bodied forage fish species or large bodied fish species. Intermittent flow and presence of dewatered sections in the channel prevent year round upstream and downstream movement of fish. Use of the channel by fish is limited to periods in spring, early summer and fall when flowing water is present and therefore any crossing structure installed should allow for migratory fish movements. The shallow water depths at or near the crossing location made the watercourse unsuitable for use as overwintering habitat as it is likely to freeze to the bed during winter.

4.33 Watercourse Crossing 78.7 (Unnamed Watercourse)

A site assessment was conducted at crossing location 78.7 on September 20, 2011. The watercourse had intermittent flows and consisted of dry sections interspersed with isolated pockets of standing water, with no

defined bed and banks. The site was located within open tundra with terrestrial vegetation consisting of dwarf shrubs, sedges, grasses, mosses and lichens.

4.34 Watercourse Crossing 82.7 (Unnamed Watercourse)

A site assessment was conducted at crossing location 82.7 on September 12, 2011. The watercourse at the crossing location had intermittent flow and had no defined bed or banks. The watercourse consisted of dry sections interspersed with isolated pockets of standing water. The site was located within open tundra with terrestrial vegetation consisting of dwarf shrubs, sedges, grasses, mosses and lichens.

The watercourse had an irregular meandering channel that was unconfined. The mean water depth of the standing water was 0.05 m with a maximum water depth of 0.1 m. No measureable flows were observed at the site.

Bankfull width at the crossing location was 4.5 m, with a wetted width of 1.4 m. The substrate throughout the surveyed section was comprised of unconsolidated organic material. Both banks throughout the surveyed reach were comprised of organic material and were well vegetated. The banks had a high stability. Approach slopes within the floodplain were flat and stable.

The watercourse at the crossing location does not have the physical characteristics required to provide suitable rearing, feeding and spawning habitat for small bodied forage fish species or large bodied fish species. Intermittent flow and presence of dewatered sections in the channel prevent year round upstream and downstream movement of fish. Use of the channel by fish is limited to periods in spring, early summer and fall when flowing water is present and therefore any crossing structure installed should allow for migratory fish movements. The shallow water depths at or near the crossing location made the watercourse unsuitable for use as overwintering habitat as it is likely to freeze to the bed during winter.

4.35 Watercourse Crossing 85.6 (Unnamed Watercourse)

A site assessment was conducted at crossing location 85.6 on September 12, 2011. The watercourse at the crossing location had intermittent flow. The watercourse consisted of dry sections interspersed with isolated pockets of standing water. The site was located within open tundra with terrestrial vegetation consisting of dwarf shrubs, sedges, grasses, mosses and lichens.

The channel at the crossing location was straight and unconfined. The mean water depth of the standing water was 0.12 m with a maximum water depth of 0.16 m. No measureable flows were observed at the site.

Bankfull width at the crossing location was 1.6 m, with a wetted width of 1.6 m. The substrate throughout the surveyed section was comprised of unconsolidated organic material. Both banks throughout the surveyed reach were comprised of organic material and were well vegetated. The banks had a high stability. Approach slopes within the floodplain were flat and stable.

The watercourse at the crossing location does not have the physical characteristics required to provide suitable rearing, feeding and spawning habitat for small bodied forage fish species or large bodied fish species. Intermittent flow and presence of dewatered sections in the channel prevent year round upstream and downstream movement of fish. Use of the channel by fish is limited to periods in spring, early summer and fall when flowing water is present and therefore any crossing structure installed should allow for migratory fish movements. The shallow water depths at or near the crossing location made the watercourse unsuitable for use as overwintering habitat as it is likely to freeze to the bed during winter.

4.36 Watercourse Crossing 88.2 (Unnamed Watercourse)

A site assessment was conducted at crossing location 88.2 on September 13, 2011. The site is located in open tundra with terrestrial vegetation consisting of dwarf shrubs, sedges, grasses, mosses and lichens.

The watercourse had an irregular meandering channel that was occasionally confined. The channel features consisted entirely of shallow run habitat. The mean water depth at the time of the survey was 0.61 m with a maximum water depth of 0.96 m. Discharge measured at the crossing location was 0.35 m^3/s.

Bankfull width at the crossing location was 8.5 m, with a wetted width of 7.3 m. The substrate at the surveyed section was comprised of 78% fines, 20% gravels and 2 % cobble. Both banks throughout the surveyed reach were comprised of organic material and were well vegetated. The banks were stable with flat and stable floodplain approach slopes. Overhanging grass, shrubs and undercut banks provided overhead cover. Instream cover was provided by instream vegetation and large organic debris.

The water temperature at the time of the crossing assessment was 8.4°C, dissolved oxygen concentration was 11.3 mg/L and conductivity was 117 µS/cm.

The watercourse at the crossing location had the physical characteristics required to provide suitable rearing, feeding and spawning habitat for small bodied forage fish species, Northern Pike, and other large bodied fish species, including Coregonid species and Burbot. The large amount of fines reduces spawning habitat potential for Arctic grayling. Instream vegetation will provide spawning and rearing for Northern Pike.

The shallow water depths at or near the crossing location made the watercourse unsuitable for use as overwintering habitat as the watercourse is likely to freeze to the bed in winter.

Table 6. Perennial and Intermittent Stream characteristics

Crossing ID	Temperature (°C)	Dissolved Oxygen (mg/l)	pH	Conductivity (µS/cm)	Bankfull width (m)	Wetted width (m)	Average depth (m)	Maximum depth (m)	Velocity range (m/s)	Average velocity (m/s)	Discharge (m^3/s)
A1-112.3/A3-106.2	7.7	9.8	-	139	6.8	4.4	0.31	0.5	0.00-0.07	0.03	-
A1-108/A3-101.9	-	-	-	-	2.1	0.9	0.29	0.5	-	-	-
A1-105.5 /A3-99.4	9.4	10.6	7.7	121	13.5	4.3	0.17	0.45	0.00-0.14	0.04	-
A1-101.9	7.6	10.7		140	8.5	5.2	0.21	0.45	0.00-0.18	0.05	-
A1-100	9.3	12.4	8.2	145	6.8	1.1	0.26	0.39	0.05-0.15	0.09	-
A3-96.4a	-	-	-	-	6.4	2.3	0.1	-	-	-	-
A3-94.7	7.8	10.3	9.1	186	7.3	4.8	0.14	0.23	-	-	-
A3-91.9	7.3	-	8.1	197	22	2.2	0.19	0.26	-	0.01	-
A3-88.9	-	-	-	-	7.2	5.5	0.18	0.23	-	-	-
26.5	-	-	-	-	2.5	1.8	0.04	0.15	-	-	-
31.1	4.5	6.3	7	122	15.4	10.5	0.21	0.35	-	-	-
39.4	5	11.7	6.5	70	2.4	2	0.57	0.97	0.04-0.87	0.42	-
41.4	4.7	8.7	6.6	60	17.9	15	0.14	0.22	-	-	-
42.5	5	11.7	6.5	70	4.2	2.3	0.09	0.14	-	-	-
45.5	3.4	3.9	7.8	72	2.3	2	0.07	0.11	-	-	-
52.4	6.8	8.1	7.3	70	13	9.8	0.23	0.5	0.00-0.01		-
54.1	-	-	-	-	21	17	0.13	0.4	0.00-0.08	0.02	-
54.9	5.7	9.1	8.5	162	13.7	7.2	0.75	1.1	-	-	0.09
66.1	7.4	12.3	-	72	11.7	6.7	0.23	0.52	-	-	1.89
76	-	-	-	-	18	15	0.06	0.12	-	-	-
76.3	-	-	-	-	10	5.4	0.09	0.2	-	-	-
82.7	-	-	-	-	4.5	1.4	0.05	0.1	-	-	-

Crossing ID	Temperature (^{o}C)	Dissolved Oxygen (mg/l)	pH	Conductivity (µS/cm)	Bankfull width (m)	Wetted width (m)	Average depth (m)	Maximum depth (m)	Velocity range (m/s)	Average velocity (m/s)	Discharge (m^3/s)
85.6	-	-	-	-	1.6	1.6	0.12	0.16	-	-	-
88.2	8.4	11.3	-	117	8.5	7.3	0.61	0.96	-	-	0.35

Note: - = not sampled.

Table 7: Fish Habitat Summary of Watercourse Crossings

Crossing ID	Watercourse Name (Tributary of)	Crossing Type	Bankfull Width (m)	Habitat Conditions	Suitability of Habitat Use for Fish in Surveyed Section
Perennial Streams					
A1-112.3 / A3-106.2	Unnamed	Culvert	6.8	-Straight channel moderate confinement, shallow run habitat. Banks comprised of fines. Bed comprised of unconsolidated organic material. Grass, forbs, and shrubs along both banks bordered by open tundra. Banks moderately stable. Flat approach slope, low to moderately stable.	-High for small bodied forage fish species -spawning, rearing and feeding and nil to low for overwintering -Limited suitability for rearing, feeding and spawning for large bodied fish species such as Norther Pike and Burbot. low habitat suitability for Arctic Grayling and Coregonid spawning and rearing. nil for overwintering.
A1-105.5 / A3-99.4	Unnamed (Unnamed waterbody)	Culvert	13.5	-Meandering channel with low confinement, shallow flat habitat. Banks comprised of fines. Bed comprised of unconsolidated organic material. Grass, forbs, and shrubs along both banks bordered by open tundra. Banks moderately stable. Flat approach slope, low to moderately stable.	-Moderate for small bodied forage fish species -spawning, rearing and feeding and low for overwintering - Moderate for large bodied fish species (Northern Pike and Burbot) - spawning, rearing, feeding, low spawning, rearing and feeding for Arctic Grayling and Coregonids and nil to low for overwintering (Northern Pike, Burbot, Arctic Grayling and Corgonids)
A1-101.9	Unnamed (Unnamed waterbody)	Culvert	8.5	-Straight channel unconfined, shallow run habitat. Banks comprised of fines. Bed comprised of unconsolidated organic material. Grass, forbs, and shrubs along both banks bordered by open tundra. Banks moderately stable. Flat approach slope, low to moderately stable.	-High for forage fish species -spawning, rearing and feeding and nil to low for overwintering - High for large bodied fish species (northern pike) -spawning, rearing, feeding and nil to low spawning, rearing and feeding for Arctic grayling and nil to low for overwintering (Northern Pike, Arctic Grayling)
A1-100	Unnamed (Unnamed waterbody)	Culvert	6.8	-Irregular meandering channel moderate confinement, shallow run habitat. Banks comprised of fines. Bed comprised of unconsolidated organic material. Grass, forbs, and shrubs along both banks bordered by open tundra. Banks moderately stable. Flat approach slope, low to moderately stable.	-Moderate for small bodied forage fish species -spawning, rearing and feeding and low for overwintering - Moderate for large bodied fish species (Northern Pike, Burbot) - spawning, rearing, feeding. low for Arctic Grayling and Coregonids spawning and nil to low for overwintering (large bodied fish species)
A3-94.7	Unnamed (Unnamed waterbody)	Culvert	7.3	-Irregular meandering channel moderate confinement, shallow run habitat. Banks comprised of fines. Bed comprised of	-Moderate for small bodied forage fish species -spawning, rearing and feeding and nil to low for overwintering

Crossing ID	Watercourse Name (Tributary of)	Crossing Type	Bankfull Width (m)	Habitat Conditions	Suitability of Habitat Use for Fish in Surveyed Section
				unconsolidated organic material. Grass, forbs, and shrubs along both banks bordered by open tundra. Banks moderately stable. Flat approach slope, low to moderately stable.	-Low to moderate for large bodied fish species (Northern Pike and Burbot), feeding, rearing and spawning. Nil for Arctic Grayling and Coregonid spawning. Nil for overwintering (large bodied fish species)
A3-91.9	Unnamed (Unnamed waterbody)	Culvert	22	-Irregular meandering channel moderate confinement, shallow run habitat. Banks comprised of fines. Bed comprised of unconsolidated organic material. Grass, forbs, and shrubs along both banks bordered by open tundra. Banks moderately stable. Flat approach slope, low to moderately stable.	-High for small bodied forage fish species -spawning, rearing and feeding and nil to low for overwintering -Low to moderate for large bodied fish speices for rearing, feeding and spawning (Northern Pike, Burbot). Nil to low for Arctic Grayling and Coregonid spawning and rearing. Nil to low for overwintering (large bodied fish species)
31.1	Unnamed (Unnamed waterbody)	Culvert	15.4	-Irregular meandering channel moderate confinement, shallow flat habitat. Banks comprised of fines. Bed comprised of unconsolidated organic material. Grass, forbs, and shrubs along both banks bordered by open tundra. Banks moderately stable. Flat approach slope, low to moderately stable.	-Nil to low for small bodied forage fish species -spawning, rearing and feeding and low for overwintering -Nil to low for large bodied fish species -spawning, rearing, feeding and nil to low for overwintering (Northern Pike, Burbot, Arctic Grayling and Coregonids)
39.4	Trail Valley Creek (Unnamed waterbody)	Bridge	2.4	-Winding channel moderate confinement, shallow run habitat. Banks comprised of fines. Bed comprised of unconsolidated organic material. Grass, forbs, and shrubs along both banks bordered by open tundra. Banks moderately stable. Flat approach slope, low to moderately stable.	-Moderate for small bodied forage fish species -spawning, rearing and feeding and low for overwintering -Moderate for large bodied fish species (northern pike) -spawning, rearing, feeding and low spawning, rearing and feeding for Arctic Grayling and nil to low for overwintering (northern pike, Arctic Grayling)
41.4	Unnamed (Unnamed waterbody)	Culvert	17.9	-Irregular meandering channel moderate confinement, shallow run habitat. Banks comprised of fines. Bed comprised of	-Low for small bodied forage fish species -spawning, rearing and feeding and nil to low for overwintering

Crossing ID	Watercourse Name (Tributary of)	Crossing Type	Bankfull Width (m)	Habitat Conditions	Suitability of Habitat Use for Fish in Surveyed Section
				unconsolidated organic material. Grass, forbs, and shrubs along both banks bordered by open tundra. Banks moderately stable. Flat approach slope, low to moderately stable.	-Low for large bodied fish species (Northern Pike) rearing, feeding and spawning. Nil to low suitability for Arctic Grayling and Coregonid species spawning and rearing. Nil to low for overwintering.
42.5	Unnamed (Unnamed waterbody)	Culvert	4.2	-Irregular meandering channel moderate confinement, shallow run habitat. Banks comprised of fines. Bed comprised of unconsolidated organic material. Grass, forbs, and shrubs along both banks bordered by open tundra. Banks moderately stable. Flat approach slope, low to moderately stable.	-nil to low for small bodied forage fish species -spawning, rearing and feeding and low for overwintering -Nil to low for large bodied fish species. Nil for overwintering.
52.4	Unnamed (Unnamed waterbody)	Culver	13	-Winding channel moderate confinement, shallow run habitat. Banks comprised of fines. Bed comprised of unconsolidated organic material. Grass, forbs, and shrubs along both banks bordered by open tundra. Banks moderately stable. Flat approach slope, low to moderately stable.	-Low to moderate for small bodied forage fish species -spawning, rearing and feeding and nil to low for overwintering - Nil to low for large bodied fish species (Northern Pike, Arctic Grayling) -spawning, rearing, feeding and nil to low overwintering
54.1	Unnamed (Unnamed waterbody)	Bridge	21	-Irregular meandering channel moderate confinement, shallow flat habitat. Banks comprised of fines. Bed comprised of unconsolidated organic material. Grass, forbs, and shrubs along both banks bordered by open tundra. Banks moderately stable. Flat approach slope, low to moderately stable.	-Nil to low for small bodied forage fish species -spawning, rearing and feeding and nil to low for overwintering - Nil for large bodied fish species
54.9	Hans Creek (Unnamed waterbody)	Bridge	13.7	-Irregular meandering channel moderate confinement, shallow run habitat. Banks comprised of fines. Bed comprised of cobble, gravels and fines. Grass, forbs, and shrubs along both banks bordered by open tundra. Banks moderately stable. Flat approach slope, low to moderately stable.	-High for small bodied forage fish species -spawning, rearing and feeding and nil to low for overwintering

Crossing ID	Watercourse Name (Tributary of)	Crossing Type	Bankfull Width (m)	Habitat Conditions	Suitability of Habitat Use for Fish in Surveyed Section
					- Moderate to high for large bodied fish species (Northern Pike, Arctic Grayling) -spawning, rearing, feeding and nil to low for overwintering
66.1	Zed Creek (Zed Lake)	Bridge	11.7	-Irregular meandering channel moderate confinement, shallow run habitat. Banks comprised of fines. Bed comprised of cobble, gravels and fines. Grass, forbs, and shrubs along both banks bordered by open tundra. Banks moderately stable. Flat approach slope, low to moderately stable.	-High for small bodied forage fish species -spawning, rearing and feeding and nil to low for overwintering -Moderate to High for large bodied fish species (Northern Pike, Arctic Grayling) -spawning, rearing, feeding and nil to low overwintering
88.2	Unnamed (Unnamed waterbody)	Bridge	8.5	-Irregular meandering channel moderate confinement, shallow run habitat. Banks comprised of fines. Bed comprised of gravel and unconsolidated organic material. Grass, forbs, and shrubs along both banks bordered by open tundra. Banks moderately stable. Flat approach slope, low to moderately stable.	-High for small bodied forage fish species -spawning, rearing and feeding and nil to low for overwintering -High for large bodied fish species (Northern Pike, Arctic Grayling and Coregonids) -spawning, rearing, feeding and rearing and feeding for Burbot. nil to low for overwintering
Ephemeral Streams					
A3-96.6	Unnamed (Unnamed waterbody)	Culvert	Undefined	Ephemeral, no defined channel exists at this location	-Nil for small bodied forage fish species -Nil for large bodied fish species
A3-96.4b	Unnamed (Unnamed waterbody)	Culvert	Undefined	Ephemeral, no defined channel exists at this location	-Nil for small bodied forage fish species -Nil for large bodied fish species
A3-92.4	Unnamed (Unnamed waterbody)	Culvert	Undefined	Ephemeral, no defined channel exists at this location	-Nil for small bodied forage fish species -Nil for large bodied fish species
1.3	Unnamed (Unnamed waterbody)	Culvert	Undefined	Ephemeral, no defined channel exists at this location	-Nil for small bodied forage fish species -Nil for large bodied fish species
8.2	Unnamed (Unnamed waterbody)	Culvert	Undefined	Ephemeral, no defined channel exists at this location	-Nil for small bodied forage fish species -Nil for large bodied fish species
25.8	Unnamed (Jimmy Lake)	Culvert	Undefined	Ephemeral, no defined channel exists at this location	-Nil for small bodied forage fish species -Nil for large bodied fish species
28.9	Unnamed (Unnamed waterbody)	Culvert	Undefined	Ephemeral, no defined channel exists at this location	-Nil for small bodied forage fish species -Nil for large bodied fish species
43.9	Unnamed	Culvert	Undefined	Ephemeral, no defined channel exists at this	-Nil for small bodied forage fish species

Crossing ID	Watercourse Name (Tributary of)	Crossing Type	Bankfull Width (m)	Habitat Conditions	Suitability of Habitat Use for Fish in Surveyed Section
	(Unnamed waterbody)			location	-Nil for large bodied fish species
46.8	Unnamed (Unnamed waterbody)	Culvert	Undefined	Ephemeral, no defined channel exists at this location	-Nil for small bodied forage fish species -Nil for large bodied fish species
52.8	Unnamed (Unnamed waterbody)	Culvert	Undefined	Ephemeral, no defined channel exists at this location	-Nil for small bodied forage fish species -Nil for large bodied fish species
78.7	Unnamed (Unnamed waterbody)	Culvert	Undefined	Ephemeral, no defined channel exists at this location	-Nil for small bodied forage fish species -Nil for large bodied fish species
Intermittent Streams					
A1-108 / A3-101.9	Unnamed (Unnamed waterbody)	Culvert	2.1	Intermittent channel with isolated pockets of water exists at this location.	-Moderate for small bodied forage fish species -spawning, rearing and feeding and low for overwintering -Low for large bodied fish species -spawning, rearing, feeding and nil to low for overwintering (Northern Pike, Arctic Grayling)
A3-96.4a	Unnamed (Unnamed waterbody)	Culvert	6.4	Intermittent channel with isolated pockets of water exists at this location.	-Nil to low for small bodied forage fish species -spawning, rearing and feeding and nil to low for overwintering -Nil to low for large bodied fish species -spawning, rearing, and nil to low for overwintering (Northern Pike, Arctic Grayling)
A3-92.8	Unnamed (Unnamed waterbody)	Culvert	Undefined	Intermittent channel with isolated pockets of water exists at this location.	-Nil for small bodied forage fish species -Nil for large bodied fish species
A3-88.9	Unnamed (Unnamed waterbody)	Culvert	7.2	Intermittent channel with isolated pockets of water exists at this location.	-Nil for small bodied forage fish species -Nil for large bodied fish species
26.5	Unnamed (Jimmy Lake)	Culvert	2.5	Intermittent channel with isolated pockets of standing water exists at this location	-Nil for small bodied forage fish species -Nil for large bodied fish species
45.5	Unnamed (Unnamed waterbody)	Culvert	2.3	Intermittent channel with isolated pockets of water exists at this location.	-Nil for small bodied forage fish species -Nil for large bodied fish species
76	Unnamed (Unnamed waterbody)	Culvert	18	Intermittent channel with isolated pockets of water exists at this location.	-Nil for small bodied forage fish species -Nil for large bodied fish species - Use of the channel by fish is limited to periods in spring, early summer and fall when flowing water is present
76.3	Unnamed (Unnamed waterbody)	Culvert	10	Intermittent channel with isolated pockets of water exists at this location.	-Nil for small bodied forage fish species -Nil for large bodied fish species -Use of the channel by fish is limited to periods in spring, early

Crossing ID	Watercourse Name (Tributary of)	Crossing Type	Bankfull Width (m)	Habitat Conditions	Suitability of Habitat Use for Fish in Surveyed Section
					summer and fall when flowing water is present
82.7	Unnamed (Unnamed waterbody)	Culvert	4.5	Intermittent channel with isolated pockets of water exists at this location.	-Nil for small bodied forage fish species -Nil for large bodied fish species
85.6	Unnamed (Unnamed waterbody)	Culvert	1.6	Intermittent channel with isolated pockets of water exists at this location.	-Nil for small bodied forage fish species -Nil for large bodied fish species

5.0 DISCUSSION

A total of 36 watercourse crossings (Table 7) were assessed by IMG-Golder in September 2011. Streams were designated as perennial, intermittent and ephemeral. Ephemeral drainages are those having no defined bed and banks or evidence of annual sediment transport. They usually dry up during late summer and winter. Intermittent watercourses only flow at certain times of the year. When flows in these streams decrease, isolated pockets of water are left in the channel. Different to ephemeral watercourses, intermittent streams have defined bed and banks and evidence of annual sediment transport. Perennial watercourses flow throughout the year. They have defined bed and banks, including fines and organic materials. The majority of the watercourses assessed to date are small, ephemeral streams. These generally drain surrounding upland areas or small, shallow unnamed lakes or ponds which are unlikely to provide year round habitat for large bodied fish species.

During the 2011 fish habitat assessment, a total of 15 perennial streams were identified and considered to provide fish habitat. Ten intermittent streams were identified and also considered to provide fish habitat at some point throughout the year. Intermittent flows and dewatered sections of channels were present at these sites, which prevent year round upstream and downstream movement of fish. Use of these channels by fish are limited to periods in spring, early summer and fall when flowing water is present and therefore are still important for migratory fish movements. Eleven ephemeral streams were identified that may not provide fish habitat at certain times of the year. When water is present and flowing in these streams, they are still important for migratory fish movements.

Based on previous assessments conducted by Kiggiak EBA, of the 36 watercourse crossings surveyed by IMG-Golder in 2011, 5 perennial streams (Kilometre Markers 39.4, 54.1, 54.9, 66.1 and 88.2) have been identified for bridge crossings to minimize or prevent potential impacts to fish and fish habitat. The remaining 10 perennial streams, 10 intermittent streams and 11 ephemeral streams (that provide fish habitat at some point throughout the year) will have culverts installed (Table 1).

A number of fish species are known to be present in the ISR (Table 4). Various life stages of these species use these watercourses at different times of the year. Improperly sized and installed culverts can impede upstream movement of fish by creating velocity barriers and thereby preventing access to upstream habitat that may be required by a particular life stage for a specific life history function. Culverts to be installed at watercourse crossings should be sized to allow upstream or downstream passage for all life stages. The determination of properly sized culverts for the crossings should be based on the slowest and weakest swimming fish that can potentially be found in the system. Of the fish potentially present, juvenile Burbot are known to be the slowest and weakest swimmers. Therefore, culverts should be sized to provide the hydraulic conditions to allow upstream movement of juvenile Burbot. Crossings that are designed to provide velocity suitable for upstream movement of Burbot will also allow upstream movement of other species potentially occurring in those streams.

CLOSURE

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