MEMO

Date: September 6, 2016 HCP Ref No.: CZN7932

From: John Wilcockson

To: David Harpley, Canadian Zinc Corp

Subject: **All season road supplementary habitat information**

The purpose of this memo is to provide supplementary habitat information specific to the proposed Prairie Creek all season road.

The supplementary habitat information was collected during a two-day field reconnaissance program completed in July 2016, as well as a re-evaluation of existing data.

July 2016 field program

On July 13 and 14, 2016, Dave Harpley (Canadian Zinc Corp (CZN)) and John Wilcockson (Hatfield Consultants) conducted habitat assessments at a number of sites along the proposed all season road alignment. Field habitat sheets are provided as Attachment 1. Locations included:

1. A new watercourse crossing of a Sundog Creek tributary at km 28.6;
2. Specific locations on Sundog Creek where the road prism is proposed to encroach on aquatic habitat[1] (km 33-38.1);
3. The proposed Sundog Creek diversion (km 35.2-36.6);
4. Watercourse crossings along the new preferred alignment within the Unnamed Creek watershed and headwaters of Grainger River (between km 104 and 124) and
5. Watercourse crossings of the Grainger River tributaries (km 126 and 143).

In addition, potential sites suitable for habitat enhancement, for potential offsetting purposes, were evaluated.

Sundog Creek and Un-named Creek locations were assessed both from the air and on the ground (i.e., ground truthing). Locations on Grainger River tributaries were assessed from the air only since the purpose was to identify possible obstructions to fish passage, and this was best conducted from the air. Fish habitat field sheets were filled out at many of the locations; however, field notes and photographs were collected where a full habitat sheet was not warranted or possible.

[1] In this memo aquatic habitat is considered to be any portion of a stream without mature vegetation. Due to the slow growth of plants in the poor soil and high elevation, combined with the short growing period of high latitudes, it is anticipated that mature vegetation coincides with a 1:10 year return.

1 - Crossing of a Sundog Creek tributary at km 28.6

The preferred road alignment between km 28 and 29 was changed after DAR submission. Consequently, two main stem crossings, at km 28.2 to 28.7, were avoided and a single tributary crossing was added at 28.6. The habitat reconnaissance conducted at km 28.6 in July 2016 identified habitat suitable for Arctic grayling for rearing and migration at the site of the crossing. Substrate tended to be coarse and flow was fast. There was negligible cover for fish. Approximately 180 m upstream of the crossing are a series of high gradient shoots and waterfalls preventing upstream fish migration. It is possible that fish spawning habitat exists upstream of the crossing; however, habitat at the crossing location only offers rearing or migration habitat. The intent of the open span bridge planned for the crossing is to avoid encroaching on instream aquatic habitat, thus we do not anticipate any permanent loss of alteration of habitat (Figure 1).

Figure 1 New crossing at km 28.6 (Tributary of Sundog Creek, looking south, aerial shot).

Figure 2 Habitat at new crossing location (km 28.6, tributary of Sundog Creek, looking south).

2 - Encroachment onto Sundog Creek

Between km 30-40, the proposed all season road encroached upon the Sundog Creek floodplain. Here the proposed alignment follows the south edge of the floodplain, thereby largely avoiding contact with aquatic habitat. However, between km 32 and 38, there are several locations where the road will encroach into aquatic habitat to some degree.

In order to maintain the all-season road on the south side and avoid creek crossings, limited portions of the active channel will need to be relocated further north. Sundog Creek has a large floodplain and the location of the active channels change from year to year. It is possible that natural changes to flow over time would redirect the current active channel away from the south bank.

The aquatic habitat in Sundog Creek between km 30 and 40 generally consists of fast riffle habitat (~80%) with associated cobble substrate (Figure 3, Figure 4). This habitat provides potential migratory habitat for Arctic grayling, and potential spawning and rearing habitat for slimy sculpin.

Figure 3 **Sundog Creek looking downstream, showing most common morphology (fast riffle).**

Figure 4 **Sundog showing most common substrates (flow to the right).**

Between 15 and 20% of habitat in this section of Sundog Creek consists of a slower riffle (Figure 5 and Figure 6). The habitat here is characterized by the presence of large gravel. These substrates are within the size range used by Arctic grayling for spawning[2]. However, Arctic grayling generally use tributaries for reproduction and it is uncertain whether they use the large gravels in the slower riffles found in the thalweg and secondary channels of Sundog creek. Slimy sculpin may use this habitat for rearing, but due to the smaller size of substrate, it would provide less cover and refuge from flow[2].

Figure 5 Sundog Creek, slow-riffle habitat occurring in 15 to 20% of the stream.

[2] Minns CK, Resit JD, & CL Evans. 2002. Life History Characteristics of Freshwater Fishes Occurring In The Northwest Territories and Nunavut, With Major Emphasis on Riverine Habitat Requirements. Department of Fisheries and Oceans. Canada.

Figure 6 Sundog Creek, substrates common to the slow-riffle habitat.

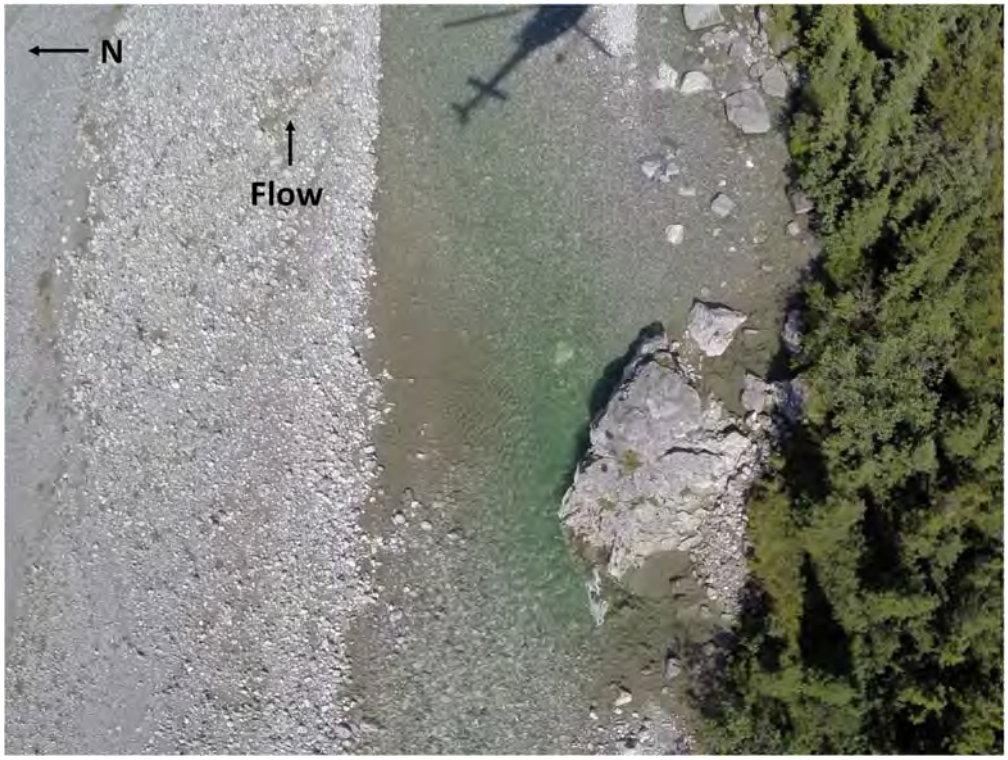
Less than 5% of habitat by area in this section of Sundog Creek consists of pools and back-eddies typically located behind boulders and encroaching bedrock (Figure 7). Substrates vary from sand to small boulders. There are pockets of fine gravels which would appear to be good spawning habitat for Arctic grayling (Figure 8). The boulders also provide refuge to grayling and sculpin during freshet and periods of greater flows after large precipitation events. The diversity of substrate, depths and flows created by the boulders create good rearing habitat for both Arctic grayling and slimy sculpin. The deepest (and largest) of the pools observed was at km 35.3, which was 1.5 m deep and approximately 10 m long at the time of survey (Figure 9 and Figure 10). This pool is immediately upstream of the proposed diversion and outside of the road envelope and therefore would not be affected by the all-season road construction. This pool is not likely to provide overwintering refuge, as it is anticipated that the depth of water would decrease substantially in the fall and winter, and therefore it is likely the residual pool would freeze to bottom. Ice thickness in the Nahanni region is typically 1 m in winter. The remainder of pools observed were smaller and less than 70 cm deep, and would likely freeze to bottom in winter.

Figure 7 **Sundog Creek showing side channel with boulders along south margin (looking upstream).**

Figure 8 **Sundog Creek - Pockets of smaller substrates often found downstream of boulders and pools.**

Figure 9 Sundog Creek – largest pool observed adjacent to the all season road.

Figure 10 Sundog Creek – largest pool observed adjacent to the all season road – aerial view.



3 - Sundog Diversion

The proposed Sundog Diversion will re-direct the flow of Sundog Creek from the south side of the channel to a pre-existing dry channel further to the north. The purpose of the diversion is to allow the road to run along the south side of the channel between km 35.3 and 36.5, where the road will need to be built into what is currently normally wetted channel.

At the upstream extent of the diversion, there are currently two side channels from the existing main channel branching off the thalweg to the south. A diversion berm would be placed parallel to the thalweg upstream of the new channel to cut off the side channels and the thalweg as it takes a right hand turn to head east (Figure 11). A preliminary design of the diversion has been provided by Tetra Tech (2016). At the head of the new channel, substrates consist largely of cobble imbedded in sand (Figure 12). Fine material is generally deposited at the head of old channels as a stream begins to adopt a new channel (Bill Rozeboom, Tetra Tech, pers. comm.). Downstream of the head of the new channel, the morphology appears to be similar to the existing channel, having varying gradients and channel widths. There were several locations having accumulations of sand in the channel, which would have deposited as the thalweg was diverted away.

Figure 11 Location or proposed diversion with estimated location of berm (in green), km 35.4, photo looking north-east.

Figure 12 Ground-level shot looking downstream in proposed future wetted channel.

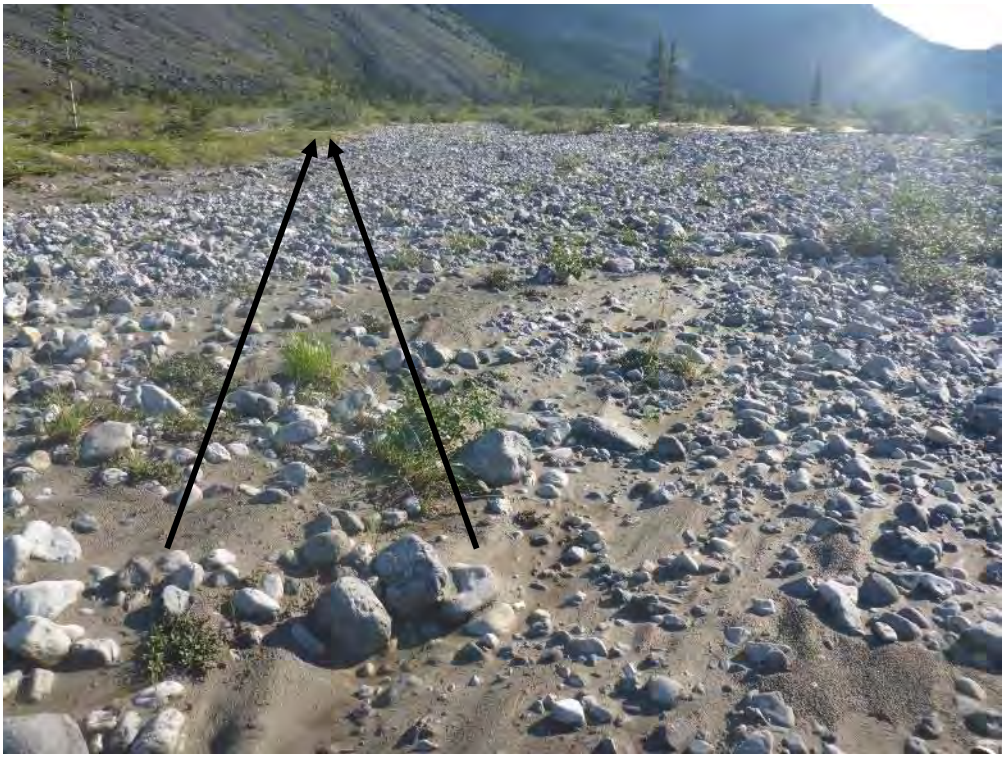


Figure 13 Ground level shot looking upstream showing connection to proposed future wetted channel.

4 - New Alignment Watercourse Crossings

The new alignment crosses a north-flowing un-named creek. This creek consists of low-gradient meandering channels, having a high frequency of beaver dams. Observations suggest that this stream provides poor fish habitat. The site reconnaissance in July 14, 2016, found moderate dissolved oxygen concentrations (7.6mg/L), abundant instream vegetation, and swimming insects suggesting the absence of fish[3].

Figure 14 New crossing near km111.3 Unnamed Creek; photo looking south (upstream).

[3] Swimming insects are readily eaten by fish, their presence can indicate the paucity of fish.
Schilling E.G, C.S. Loftin, and A.D. Huryn , 2009. Macroinvertebrates as indicators of fish absence in naturally fishless lakes Freshwater Biology 54:1, P181–202

Figure 15 New crossing near km111.3 Unnamed Creek.

At km 119, the road crosses a large alluvial outwash fan. This outwash fan drains a mountainous watershed approximately 8 km long, and drains into the Grainger River as it exits Gap Lake. It was completely dry during field visits in July and September 2014 and July 2016. It is anticipated that the only time it is wetted is during large rainfall events coinciding with rapid melting of snow on adjacent mountains. Due to the highly ephemeral nature of this water feature, it is unlikely to provide aquatic habitat.

Figure 16 km 119 – Crossing of alluvial outwash fan (near bottom of photo); photo looking South.

5 - Grainger Tributary Crossings

Between km 126 and 143 small tributaries flowing from the east side of the first Nahanni Range flow east towards progressively lower gradient slopes (Figure 17). These streams typically drain to wetlands or are beaver impounded (Figure 18). It is believed that these streams are not accessible to fish at the road crossings.

Figure 17 **Tributary to Granger River showing decrease of gradient with distance from Nahanni Range (i.e., downstream of proposed road) ~km 128 – 139; photo looking west.**

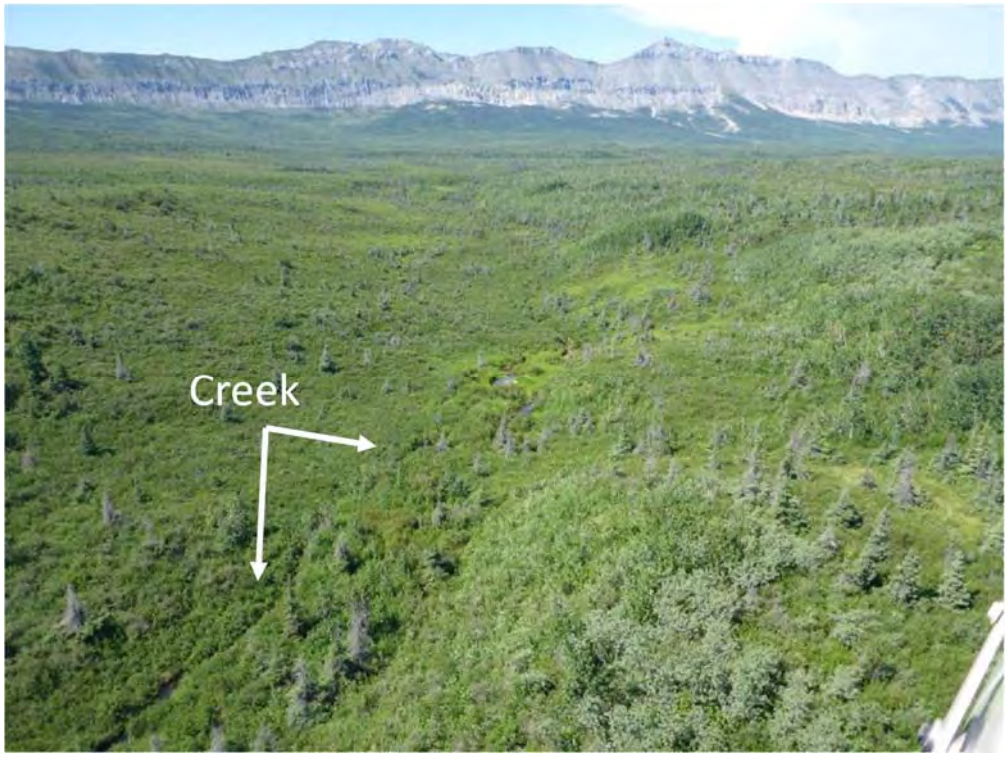


Figure 18 **Beaver dam on tributary to Granger River ~km 136.**

Supplementary Habitat Information on the Liard Crossing

In September 2014, Hatfield and CZN staff visited the proposed Liard Crossing location. The purpose of this visit was to gather site bathymetric and hydrological data as well as some habitat information. The data from 2014 was used to retrospectively create a field habitat sheet for the proposed barge crossing. The bathymetry data was provided in Appendix 11 of the DAR. A field habitat sheet is provided as Attachment 2. Habitat consists of run morphology with predominantly sand/silt substrates. Based on available data, the habitat at the proposed Liard River crossing does not appear to be unique to the area. It is likely that this portion of the Liard River is used for fish migration purposes only.

Figure 19 Liard River adjacent to crossing location example of bank substrate [photo 1].

Figure 20 Liard River adjacent to crossing location example of bank substrate [photo 2].

Attachment 1

Habitat Sheets

Stream Habitat Information

Data Collectors	Date	Time (24 H)
John W Dave H	13 July '16	820
Site Sundog CK	**Station** diversion – Sundog (KP 35.2)	**Project** CZN 7932
UTM NAD	**Upstream Northing** WP11	**Upstream Easting**
Access Heli	**Downstream Northing**	**Downstream Easting**

Morphology

Stream Morphology Types (%)			Length (m)				Velocity (60% depth or surface)		
Run	(Riffle)	Pool	Depth Transect (m)	@ 25% width	50%	75%	25%	50%	75%
Fall	Other:		1	0.22	0.21	0.19	0.32	0.70	0.1.05
Depth/Pool (m)			2	0.10	0.21	0.14	0.33	0.63	0.38
Channel Slope (°)	—		3	0.17	0.17	0.22	0.32	0.67	0.58
Wetted Width	12 / 15 / 11 / /	m	Channel Width (m)	108 / . / /		Unstable Banks (5%)		Scree	
Meander Frequency	/ / / / 200	m	Regular / (Irregular) meanders			Bank slope (5°)	— . L — R —		

Instream Cover

Instream Cover (Detritus)	— %	Instream Cover (Twigs/Sticks, etc)	— %	Substrate (as cover)	100 %
Instream Cover (logs, etc)	— %	Instream vegetation	— %	Undercut Bank	— %
Woody Debris Description (log jams, fallen trees, beaver activity, etc)					

Substrate Composition (Sum 100%)

		Embed. (%)
% Organics		-
% Clay		-
% Silt		-
% Sand	5	-
% Gravel (lg only)	40	0
% Cobble	40	0
% Boulder	15	0
% Bedrock		-

Instream Vegetaion (Sum 100%)

Rooted Emergent	0 %
Rooted Submergent	0 %
Rooted Floating	0 %
Free-floating (None)	0 %
Floating Algae	0 %
Attached Algae	0 %
Periphyton	0 %
Filamentous	0 %
Aquatic Moss	0 %
Flooded Terrestrial Plants	0 %

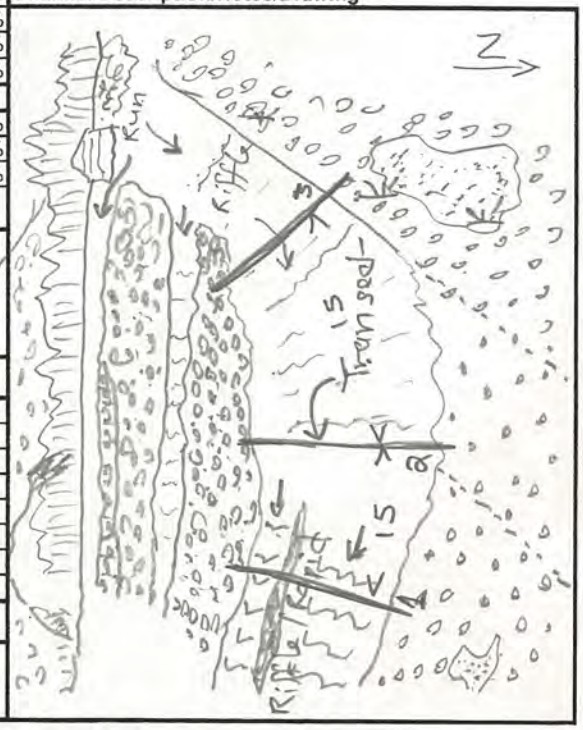
Riprian Zone (25 m Buffer) circle

(Mixed Forest)	Coniferous Forest
Grasses	Deciduous Forest
Re-growth forest	(Shrubs)
Flooded	Sedges
(Roads)	Cutlines

Overhead Cover (None)

Overhead Litter <150 mm	— %	Overhead Litter >150 mm (%)	— %
Overhead Undercut Banks	— %	Overhanging Trees	— %
Overhanging Grasses	— %	Overhanging Shrubs	— %

Channel Description/Notes/Drawing



Miscellaneous

High water mark	~1m m	Weather: previous 24 H
Flood Evidence (Debris on plants, etc)	NO m	mixxed (rain)
Air Temperature	12 °C	
Cloud Cover (5%)	0	
Wind Direction + speed (km/h)	NNW	

In situ Water Parameters

Sample Depth (m)	15cm surface		
Dissolved Oxygen (%)	—		
Dissolved Oxygen (mg/L)	9.8 mg/L		
Secchi Depth (m)	—		
Temperature (°C)	7.6		
pH	6.8	8.488 ← AN	
Turbidity (TCU)			
Conductivity (uS/cm)	191	198 ← AN	

Landscape (Beyond 25 m Buffer) BA circle

(Mixed Forest)	Coniferous Forest	(Roads)
Grasses	Deciduous Forest	Cutlines
Re-growth forest	(Shrubs)	(Hills)

Visible Disturbance circle

Surface Debris	Culvert
Beaver Dam	Weir
Collapsed Bank	

Photos

yes		

Channel Features

	#	Dimensions
Islands		
Bars		

Notes

25 July '16

Stream Habitat Information

Data Collectors John W Dave H	**Date** 13 July '16 (KP36.3)	**Time (24 H)** 1240
Site Sundog	**Station** Encroachment (KP33)	**Project** CZN7932
UTM NAD	**Upstream Northing** WP 36 ± 20m *	**Upstream Easting**
Access Heli	**Downstream Northing**	**Downstream Easting**

Morphology

Stream Morphology Types (%)			Length (m)				Velocity (60% depth or surface)		
Run	Riffle	Pool	Depth Transect (m)	@ 25% width	50%	75%	25%	50%	75%
Fall	Other:	frost (rapids)	1	.32	.27	.31	.81	.58	.61
Depth/Pool (m)			2	.24	.30	.32	.73	.73	1.26
Channel Slope (°)			3	.17	.41	.26	.49	1.08	.97
Wetted Width / / / m			Channel Width (m) / . / /				Unstable Banks (5%)		
Meander Frequency / / / / m			Regular / Irregular meanders				Bank slope (5°) . L R		

Instream Cover

Instream Cover (Detritus)	— %	Instream Cover (Twigs/Sticks, etc)	— %	Substrate (as cover)	100 %
Instream Cover (logs, etc)	— %	Instream vegetation	— %	Undercut Bank	— %

Woody Debris Description (log jams, fallen trees, beaver activity, etc)

Substrate Composition (Sum 100%)

		Embed. (%)
% Organics	0	-
% Clay	0	-
% Silt	0	-
% Sand	0	-
% Gravel	10	0
% Cobble	60	0
% Boulder	30	0
% Bedrock	—	-

Instream Vegetaion (Sum 100%)

Rooted Emergent	0 %
Rooted Submergent	0 %
Rooted Floating	0 %
Free-floating	0 %
Floating Algae	0 %
Attached Algae	0 %
Periphyton	0 %
Filamentous	0 %
Aquatic Moss	0 %
Flooded Terrestrial Plants	0 %

Riprian Zone (25 m Buffer) circle

Mixed Forest	Coniferous Forest
Grasses	Deciduous Forest
Re-growth forest	Shrubs
Flooded	Sedges
Roads	Cutlines

Channel Description/Notes/Drawing

Overhead Cover

Overhead Litter <150 mm	0 %	Overhead Litter >150 mm (%)	0 %
Overhead Undercut Banks	0 %	Overhanging Trees	0 %
Overhanging Grasses	0 %	Overhanging Shrubs	0 %

Miscellaneous

High water mark	.3 m	Weather: previous 24 H
Flood Evidence (Debris on plants, etc)	m	rain/
Air Temperature	16 °C	Sunshine
Cloud Cover (5%)	50	Thunder
Wind Direction + speed (km/h)	0	

In situ Water Parameters

See diversion sheet (KP35.2)

Sample Depth (m)				
Dissolved Oxygen (%)				
Dissolved Oxygen (mg/L)				
Secchi Depth (m)				
Temperature (°C)				
pH				
Turbidity (TCU)				
Conductivity (uS/cm)				

Landscape (Beyond 25 m Buffer) circle

Mixed Forest	Coniferous Forest	Roads
Grasses	Deciduous Forest	Cutlines
Re-growth forest	Shrubs	Hills

Visible Disturbance circle

Surface Debris	Culvert
Beaver Dam	Weir
Collapsed Bank	

Photos

yes

Channel Features

	#	Dimensions
Islands		
Bars		

Notes

Side channel width
T1 4.9m
T2 11 m (flow amongst gravel)
T3 0 (no island @ top)
possible spawning habitat in side channel ~10m x 1m
pool 73 cm deep (2m x 2m)

Side Channel
① V .22 .39 .59
D 8 17 30
② V .22 .35 .91
D 7 10 16
③ V .39 .60 .13
D 11 16 11

* upstream of KP 36.3 lower bridge

Stream Habitat Information

Data Collectors John W David H	**Date** 13 July '16	**Time (24 H)** ~~12~~ ~~12:40~~ 1300
Site Sundog	**Station** ~~KP 37~~ lower bridge Xing	**Project** CZN 7392
UTM NAD	**Upstream Northing** WP37 ± 20 * KP 36.3 9M	**Upstream Easting**
Access Heli	**Downstream Northing** (D/S) (25 July '16)	**Downstream Easting**

Morphology

Stream Morphology Types (%)
Run (Riffle) Pool
Fall Other: slow riffle
Depth/Pool (m)
Channel Slope (°) see Lidar
Wetted Width / / / / m
Meander Frequency / / / / m

Length (m) Depth Transect (m)	@ 25% width	50%	75%	Velocity (60% depth or surface) 25%	50%	75%
1	0.15	0.24	0.42	0.48	0.57	0.83
2	0.21	0.28	0.20	0.17	0.62	0.45
3	0.31	0.35	0.33	0.47	0.64	0.74

Channel Width (m) / . / /
Regular / Irregular meanders
Unstable Banks (5%)
Bank slope (5°) . L 45 R 20

Instream Cover

Instream Cover (Detritus)	0 %	Instream Cover (Twigs/Sticks, etc)	0 %	Substrate (as cover)	100 %
Instream Cover (logs, etc)	0 %	Instream vegetation	0 %	Undercut Bank	0 %

Woody Debris Description (log jams, fallen trees, beaver activity, etc)

Substrate Composition (Sum 100%)

		Embed. (%)
% Organics	0	-
% Clay	0	-
% Silt	0	-
% Sand	0	-
% Gravel	60	0
% Cobble	30	0
% Boulder	10	0
% Bedrock	0	-

gravel large

Instream Vegetaion (Sum 100%)

Rooted Emergent	0 %
Rooted Submergent	%
Rooted Floating	%
Free-floating	%
Floating Algae	%
Attached Algae	%
Periphyton	%
Filamentous	%
Aquatic Moss	%
Flooded Terrestrial Plants	%

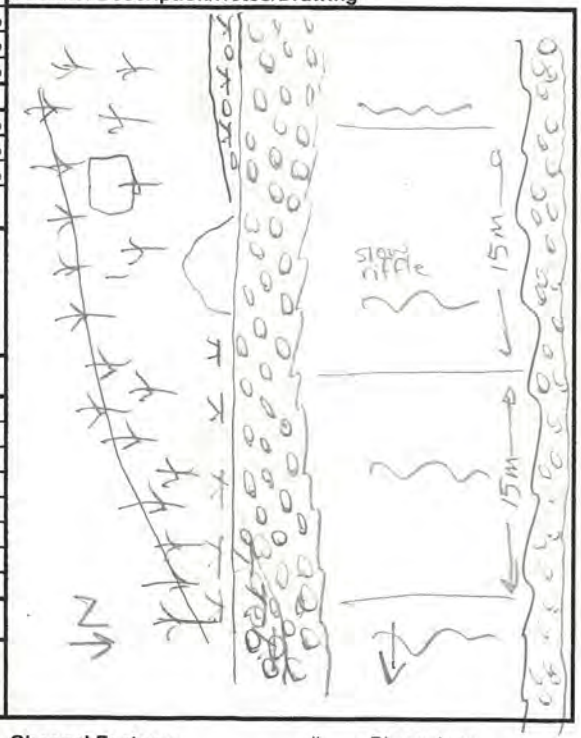
Riprian Zone (25 m Buffer) circle

Mixed Forest — Coniferous Forest
Grasses — Deciduous Forest
Re-growth forest — Shrubs
Flooded — Sedges
Roads — Cutlines

Overhead Cover

Overhead Litter <150 mm	0 %	Overhead Litter >150 mm (%)	0 %
Overhead Undercut Banks	0 %	Overhanging Trees	0 %
Overhanging Grasses	0 %	Overhanging Shrubs	0 %

Channel Description/Notes/Drawing



Miscellaneous

High water mark	0.3 m	Weather previous 24 H
Flood Evidence (Debris on plants, etc)	m	rain thunder sun
Air Temperature	20 °C	
Cloud Cover (5%)	20	
Wind Direction + speed (km/h)	0	

In situ Water Parameters

see diversion sheet (KP35.2)

Sample Depth (m)				
Dissolved Oxygen (%)				
Dissolved Oxygen (mg/L)				
Secchi Depth (m)				
Temperature (°C)				
pH				
Turbidity (TCU)				
Conductivity (uS/cm)				

Landscape (Beyond 25 m Buffer) circle

Mixed Forest — Coniferous Forest — Roads
Grasses — Deciduous Forest — Cutlines
Re-growth forest — Shrubs — Hills

Visible Disturbance circle

Surface Debris — Culvert
Beaver Dam — Weir
Collapsed Bank

Photos

yes

Channel Features

	#	Dimensions
Islands		
Bars		

Notes

slower riffle than ~~KP 37~~ 36.3 9M (25 July '16) (U/S)
Finish 1400

* down stream of 36.3 KM encroachment).

Stream Habitat Information

Data Collectors	Date	Time (24 H)
John W Dave H	13 July '16	1628
Site	**Station**	**Project**
Sundog	Crossing @ KP 28.6	CZN 7392
UTM NAD	**Upstream Northing**	**Upstream Easting**
	(WP47)*	
Access	**Downstream Northing**	**Downstream Easting**
Heli		

Morphology

Stream Morphology Types (%)		Length (m)				Velocity (60% depth or surface)		
Run (Riffle) (Steep) Pool		Depth Transect (m)	@ 25% width	50%	75%	25%	50%	75%
Fall Other: Cascade		1	.16	.31	.20	.02	1.22	.07
Depth/Pool (m)		2	.04	.09	.12	.09	.23	.7
Channel Slope (°)		3	.21	.24	.15	.37	.42	.21
Wetted Width	1 | 1.46 | 6 | 2.45 m	Channel Width (m)	10 | 7 | 8 |			Unstable Banks (5%)		
Meander Frequency	- | - | - | - → m	Regular / Irregular meanders				Bank slope (5°)	L	R

Instream Cover

Instream Cover (Detritus)	0 %	Instream Cover (Twigs/Sticks, etc)	0 %	Substrate (as cover)	100 %
Instream Cover (logs, etc)	0 %	Instream vegetation	0 %	Undercut Bank	0 %
Woody Debris Description (log jams, fallen trees, beaver activity, etc)					

Substrate Composition (Sum 100%)

		Embed. (%)
% Organics		-
% Clay		-
% Silt		-
% Sand	0	-
% Gravel	20	—
% Cobble	70	—
% Boulder	10	—
% Bedrock	0	-

Instream Vegetaion (Sum 100%)

Rooted Emergent	0 %
Rooted Submergent	%
Rooted Floating	%
Free-floating	%
Floating Algae	%
Attached Algae	%
Periphyton	%
Filamentous	%
Aquatic Moss	%
Flooded Terrestrial Plants	%

Riprian Zone (25 m Buffer) circle

Mixed Forest	Coniferous Forest
Grasses	(Deciduous Forest)
Re-growth forest	(Shrubs)
Flooded	(Sedges)
Roads	Cutlines

Overhead Cover

Overhead Litter <150 mm	0 %	Overhead Litter >150 mm (%)	0 %
Overhead Undercut Banks	0 %	Overhanging Trees	0 %
Overhanging Grasses	0 %	Overhanging Shrubs	<5 %

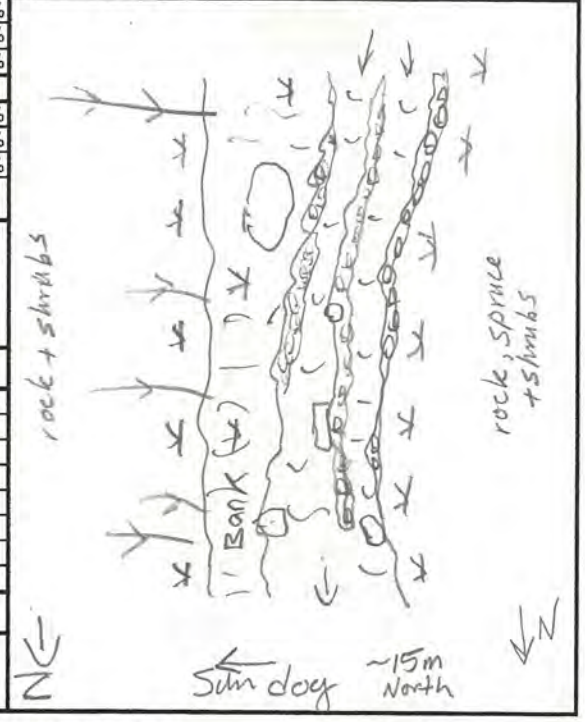
Miscellaneous

		Weather
High water mark	.40 m	previous 24 H
Flood Evidence (Debris on plants, etc)	~0 m	rain thunder sun
Air Temperature	25 °C	
Cloud Cover (5%)	15-7	
Wind Direction + speed (km/h)	slight breeze	

In situ Water Parameters

Sample Depth (m)	—			
Dissolved Oxygen (%)	—			
Dissolved Oxygen (mg/L)	6.4			
Secchi Depth (m)	—			
Temperature (°C)	13.9			
pH	8.5			
Turbidity (TCU)	—			
Conductivity (uS/cm)	151			

Channel Description/Notes/Drawing



Landscape (Beyond 25 m Buffer) circle

Mixed Forest	(Coniferous Forest)	Roads	
Grasses	Deciduous Forest	Cutlines	
Re-growth forest	Shrubs	Hills	

Visible Disturbance circle

Surface Debris	Culvert
Beaver Dam	Weir
Collapsed Bank	

Photos

yes

Channel Features

	#	Dimensions
Islands		
Bars		

Notes Forest to west, more open + shrubby to east. Large waterfall ~200-300m U/S.

* mid point of reach

Stream Habitat Information

Data Collectors John W/ Dave H	**Date** 13 July '16	**Time (24 H)** 1740
Site Sundog	**Station** KP36.2 (encroachment)	**Project** CZN 7932
UTM NAD —	**Upstream Northing** (KP36.0)	**Upstream Easting**
Access Heli	**Downstream Northing** WP50 (DS)	**Downstream Easting**

Morphology

Stream Morphology Types (%): Run (Riffle) Pool; Fall; Other:

Depth/Pool (m) —

Channel Slope (°) —

Wetted Width / / / bottom m

Meander Frequency / / / / bottom m

Length (m) Depth Transect (m)	@ 25% width	50%	75%	Velocity (60% depth or surface) 25%	50%	75%
1	.22	.26	.18	.67	.58	.52
2	.19	.56	.72	.19	.56	.72
3	.26	.35	.27	.57	1.02	.53

Channel Width (m) —

Regular / Irregular meanders

Unstable Banks (5%) —

Bank slope (5°) L 45 R 60

Instream Cover

Instream Cover (Detritus)	0 %	Instream Cover (Twigs/Sticks, etc)	0 %	Substrate (as cover)	100 %
Instream Cover (logs, etc)	0 %	Instream vegetation	0 %	Undercut Bank	0 %

Woody Debris Description (log jams, fallen trees, beaver activity, etc)

Substrate Composition (Sum 100%)

		Embed. (%)
% Organics		-
% Clay		-
% Silt		-
% Sand	10	-
% Gravel	50	60
% Cobble	30	0
% Boulder	20	50
% Bedrock		-

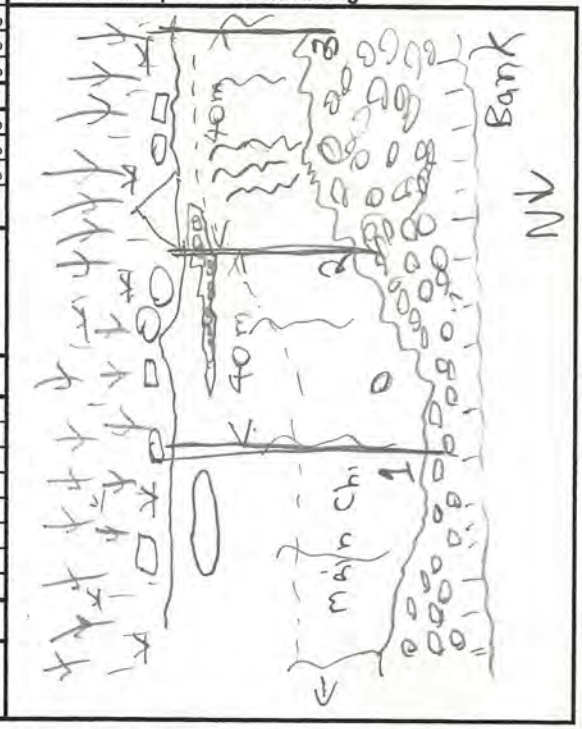
Instream Vegetaion (Sum 100%)

Rooted Emergent	N/O %
Rooted Submergent	%
Rooted Floating	%
Free-floating	%
Floating Algae	%
Attached Algae	%
Periphyton	%
Filamentous	%
Aquatic Moss	%
Flooded Terrestrial Plants	%

Riprian Zone (25 m Buffer) circle

Mixed Forest	(Coniferous Forest)
(Grasses)	Deciduous Forest
Re-growth forest	(Shrubs)
Flooded	Sedges
Roads	Cutlines

Channel Description/Notes/Drawing



Overhead Cover

Overhead Litter <150 mm	0 %	Overhead Litter >150 mm (%)	0 %
Overhead Undercut Banks	0 %	Overhanging Trees	0 %
Overhanging Grasses	0 %	Overhanging Shrubs	<5 %

Miscellaneous

		Weather
High water mark	.40 m	previous 24 H
Flood Evidence (Debris on plants, etc)	N/O m	rain thunder sun
Air Temperature	25 °C	
Cloud Cover (5%)	5 %	
Wind Direction + speed (km/h)	Slight breeze	

In situ Water Parameters

See diversion sheet

Sample Depth (m)				
Dissolved Oxygen (%)				
Dissolved Oxygen (mg/L)				
Secchi Depth (m)				
Temperature (°C)				
pH				
Turbidity (TCU)				
Conductivity (uS/cm)				

Landscape (Beyond 25 m Buffer) circle

Mixed Forest	(Coniferous Forest)	Roads
Grasses	Deciduous Forest	Cutlines
Re-growth forest	(Shrubs)	(Hills)

Visible Disturbance circle

Surface Debris	Culvert
Beaver Dam	Weir
Collapsed Bank	

Photos

yes

Channel Features

	#	Dimensions
Islands		
Bars		

Notes

WW 1 22 2 19 3 13 Reach L 136m

BW 26 24 22

Stream Habitat Information

Data Collectors	Date	Time (24 H)
John W David H	13 July '16 / 14 July '16	1840 / 0745
Site Sundog	**Station** KP 35.9	**Project** CZN 7932
UTM NAD	**Upstream Northing** U/S transect WP51	**Upstream Easting**
Access Heli	**Downstream Northing**	**Downstream Easting**

Morphology

Stream Morphology Types (%): Run (Riffle) Pool; Fall; Other:

Depth/Pool (m): 0.47

Channel Slope (°): —

Wetted Width / / / m

Meander Frequency / / / / m

Length (m)				Velocity (60% depth or surface)		
Depth Transect (m)	@ 25% width	50%	75%	25%	50%	75%
1 S	0.10	0.25	0.16	0.03	0.48	0.44
2 S	0.21	0.12	0.22	*0.79	0.14	0.23
3 S	0.15	0.27	0.24	0.17	0.21	0.13

Channel Width (m) / . / /

Unstable Banks (5%)

Regular / Irregular meanders

Bank slope (5°) . L R

Instream Cover

Instream Cover (Detritus)	0 %	Instream Cover (Twigs/Sticks, etc)	2 %	Substrate (as cover)	100 %
Instream Cover (logs, etc)	0 %	Instream vegetation	8 %	Undercut Bank	0 %

Woody Debris Description (log jams, fallen trees, beaver activity, etc)

Substrate Composition (Sum 100%)

		Embed. (%)
% Organics	0	-
% Clay	0	-
% Silt	0	-
% Sand	0	-
% Gravel	30	0
% Cobble	60	0
% Boulder	10	50
% Bedrock		-

Instream Vegetaion (Sum 100%)

Rooted Emergent	%
Rooted Submergent	NONE %
Rooted Floating	%
Free-floating	%
Floating Algae	%
Attached Algae	%
Periphyton	%
Filamentous	%
Aquatic Moss	%
Flooded Terrestrial Plants	%

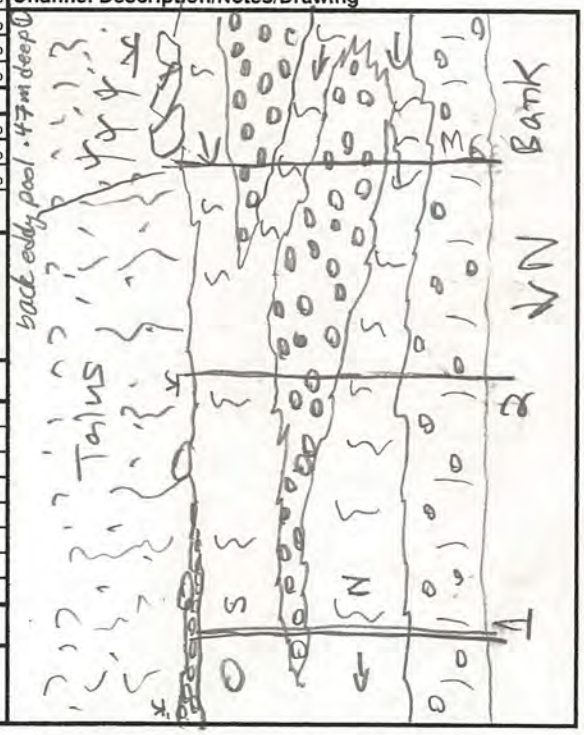
Riprian Zone (25 m Buffer) circle

Mixed Forest	(Coniferous Forest)
Grasses	Deciduous Forest
Re-growth forest	(Shrubs)
Flooded	Sedges
Roads	Cutlines

Overhead Cover

Overhead Litter <150 mm	0 %	Overhead Litter >150 mm (%)	0 %
Overhead Undercut Banks	0 %	Overhanging Trees	0 %
Overhanging Grasses	0 %	Overhanging Shrubs	0 %

Channel Description/Notes/Drawing



Miscellaneous

High water mark	0.40 m	Weather: previous 24 H
Flood Evidence (Debris on plants, etc)	— m	rain thunder sun
Air Temperature	~20 °C	
Cloud Cover (5%)	0	
Wind Direction + speed (km/h)	slight	

In situ Water Parameters

see diversion sheet (KP35.2)

Sample Depth (m)
Dissolved Oxygen (%)
Dissolved Oxygen (mg/L)
Secchi Depth (m)
Temperature (°C)
pH
Turbidity (TCU)
Conductivity (uS/cm)

Landscape (Beyond 25 m Buffer) circle

Mixed Forest	(Coniferous Forest)	Roads	
Grasses	Deciduous Forest	Cutlines	
Re-growth forest	(Shrubs)	(Hills)	

Visible Disturbance circle

Surface Debris	Culvert
Beaver Dam	Weir
Collapsed Bank	

Photos

yes

Channel Features

	#	Dimensions
Islands		
Bars		

Notes

WW 1N 815 9 | 2N 825 9 | Reach L | 95m | 3N6 354

BW 25 | 30 | 36

① 5m x 3m 1g gravel mostly large gravels small pocket ~ 2m x 2m finer gravel

* flow between 2 rocks

Stream Habitat Information

Data Collectors John W, Dave H	**Date** 14 July '16	**Time (24 H)** 0942
Site Sundog	**Station** (KP 34.6) U/S crossing (alt to diversion)	**Project** CEN7932
UTM NAD	**Upstream Northing** WP66	**Upstream Easting**
Access Heli	**Downstream Northing**	**Downstream Easting**

Morphology

Stream Morphology Types (%): Run (Riffle) Pool; Fall Other: fast (rapids)

Depth/Pool (m) ——

Channel Slope (°) ——

Wetted Width —— / below m

Meander Frequency —— / below m

Channel Width (m) —— / below

Regular / Irregular meanders

Length (m) Depth Transect (m)	@ 25% width	50%	75%	Velocity (60% depth or surface) 25%	50%	75%
1	.34	.31	.24	.74	1.6	.23
2	.33	.38	.23	.49	.63	.69
3	.25	.19	.23	.77	.61	.29

Unstable Banks (5%) ——

Bank slope (5°) . L —— R ——

Instream Cover

Instream Cover (Detritus)	0 %	Instream Cover (Twigs/Sticks, etc)	0 %	Substrate (as cover)	100 %
Instream Cover (logs, etc)	0 %	Instream vegetation	0 %	Undercut Bank	0 %

Woody Debris Description (log jams, fallen trees, beaver activity, etc)

Substrate Composition (Sum 100%)

		Embed. (%)
% Organics		-
% Clay		-
% Silt		-
% Sand		-
% Gravel	10	0
% Cobble	20	0
% Boulder	70	0
% Bedrock		-

Instream Vegetaion (Sum 100%)

Rooted Emergent	%
Rooted Submergent NV	%
Rooted Floating	%
Free-floating	%
Floating Algae	%
Attached Algae	%
Periphyton	%
Filamentous	%
Aquatic Moss	%
Flooded Terrestrial Plants	%

Riprian Zone (25 m Buffer) circle

Mixed Forest	(Coniferous Forest)
Grasses	Deciduous Forest
Re-growth forest	(Shrubs)
Flooded	Sedges
Roads	Cutlines

R bank thin strip

Overhead Cover

Overhead Litter <150 mm	0 %	Overhead Litter >150 mm (%)	0 %
Overhead Undercut Banks	0 %	Overhanging Trees	0 %
Overhanging Grasses	0 %	Overhanging Shrubs	0 %

Miscellaneous

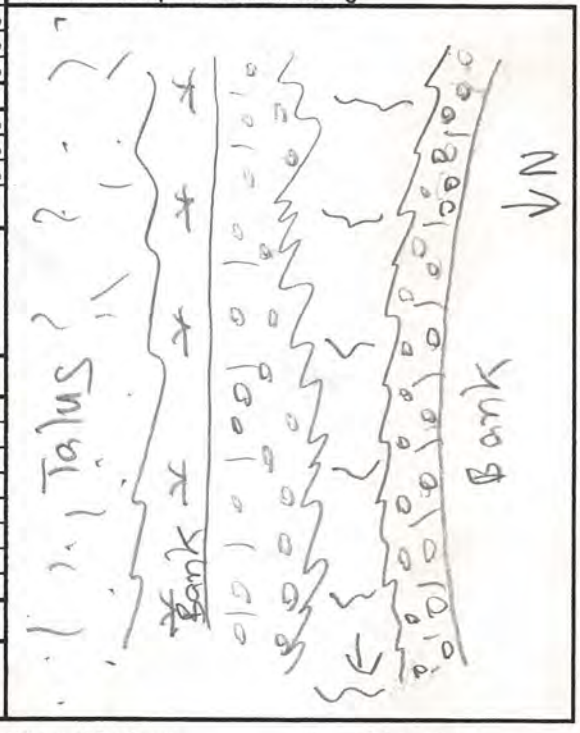
High water mark	.5 m	Weather: previous 24 H
Flood Evidence (Debris on plants, etc)	— m	rain
Air Temperature	20 (shade) °C	thunder
Cloud Cover (5%)	<5%	sun
Wind Direction + speed (km/h)	SW breeze	

In situ Water Parameters

See d/s crossing data

Sample Depth (m)	
Dissolved Oxygen (%)	
Dissolved Oxygen (mg/L)	
Secchi Depth (m)	
Temperature (°C)	
pH	
Turbidity (TCU)	↓
Conductivity (uS/cm)	

Channel Description/Notes/Drawing



Landscape (Beyond 25 m Buffer) L bank only circle

Mixed Forest	(Coniferous Forest)	Roads	
Grasses	Deciduous Forest	Cutlines	
Re-growth forest	Shrubs	Scree	(Hills)

Visible Disturbance circle

Surface Debris	Culvert
Beaver Dam	Weir
Collapsed Bank	

Photos

yes

Channel Features

	#	Dimensions
Islands		
Bars		

Notes

WW 1 12 2 15 3 19

BW 26 25 29

channel through rocks + shallower on right bank.

Stream Habitat Information

Data Collectors John W Dave H	**Date** 14 July '16	**Time (24 H)** 1140
Site Unnamed Ck	**Station** Unnamed Ck Crossing	**Project** CEN7932
UTM NAD —	**Upstream Northing** WP71	**Upstream Easting** —
Access Heli	**Downstream Northing** —	**Downstream Easting** —

Morphology — riffle habitat uncommon, ~~only~~ riffle only observed @ study reach,

Stream Morphology Types (%)			Length (m)				Velocity (60% depth or surface)		
Run	(Riffle) 20	(Pool) 80	Depth Transect (m)	@ 25% width	50%	75%	25%	50%	75%
Fall	Other:		1	.39	.42	.44	0	.04	.02
Depth/Pool (m)	0.74		2	.07	.13	.29	.01	0	.13
Channel Slope (°)	—		3	.22	.49	.74	0	.04	.06
Wetted Width	/ + + + below	m	Channel Width (m)	+ . + below		Unstable Banks (5%)			
Meander Frequency	+ + + +	m	Regular / (Irregular meanders)			Bank slope (5°)	. L 90	. R 90	

Instream Cover

Instream Cover (Detritus)	— %	Instream Cover (Twigs/Sticks, etc)	5 %	Substrate (as cover)	0 %
Instream Cover (logs, etc)	< %	Instream vegetation	5 %	Undercut Bank	85 %
Woody Debris Description (log jams, fallen trees, beaver activity, etc)	dam u/s				

Substrate Composition (Sum 100%)

		Embed. (%)
% Organics	0	-
% Clay	0	-
% Silt	(1) ~~70~~ 100	-
% Sand	0	-
% Gravel	30 ~~0~~	0
% Cobble	0	1
% Boulder	0	
% Bedrock	0	-

Instream Vegetaion (Sum 100%)

~~Rooted Emergent~~	~~10~~ %
Rooted Submergent	90 %
Rooted Floating	0 %
Free-floating	0 %
Floating Algae	0 %
Attached Algae	0 %
Periphyton	0 %
Filamentous	0 %
Aquatic Moss	0 %
~~Flooded~~ Terrestrial Plants	10 %

Riprian Zone (25 m Buffer) circle

~~Mixed Forest~~	Coniferous Forest
~~Grasses~~	Deciduous Forest
Re-growth forest	(Shrubs)
Flooded	Sedges
Roads	Cutlines

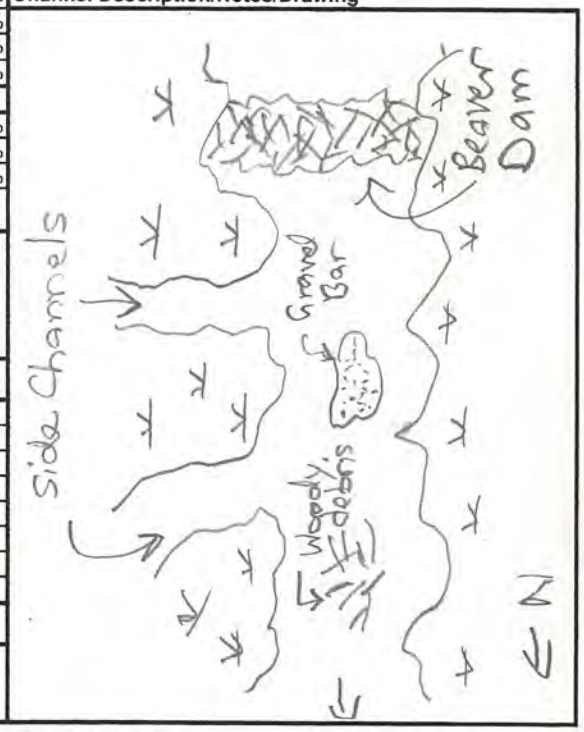
Overhead Cover

Overhead Litter <150 mm	0 %	Overhead Litter >150 mm (%)	0 %
Overhead Undercut Banks	70 %	Overhanging Trees	0 %
Overhanging Grasses	20 %	Overhanging Shrubs	10 %

Miscellaneous

High water mark	~10 (2) m	Weather: previous 24 H
Flood Evidence (Debris on plants, etc)	0 (3) m	Rain Thunder
Air Temperature	25 °C	
Cloud Cover (5%)	2	Sun
Wind Direction + speed (km/h)	S slight	

Channel Description/Notes/Drawing



***In situ* Water Parameters**

Sample Depth (m)	0
Dissolved Oxygen (%)	—
Dissolved Oxygen (mg/L)	7.6
Secchi Depth (m)	—
Temperature (°C)	12.4
pH	7
Turbidity (TCU)	—
Conductivity (uS/cm)	465

Landscape (Beyond 25 m Buffer) circle

~~Mixed Forest~~	(Coniferous Forest)	Roads
Grasses	Deciduous Forest	Cutlines
Re-growth forest	Shrubs	Hills

(wetland)

Visible Disturbance circle

Surface Debris	Culvert
(Beaver Dam)	Weir
Collapsed Bank (slight)	

Photos

yes

Channel Features

	#	Dimensions
Islands		
Bars		

Notes

WW + BW - 1 3,75 2 3,8 3 5,2
water strider noted + dragon fly

(1) Note crossing not typical habitat of area predominantly fines.
(2) difficult to tell.
(3) upstream ∴ 0m

Attachment 2

Liard Crossing Habitat

Stream Habitat Information

Data Collectors Chris Jaeggle, Dave H	**Date** 25 Sept '14	**Time (24 H)** 1030
Site Liard barge Crossing	**Station** same	**Project** CZN6788
UTM NAD —	**Upstream Northing** 6770339	**Upstream Easting** 484731
Access ~~Heli~~ Boat	**Downstream Northing** 6770067	**Downstream Easting** 484167

Morphology

Stream Morphology Types (%)			Length (m)				Velocity (60% depth or surface)		
Run 100	Riffle	Pool	Depth Transect (m)	@ 25% width	50%	75%	25%	50%	75%
Fall	Other:		1 (mid)	9	11	5			
Depth/Pool (m)	—		2 (d/s)	6	7	7.5			
Channel Slope (°)	—		3 (u/s)	13	10	7			
Wetted Width	—	475 m	Channel Width (m)	—	—	550	Unstable Banks (5%)	—	
Meander Frequency / / / /		m	Regular / Irregular meanders				Bank slope (5°) — L — R —		

Instream Cover

Instream Cover (Detritus)	0 %	Instream Cover (Twigs/Sticks, etc)	0 %	Substrate (as cover)	0 %
Instream Cover (logs, etc)	0 %	Instream vegetation	0 %	Undercut Bank	0 %

Woody Debris Description (log jams, fallen trees, beaver activity, etc)

Substrate Composition (Sum 100%)

		Embed. (%)
% Organics	0	-
% Clay	0	-
% Silt	45	-
% Sand	45	-
% Gravel	0	—
% Cobble	10	?
% Boulder	0	—
% Bedrock	0	-

Instream Vegetaion (Sum 100%)

Rooted Emergent	0 %
Rooted Submergent	%
Rooted Floating	%
Free-floating	%
Floating Algae	%
Attached Algae	%
Periphyton	%
Filamentous	%
Aquatic Moss	%
Flooded Terrestrial Plants	%

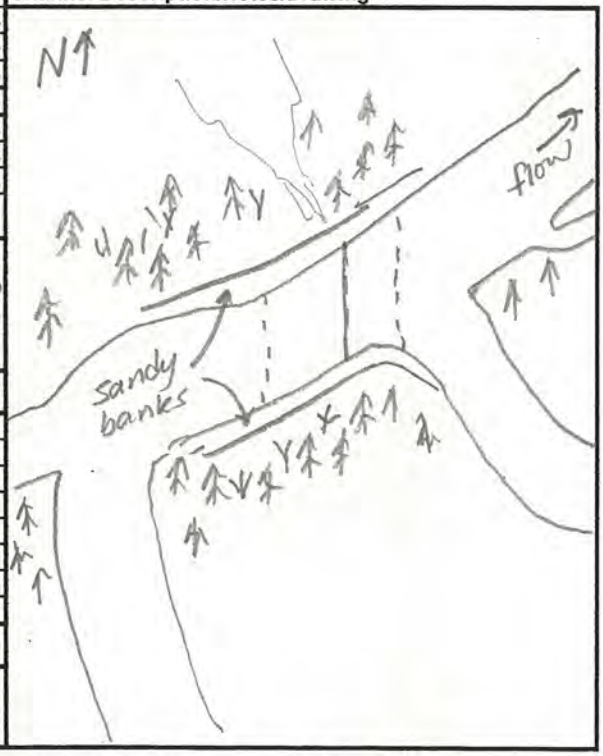
Riprian Zone (25 m Buffer) circle

Mixed Forest	Coniferous Forest
Grasses	Deciduous Forest
Re-growth forest	Shrubs
Flooded	Sedges
Roads	Cutlines

Overhead Cover

Overhead Litter <150 mm	0 %	Overhead Litter >150 mm (%)	0 %
Overhead Undercut Banks	%	Overhanging Trees	%
Overhanging Grasses	%	Overhanging Shrubs	%

Channel Description/Notes/Drawing



Miscellaneous

High water mark	5.0 m	Weather: previous 24 H overcast, rain
Flood Evidence (Debris on plants, etc)	— m	
Air Temperature	~0 °C	
Cloud Cover (5%)	100	
Wind Direction + speed (km/h)	Na	

In situ Water Parameters

Sample Depth (m)				
Dissolved Oxygen (%)				
Dissolved Oxygen (mg/L)				
Secchi Depth (m)				
Temperature (°C)				
pH				
Turbidity (TCU)				
Conductivity (uS/cm)				

Landscape (Beyond 25 m Buffer) circle

Mixed Forest	Coniferous Forest	Roads
Grasses	Deciduous Forest	Cutlines
Re-growth forest	Shrubs	Hills

Visible Disturbance circle

Surface Debris	Culvert
Beaver Dam	Weir
Collapsed Bank	

Photos

Channel Features

	#	Dimensions
Islands		
Bars		

Notes Data sheet created from bathymetric report and field notes from September 2014.

Attachment 3

Field Notebook

CZN 7932 — 12 July '16

John Wilcocksen
David Harpley

Purpose: trip up to mine
730 AM from Vancouver
~~arrive @~~ arrive @ mine
@ 1330 ish via PG and
Fort Nelson, Flew along
bottom of cumulus clouds
from FN.

Phone call w/ Garry Stringeour
(Parks) to fill him in on
objectives. Will likely go to
first crossing tonight (28.6)

Calibration - OZ-1560 AN

	Pre	Post
1413	1546	1406
pH7	—	6.93
pH4	3.29	3.99
Temp		28.9°C

OZ-3390-BA

	Pre	Post
1413	1860	1410
pH7	7.01	7.01
pH4	4.14	3.99
Temp		22.9

CZN 7932 — 12 July '16

Notes for go Pro use

1 Power button (front)
2 WIFI (side)
3 Shutter for menu (top)
4 Press Power until GoPro App (front)
5 Shutter to accept
Should work if not
press power button to cycle
to exit then shutter to
exit from WIFI
- IPAD unlock 3261
- All north Logm
Allnorth Field
Allnorth @ 2015

(32)

CZN 7932 13 July '16

purpose: Sundog Ck '33 - 38
hab assessments

crew: John W, Dave H

weather: Sunny no clouds slight ~~bri~~ wind. ~16°C

on site @ 755, safety talk. Starting @ top of Ck re-alignment. Braided channel (3) largest on left (N) bank all riffle cobble w/ gravel ~100m U/S riffle slower and ~~no~~ higher gravel content
(Kp35.3) wp 011 - Diversion - D/S higher gradient ~~more~~ rapids/ higher gradient riffle

905 - photos of Sundog diverson top - mostly ~~san~~ cobble w/ sand some small plants starting to grow current gradient is less than Sundog Left channel (wetted left)
photos from bank
photo U/S 67m

(33)

CZN 7932 13 July '16

0917 centre channel 1.7m ww.
riffle Cobble 85, Lg Gravel 15
V .21/.92/.76 m/sec 25/50/75
D 15/14/14 cm deep
no periphyton wp12 (Kp35H)

0940 walking d/s on proposed realignment channel, cobble + gravel less sand here.
wp13 (Kp35.4) d/s slightly higher gradient

0946 further d/s vegetation in middle of channel, wp14 (Kp35.4)

~~0952~~ 9 wp15 confluence of two dry channels more sand but also cobble/sand
Little ~~further~~ d/s - sand

wp16 grassy bank (Kp35.5)

~~0958~~ 958 bend wp17 (Kp35.5)
bank @ wp18 (1-2m high)

Rite in the Rain

CEN 7932 13 July 16

1003 WP 19 Standing water ~5cm deep. (KP 35.6)

(KP 35.7)

1006 WP 20 deformed bank on L (North) side only. (photos before here)

(KP 35.9)

1011 WP 21 wide channel, deep on right (S) bank ~~some~~ areas of imbedded gravels.

(KP 36)

1017 WP 22 Area where dry channel used to come back to current wet channel, however return braid is less deep than main dry channel.

short break for water + washroom break, discussed plan.

(KP 36.1)

1032 @ WP 23 @ location of possible culvert if 2 bridge alternative is used

bankfull width 13, 15, 9 m
" depth 66, 72, 46

(from bottom of dry channel to top of bank).

CEN 7932 13 July '16

riparian veg includes shrubs, grass, spruce + moss.

substrate Cobble + Gravel ~ 50/50 except higher areas have more gravel. All imbedded in sand.

(KP 36.2)

1100 WP 24 - area of standing water. Bubbles coming from bottom (displaced air from rain last couple of days? - also trib coming in from North

7.3 pH temp 9, ~~210 µs~~ 230 µs no observable flow. Algae on bottom ~~when~~ see photos, DO 8.0 mg/L (KP 36.2)

1110 WP 25 Tributary on N side pool > 1m deep water clear thick moss d/s of pool (possible high flows because of rains?) channel ~ 4m wide - bad flies, some clean looking gravel, but sand too w/ some imbedded gravels

(KP 36.2)

1120 WP 26 location of two smaller tribs coming in.

CZN7932 13 July '16

bottom silty w/ animal tracks algae on bottom in areas.

10m us both channels go to ground

1135 wp 27 - main trib u/s ~20m ~6m wide 35cm deepest Rock near centre have ~~algae~~ moss + lichen suggesting stream may go dry in fall or low precip periods. 193 µS 5.1°C pH 7.27 (KP 36.3)

1150 wp 28 | confluence of trib and diversion channel d/s bank is high, so water will likely be re-directed back to Sundog. Thunder to S.E. dark clouds. (KP 36.5)

1200 wp 29 | close to where major trib and diversion channel will meet (KP 36.8)

wp 30 | intercepted (KP 36.3)

1207 wp 31 | possible location for off set - lower, more likely to have water from sub surface

GW

CZN 7932 13 July '16

deepest 45cm channel 15m wide (KP 36.3)

1216 @ wp 32 | adjacent rapids.

1220 @ wp 33 (KP 36.2) | area of coarse gravel, slower riffle.

wp 34 tail end of gravel. becomes faster flow more cobble

1226 @ area where road will encroach into active channel (below HWM) wp 35 (KP 36.2) will do a habitat sheet here as well as on ~20m d/s where bridge would cross back

KP 36.3 ~~Thunder Storm~~ closer.

KP ~~33~~ (Encroachment)

		Side channel		
① velocity	.81	.58	.61	.22 .39 .59
depth	32	27	31	8 17 30
②	.73	.73	1.26	.22 .35 .91
	24	30	32	7 10 16
③	.49	1.08	.97	.39 .60 .13
	17	41	26	11 16 11

GW

CZN 7932 13 July '16

~~KP33~~ (KP36.3) (encroachment)

~~Transect~~

Transect	1	2	3
WW	11	11	13
BW	13	15	15

(KP36.2)

~~KP34~~ (lower bridge alternative)

Transect	1	2	3
WW	22	18	13
BW	27	25	22

1455 back @ mine w/ helicopter to refuel - pickup battery for go pro.

1600 finished gopro work stopped @ Sunday trib @ KP 39.4 crossing (KP39.2) already assessed by Chris WP 43 WP 44 further U/S @ pool visited by Chris that went dry during 1wk visit.

Then stopped @ bluffs to take photos while Heli under power. (KP47.7)

JW

CZN 7932 13 July '16

1630 arriving at KP 28.7 crossing do full habitat assessment here.

1642 lost all pencils!

mid point of reach WP 47

Transect #1	1.46 ww		10 bw
velocity	.02	1.22	.07
depth	16cm	31	20
#2	6 ww		7 bw
velocity	.09	.23	.7
depth	4cm	9cm	12

channel split, moved sampling locations slightly to get water flow + depth

#3	2.45		8 bw
V	.37	.42	.21
D	21cm	24cm	15cm

~~15cm~~

total reach 35m long.

photo upstream (large waterfall) (180m U/S)

Photo Confluence.

1720 leaving site.

1740 starting @ KP ~~3~~6.2 (WP48) (encroachment).

JW

Rite in the Rain

CZN 7932 13 July '16

Transect #1

vel	.67	.58	.52
depth	22cm	26cm	18cm

Tran # 2

v	.19	.56	.72
d	30cm	43cm	44cm

nice backeddy @ bottom of rapids; small gravels

(wp49) water 30-35cm (R bank) water flowing out of L bank

tran #3

v	.57	1.02	.53
d	26cm	35cm	27cm

creek flowing out of R bank

WP48 (KP 36.0)

finish @ 1825

1840 @ 35.9 dave est 95m berg based on range finder for encroachment (KP 35.8)

WP51 ~~Bill~~ transect 1 depths @ 1m here for Bill

15	28	36	39	23	14
1m	2m	3m	4m	5m	6m

Helicopter coming, will have

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to continue tomorrow, Back @ Camp at 1915 - dinner + then downloading data

Calcheck - 02-3390BA

	pre	post	
1413µS	1258	1479	new cal soln
4.0	4.11	3.97	✓
7.0	7.04	7.01	7.02

02-1560AN

	pre	post	
~~1413µS~~	~~pre~~		
4.0	3.54		
7.0	6.57		22.9°C
1413	1195	1411	

Try again

new solution

4.0		
7.0	5.53	5.55

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purpose: finish off Sundog habitat transects, then visit un-named ck for habitat followed by a few ~~5~~ Tribs to Granger that may have d/s obstructions.

Crew: John W, Dave H

weather: clear ~ 17°C

Arrive on site @ 732 - finish where left off yesterday.

remainder of first transect

7m	8m	9	10	11	12	13	14
0	0	4	7	8	0	2	10
15	16	17	18	19			
12	20	10	18	15	0		

~~#2~~ 2nd transect

cross(m)	1	2	3	4	5	6	7	8	9	10	11	12	13
depth (cm)	23	32	19	12	12	12	5	0	0	0	0	0	6
	14	15	16	17	18	19	20	21	22	23	24	25	26
	0	0	0	0	10	21	11	17	15	12	9	10	0

JW

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3rd transect

1	2	3	4	5	6	7	8-15
0.40	0.33	0.20	0.16	0.09	0.05	0.03	0
16	17	18	19	20	21	22	23	24-27
0.03	0.02	0.02	0.03	0.03	0.01	0.13	0.10	0
28	29	30	31	32				
0.02	0.11	0.17	0.09	0				

leaving site @ 822

KP35.5 @ 840 road will come out ~4m from bank here returns 10 m d/s. Dave thinks might be above HWM. WP53 (KP35.5) @ WP54 dave feels 2m of habitat loss ~~US~~ U/S End WP 55.

WP57 dave in pool not deep enough for overwintering 1m x 1m gravel, but shallow 0-40cm

0855 WP58 KP35.3 encroachment on channel, but above HWM. (KP35.2)

900 WP60 L 10-15m long pool WP61 d/s end of slower riffle = gravels, mostly.

JW

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pool 1.5m deep (likely dry overwinter)
WP62 above HWM (KP35)
WP63 (KP35) encroachment ~~onto~~ below HWM ~2-3m 0922
KP35.1 pockets of possible spawning habitat ~1 x 14m (rangefinder)
WP65 (KP34.6) ~~done~~ not stopping - assume road above HWM
WP66 (KP34.5) same (KP34.5)
0942 @ U/S crossing alternative (to diversion).
WP66 (KP34.5)
Flows

T1	V	.74	1.6	.23
	D	34	31	24
T2	V	.49	.63	.69
	D	33	38	23
T3	V	.77	.61	.29
	D	25	19	23

1020 finished
WP67 (KP34.1) 1030 - old road alignment
WP68 (KP34) 1032 dry channel shown on plans that road will pass through.

SW

CEN 7932 (KP111.6) 14 July '16

1140 @ WP71 [Location of unnamed creek crossing. Trees encroach on ck, likely place for the crossing (indicates more solid ground. 10m d/s of beaver pond ~15m of riffle, not typical as seen from air.

T1

V	0	.04	.02
d	39cm	42cm	44

T2

V	0.01	0	0.13
d	7cm	13cm	29cm

T3

V	0	0.04	0.06
d	22cm	49cm	74cm

water strider noted
finishing @ 1210 - no fish observed.
WP72 Landing spot, ~50m U/S of site, U/S of beaver dam.
Most of bottom ~~strut~~ substrate has no veg, just mud, clear water, can see bottom easily

Rate in the Rain

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even u/s of beaver pond ~1m deep in spots no life seen in pond next to drop off.
1227 in heli leaving site
noted two addnl beaver dams as we were exiting to south.
- Dave counted
Kp 126.2 @ 1307 small connection w/ ~~Smedog~~ Granger, but appears to peter-out after 100m or so

Kp ~~132.9~~ Kp 130 channel peters out up + down
Kp 132 good channel but peters out d/s into wetland, no apparent connection

Kp 134.5 1317 3 beaver dams @ WP 73 (ds of road)

Kp 135.5 up 74 another ck ending in beaver dam.
- 77 (several dams) + 78
up 75 another beaver dam on a larger channel.

SW

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up 79 another beaver dam
WP 80 location to pickup veg + wild life team
Back @ mine @ 1500
Plan to be on flight out of mine at 1830. Overnight @ Simpson + catch early flight to YK then Home.

Cal check
02-3390-BA
Pre

1413 µS	1443	
pH 4	4.08	22.0°C
pH 7	7.10	