

Appendix 14-C

Harper Creek Fish Habitat Baseline Report

HARPER CREEK PROJECT

**Application for an Environmental Assessment Certificate /
Environmental Impact Statement**



Prepared for:



HARPER CREEK
MINING CORP.

HARPER CREEK PROJECT Harper Creek Fish Habitat Baseline Report

January 2015

Harper Creek Mining Corporation

HARPER CREEK PROJECT

Harper Creek Fish Habitat Baseline Report

January 2015

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GLOSSARY AND ABBREVIATIONS

Terminology used in this document is defined where it is first used. The following list will assist readers who may choose to review only portions of the document.

Adfluvial	A life history form where fish overwinter and mature in lakes, and then migrate to tributary streams to spawn.
BC MOE	British Columbia Ministry of Environment
DFO	Fisheries and Oceans Canada
EA	Environmental Assessment
FHAP	Fish Habitat Assessment Procedure
FISS	Fisheries Information Summary System
GPS	Global Positioning System
HCMC	Harper Creek Mining Corporation
LWD	Large Woody Debris
N	Sample size or number
QA/QC	Quality Assurance/Quality Control
Redd	A nest of fish eggs consisting of gravel, typically formed by digging motion performed by an adult female.
SD	Standard Deviation
SE	Standard Error
TL	Total Length
UTM	Universal Transverse Mercator (grid)

1. INTRODUCTION

Harper Creek Mining Corporation (HCMC) proposes to construct and operate the Harper Creek Project (the Project), an open pit copper mine near the unincorporated community of Vavenby, British Columbia (BC). The Project is located in the Thompson-Nicola Regional District of BC, approximately 150 km northeast of Kamloops along Yellowhead Highway 5, and approximately 10 km southwest of Vavenby, BC. Prior to project development, a baseline program was conducted to facilitate the prediction, assessment, mitigation, and management of potential Project-related effects. Project-specific baseline studies related to fish habitat were conducted by Knight Piésold (2013) from 2011 to 2013. A technical review conducted by ERM Rescan in 2013 indicated that additional fish habitat data is required for upper Harper Creek, between P and T creeks.

The purpose of this program was to conduct fish habitat surveys following methods used by Knight Piésold (2013) at sites along Harper Creek, between P and T creeks.

2. METHODS

2.1 HARPER CREEK HABITAT SURVEY

Detailed Level 1 fish habitat surveys were conducted at 11 sites on upper Harper Creek, between P Creek and T Creek, from September 11 to 13, 2014 (Table 2.1-1; Figure 2.1-1). This approximately 4 km stretch of upper Harper Creek includes stream reaches 12 to 16. Site names, stream reaches, and locations were based upon previous studies conducted by Knight Piésold (2013). These 11 sites also correspond to electrofishing site locations conducted by Knight Piésold in 2011 and 2012.

Table 2.1-1. Detailed Level 1 Fish Habitat Survey Sites, 2014

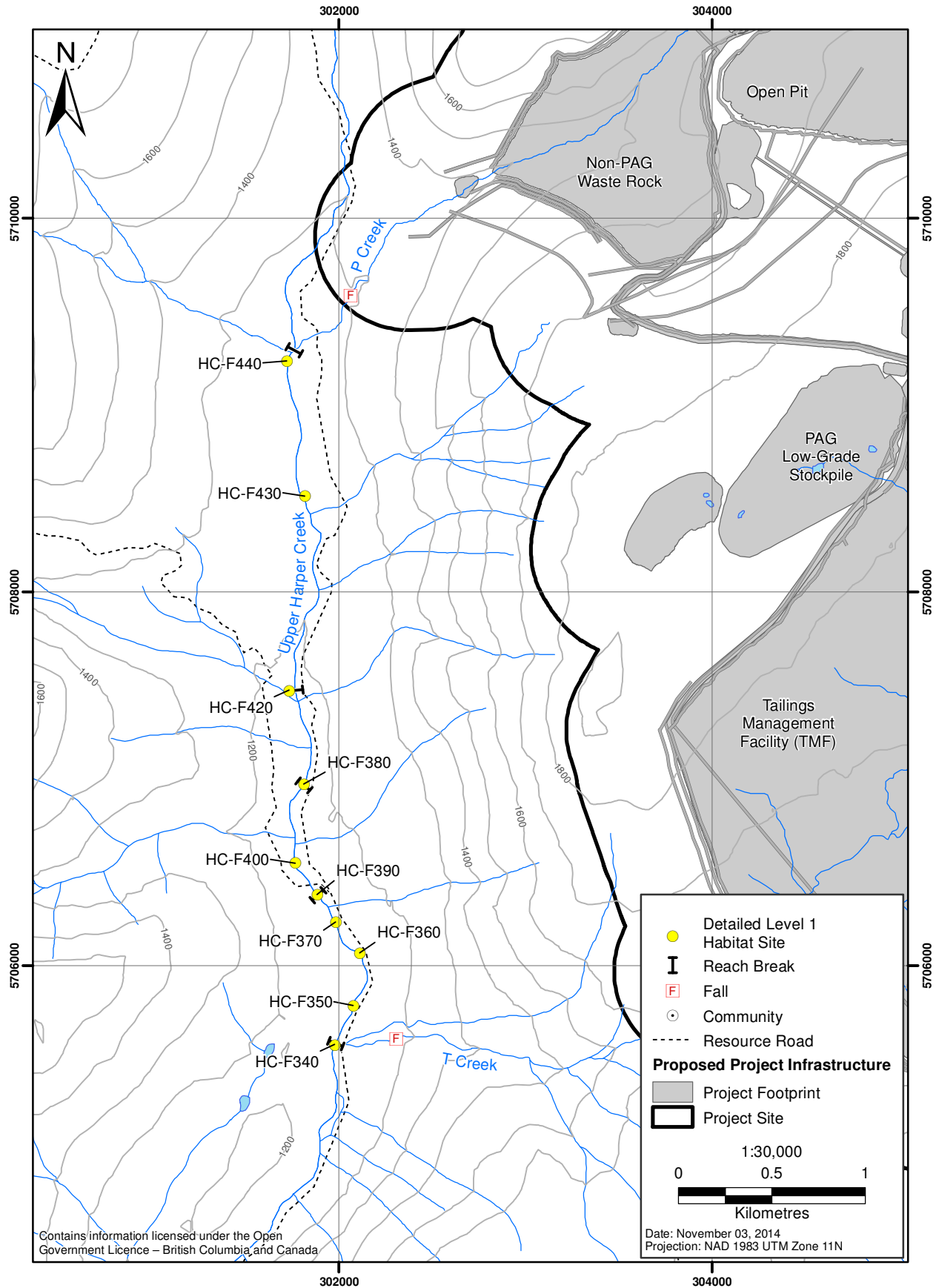
Site No.	Date	UTM Location			Harper Creek Reach	Mainstem km
		Zone	Easting	Northing		
HC F-440	11-Sep	11U	301723	5709233	16	24.3
HC F-430	11-Sep	11U	301814	5708505	16	23.5
HC F-420	11-Sep	11U	301766	5707473	16	22.4
HC F-410	12-Sep	11U	301847	5707177	15	22.2
HC F-380	12-Sep	11U	301813	5706965	15	21.2
HC F-400	12-Sep	11U	301758	5706613	15	21.5
HC F-390	12-Sep	11U	301883	5706374	15	21.3
HC F-370	12-Sep	11U	301966	5706264	14	21
HC F-360	13-Sep	11U	302118	5706069	13	20.9
HC F-350	13-Sep	11U	302082	5705794	13	20.6
HC F-340	13-Sep	11U	301910	5705500	12	20.3

Detailed Level 1 habitat surveys were completed using the methods developed by Knight Piésold (2013), and adopted from Simonson et al. (1994) and Johnston and Slaney (1996). Using this procedure, measurements and observations of the following habitat variables were evaluated:

- identification and documentation of any side channels or off channel habitat;
- habitat type (riffle, pool, glide, cascade);
- stream gradient;
- mean bankfull and wetted widths;
- mean bankfull and wetted depths;
- residual pool depth;
- dominant and subdominant stream bed substrate material;
- large woody debris (LWD);
- available instream cover and type; and
- riparian vegetation type, structure, and canopy closure.

Figure 2.1-1

Detailed Level 1 Fish Habitat Survey Sites, 2014



Habitat types were classified using the following criteria:

- Pool – low velocity area with smooth, non-turbulent flow, low gradient (near 0%), and a concave bottom;
- Glide – an area of smooth, non-turbulent flowing water with moderate velocity and gradient less than 4%;
- Riffle – an area of turbulent, fast-flowing water with a gradient less than 4%; and
- Cascade – high gradient (> 4%) area of turbulent, fast-flowing water.

Stream morphological measurements (e.g., bankfull width, wetted depth) were collected with a metre stick, measuring tape, and/or range finder. Stream gradient was measured using a clinometer. Waypoint and UTM coordinates of the upstream and downstream ends of each site were recorded with a handheld Garmin 60 GPS unit. Photographs were taken of stream habitat types (e.g., pools, glides, etc.) or important features (e.g., barriers or falls). The UTM coordinates for important stream features were also recorded using the same hand-held GPS unit.

Data collected for each habitat variable were used to evaluate the overall quality of fish habitat. Professional knowledge and expertise was used to rank habitat suitability for each fish life history stage (i.e., spawning, rearing, over-wintering, and migration; categorized as none, poor, fair, or good; Table 2.1-2). Overall habitat quality was ranked as none, marginal, important, or critical (Table 2.1-2).

Table 2.1-2. Life History Habitat Suitability and Overall Habitat Quality Criteria

Life Stage Suitability Rank	Criteria
None	No habitat present for any life history stage
Poor	Most of the necessary physical/biological components of the habitat for this life history stage are missing or severely deficient
Fair	Some of the necessary physical/biological components of the habitat for this life history stage are present, but a key component is missing
Good	All of the necessary physical/biological components of the habitat for this life history stage are present
Overall Habitat Quality Rank	Criteria
None	No habitat present
Marginal	Low productive capacity
Important	Common habitat which supplies basic needs of fish (typically includes rearing habitat with some spawning habitat potential)
Critical	Rare or exceptionally productive or unusual habitat with very high habitat values which are of uncommon and/or highly valuable

2.2 BULL TROUT REDD SURVEY

Adfluvial and resident Bull Trout spawning redd locations were observed during Detailed Level 1 habitat surveys along upper Harper Creek, between P and T creeks from September 11 to 13, 2014. To

further document Bull Trout spawning habitat, physical habitat data were collected at each redd, including: redd depth, crest depth, redd length and width, distance of redd from the stream bank, location (UTM coordinate), water temperature, substrate type, macro-habitat type, cover type, percent cover, and Bull Trout behavioural observations. Photos were taken of each redd and flagging tape was used to mark each redd site. Additional biological data from observed Bull Trout (e.g., total length, sex, life history form [e.g., adfluvial or resident]) were collected where possible.

2.3 QUALITY ASSURANCE AND QUALITY CONTROL

To ensure consistency and accuracy of collected data, a QA/QC program was established at the outset of the field program. All fish habitat data sheets were reviewed at the end of each field day to ensure data were complete and collected properly. Field notes were transcribed onto electronic spreadsheets once in the office and all transcriptions were checked visually against the field forms and any errors corrected.

3. RESULTS AND DISCUSSION

3.1 HARPER CREEK HABITAT SURVEY

Detailed Level 1 habitat data collected for each site (HC F-340 to HC F-440) are presented in Appendix A. Photographs of selected habitat units and sites are shown in Appendix B. Habitat data were pooled and characterized by reach.

Reach 16 (mainstem km 22.4 to 24.3) included three sites (HC F-440, HC F-430, and HC F-420). Figures 3.1-1, 3.1-2, and 3.1-3 show the distribution of habitat types at sites HC F-440, HC F-430, and HC F-420, respectively. A total of 30 habitat units were surveyed over a 420 m section of reach 16. Stream morphology of reach 16 was classified as riffle-pool, with riffle and glide habitat representing the dominant and sub-dominant macro-habitat types, respectively. Habitat units ranged in length from 3 m to 34 m, with a mean length of 13.4 m. Stream gradient was low, ranging from 1% to 4%. A total of six pools were recorded, with maximum depth ranging from 0.4 m to 1 m.

The dominant substrate varied widely within reach 16; from boulder (site HC F-420) to cobble (site HC F-440) to gravel (site HC F-430). Large woody debris, overhanging vegetation, and boulder were the most common cover types within reach 16. Overall habitat was rated as important, with critical adfluvial Bull Trout spawning habitat observed at habitat unit 5 within site HC F-430.

Reach 15 (mainstem km 21.3 to 22.2) included four sites (HC F-410, HC F-380, HC F-400, and HC F-390). Figures 3.1-4, 3.1-5, 3.1-6, and 3.1-7 show the distribution of habitat types at sites HC F-410, HC F-380, HC F-400, and HC F-390, respectively. In total, 504 m of fish habitat was surveyed and divided into 40 habitat units. Stream morphology of reach 15 was classified as riffle-pool, with glide and riffle habitat representing the dominant and sub-dominant macro-habitat types, respectively. Habitat units ranged in length from 3 m to 78 m, with a mean length of 12.6 m. Cobble and gravel represented the dominant and sub-dominant substrate type, respectively. Pea gravel and coarse gravel for adfluvial Bull Trout spawning was abundant in glide and pool habitat units, particularly within site HC F-380. Overall, habitat was rated as important, with critical adfluvial Bull Trout spawning habitat observed at four pool habitat units within this reach.

Fish habitat within reach 14 (mainstem km 21) was surveyed at site HC F-370. Figure 3.1-8 shows the distribution of habitat types at site HC F-370. A total of 138 m of fish habitat was divided into 10 habitat units, and classified as riffle-pool morphology. Pools and glides were the most common macro-habitat type. Habitat units ranged in length from 4 m to 26 m, with a mean of 13.8 m. Cobble and gravel were observed as the dominant and sub-dominant substrate types, respectively. Large woody debris (dominant) and overhanging vegetation (sub-dominant) were the most commonly observed cover types. Pea gravel and coarse gravel for adfluvial Bull Trout spawning was present in glide and pool habitat units. Overall, habitat was rated as important, with critical adfluvial Bull Trout spawning habitat observed at glide and pools within this reach.

Figure 3.1-1

Macro-Habitat Units at Site HC F-440, Upper Harper Creek

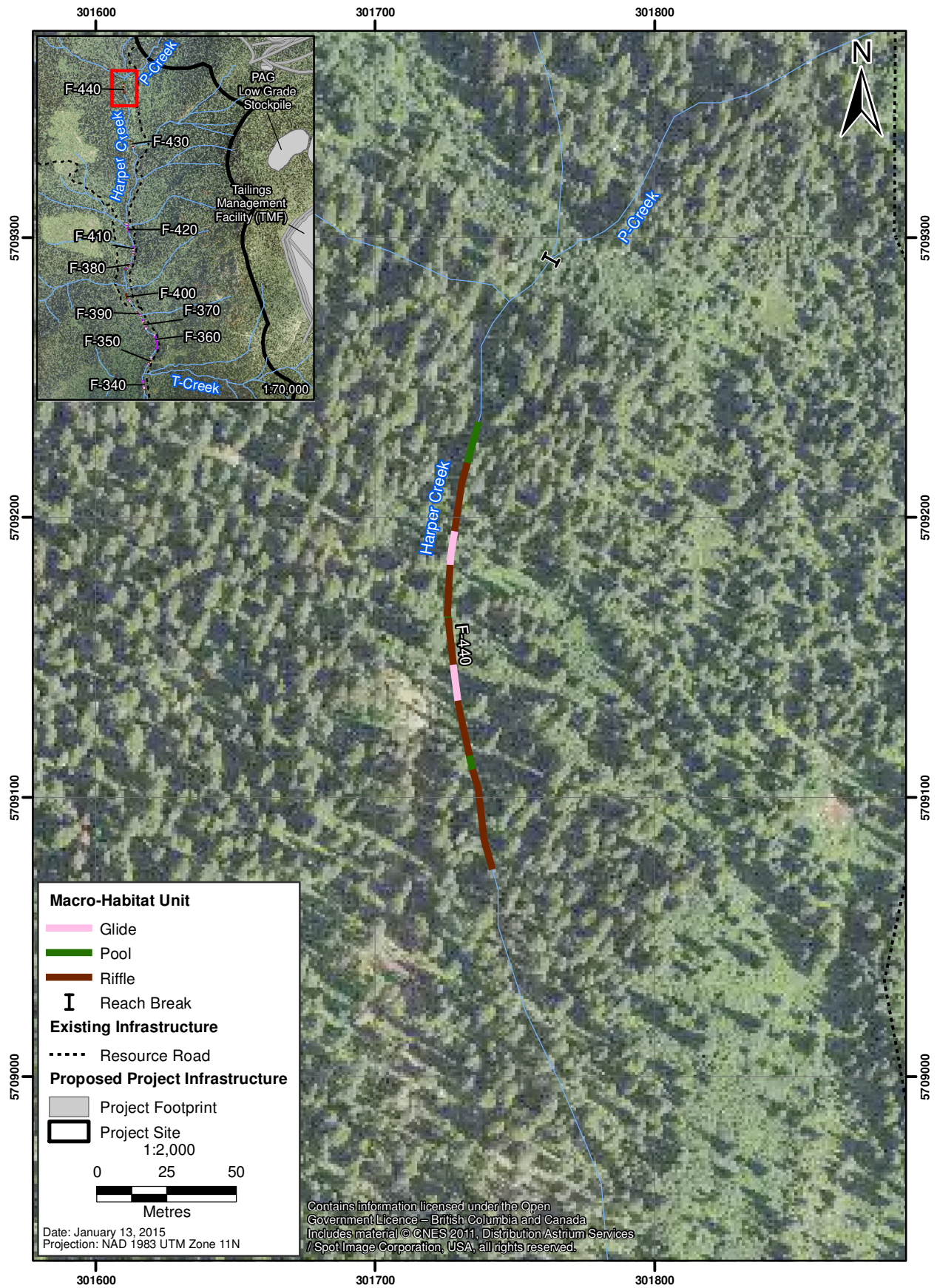


Figure 3.1-2

Macro-Habitat Units at Site HC F-430, Upper Harper Creek

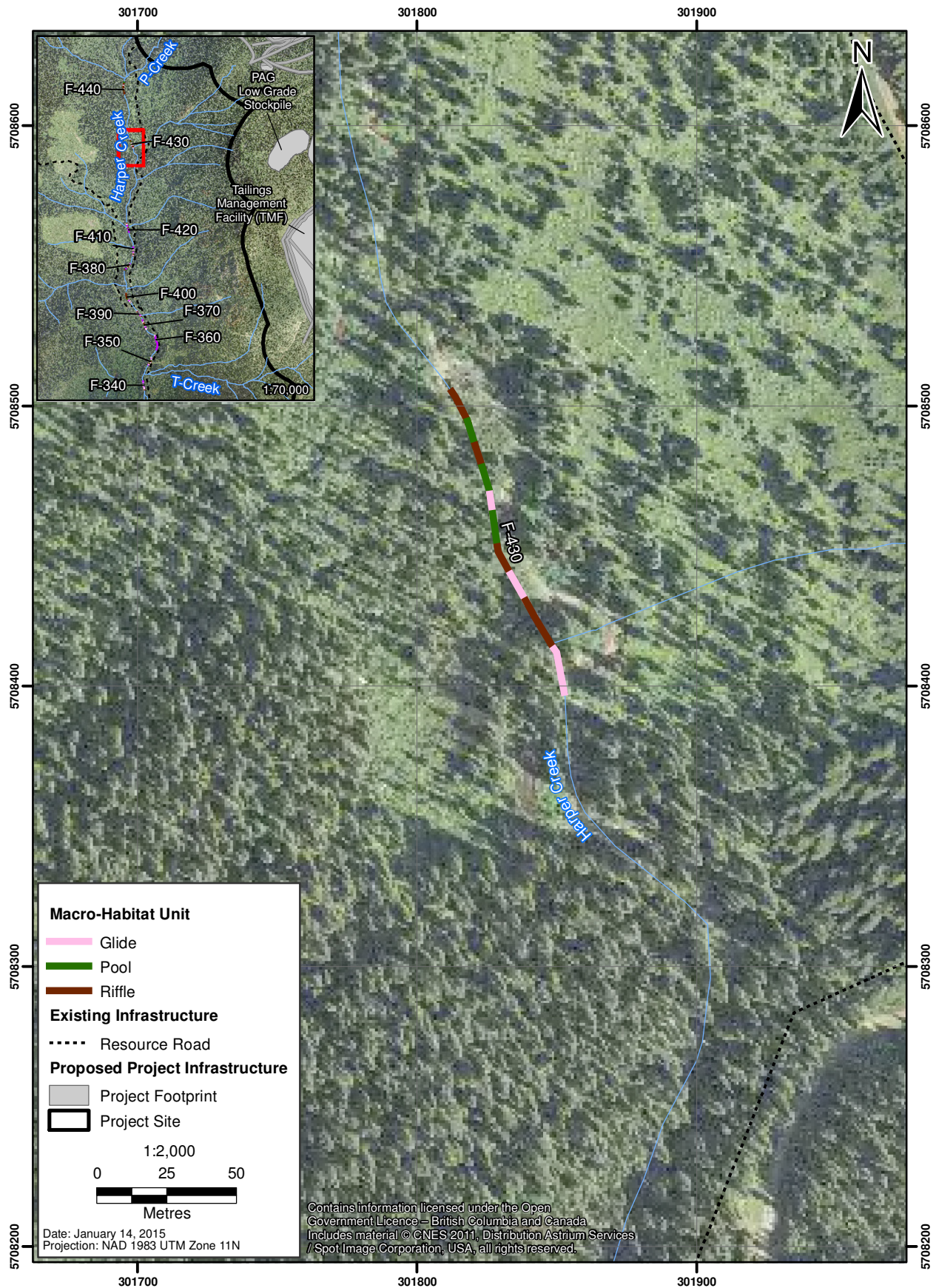


Figure 3.1-3

Macro-Habitat Units at Site HC F-420, Upper Harper Creek

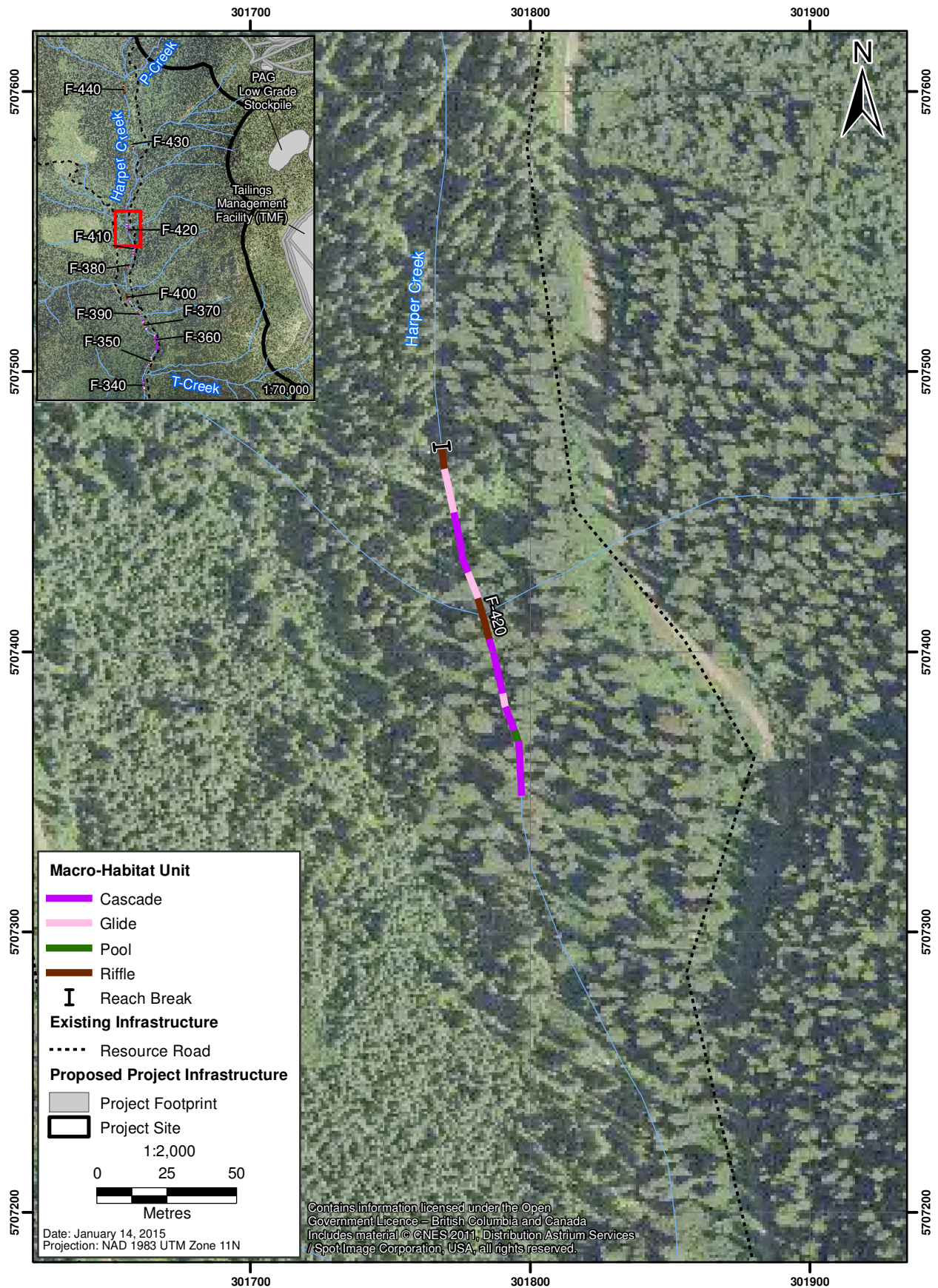


Figure 3.1-4

Macro-Habitat Units at Site HC F-410, Upper Harper Creek

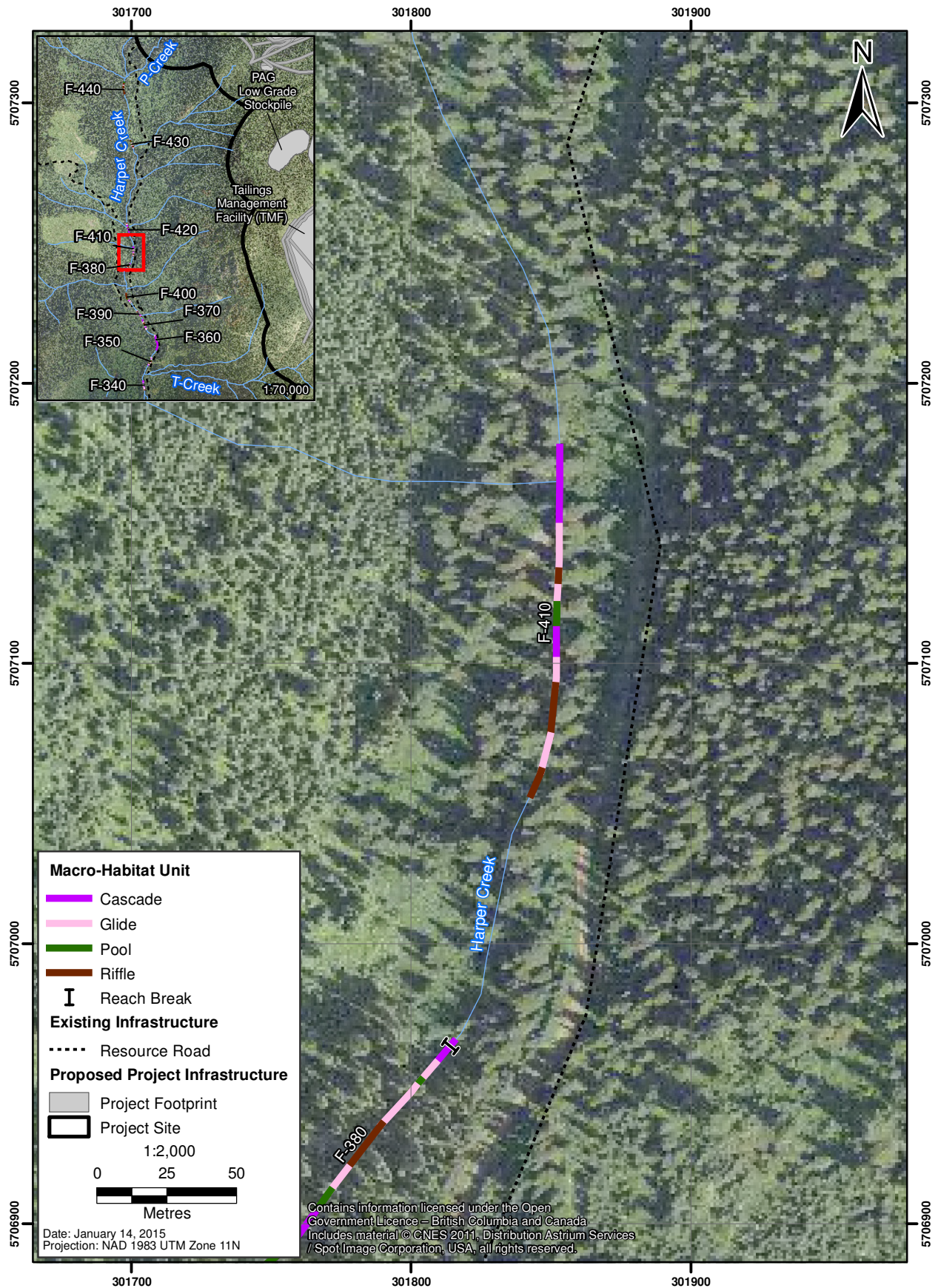


Figure 3.1-5

Macro-Habitat Units at Site HC F-380, Upper Harper Creek

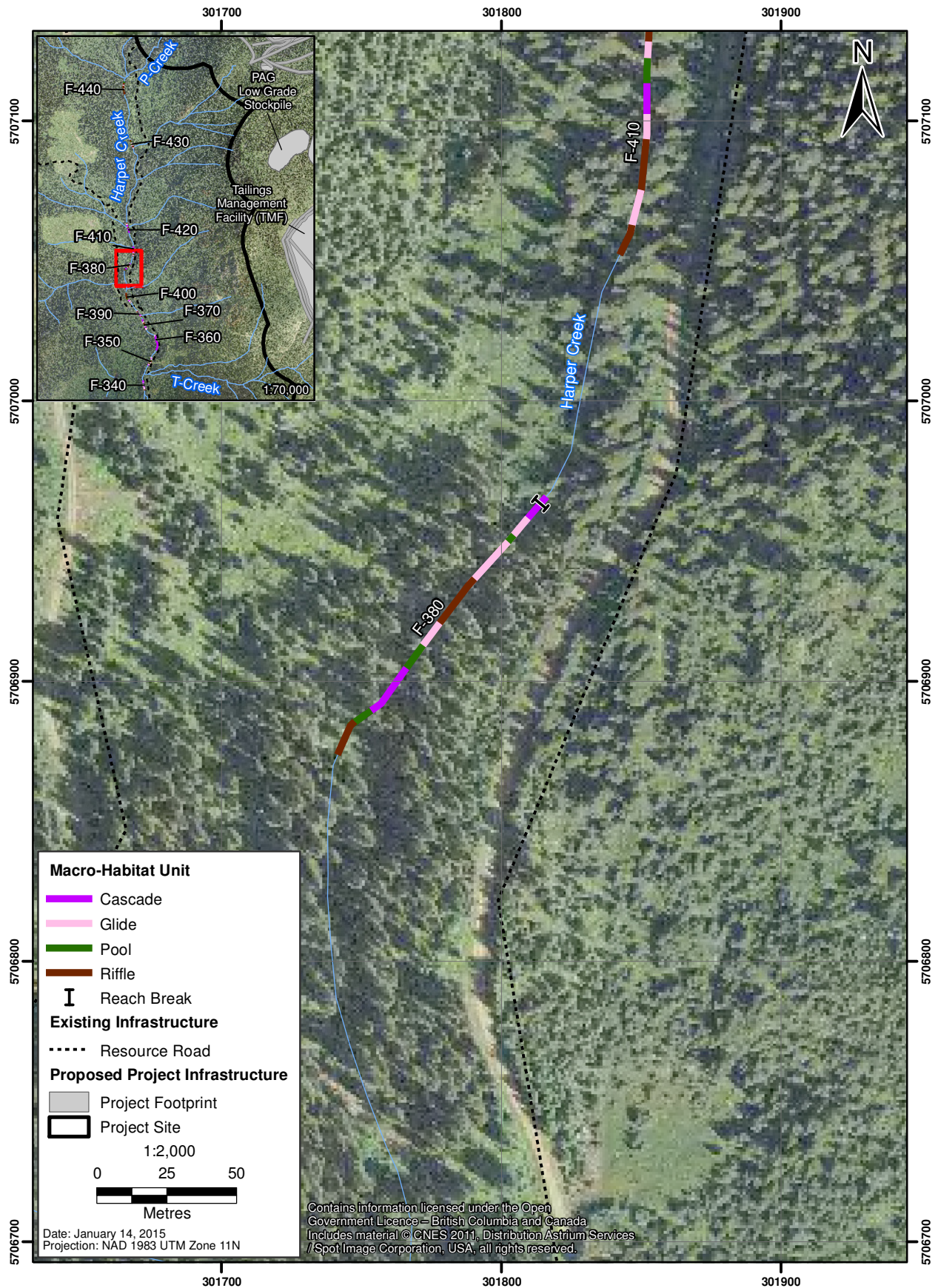


Figure 3.1-6

Macro-Habitat Units at Site HC F-400, Upper Harper Creek

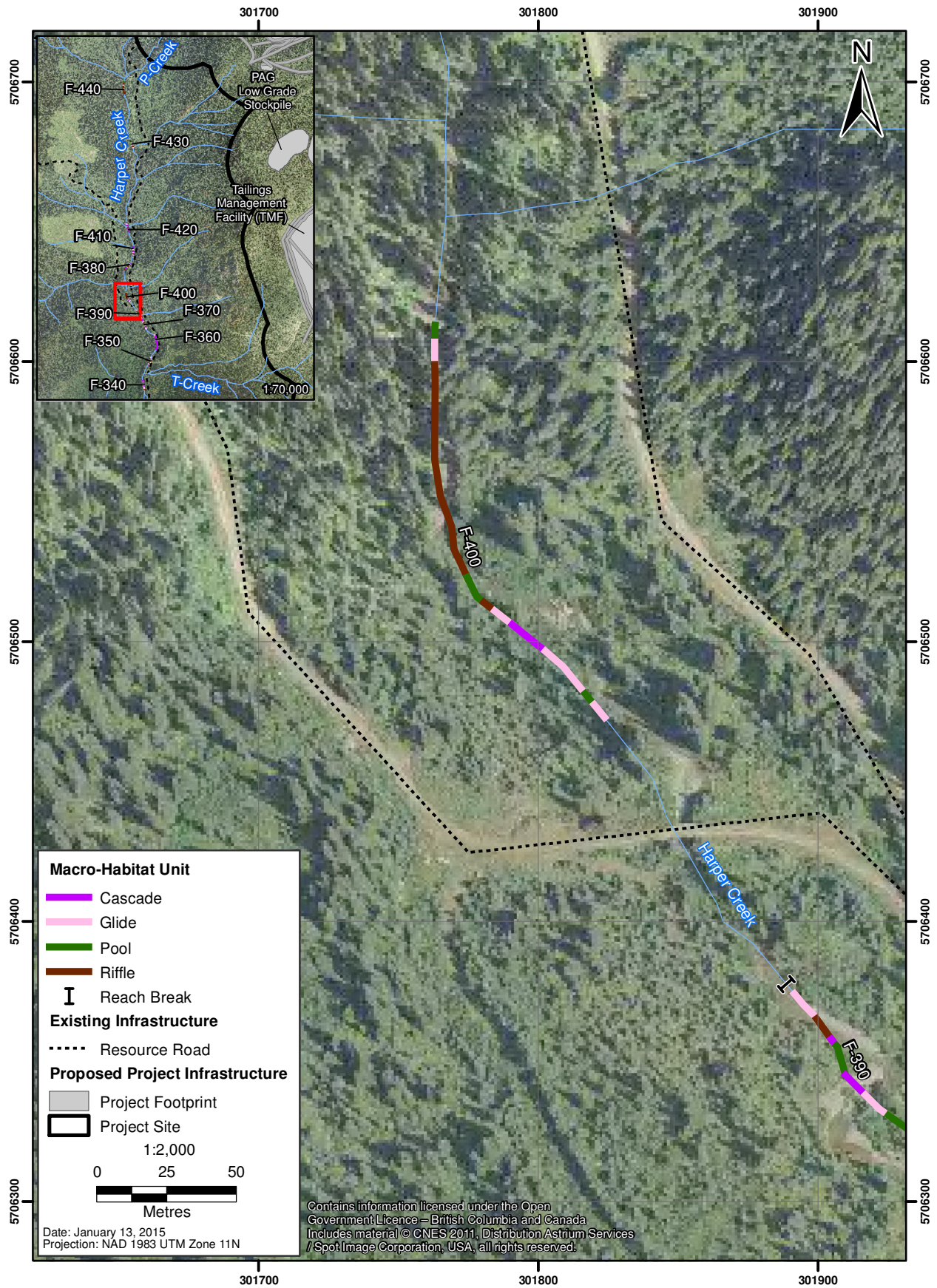


Figure 3.1-7

Macro-Habitat Units at Site HC F-390, Upper Harper Creek

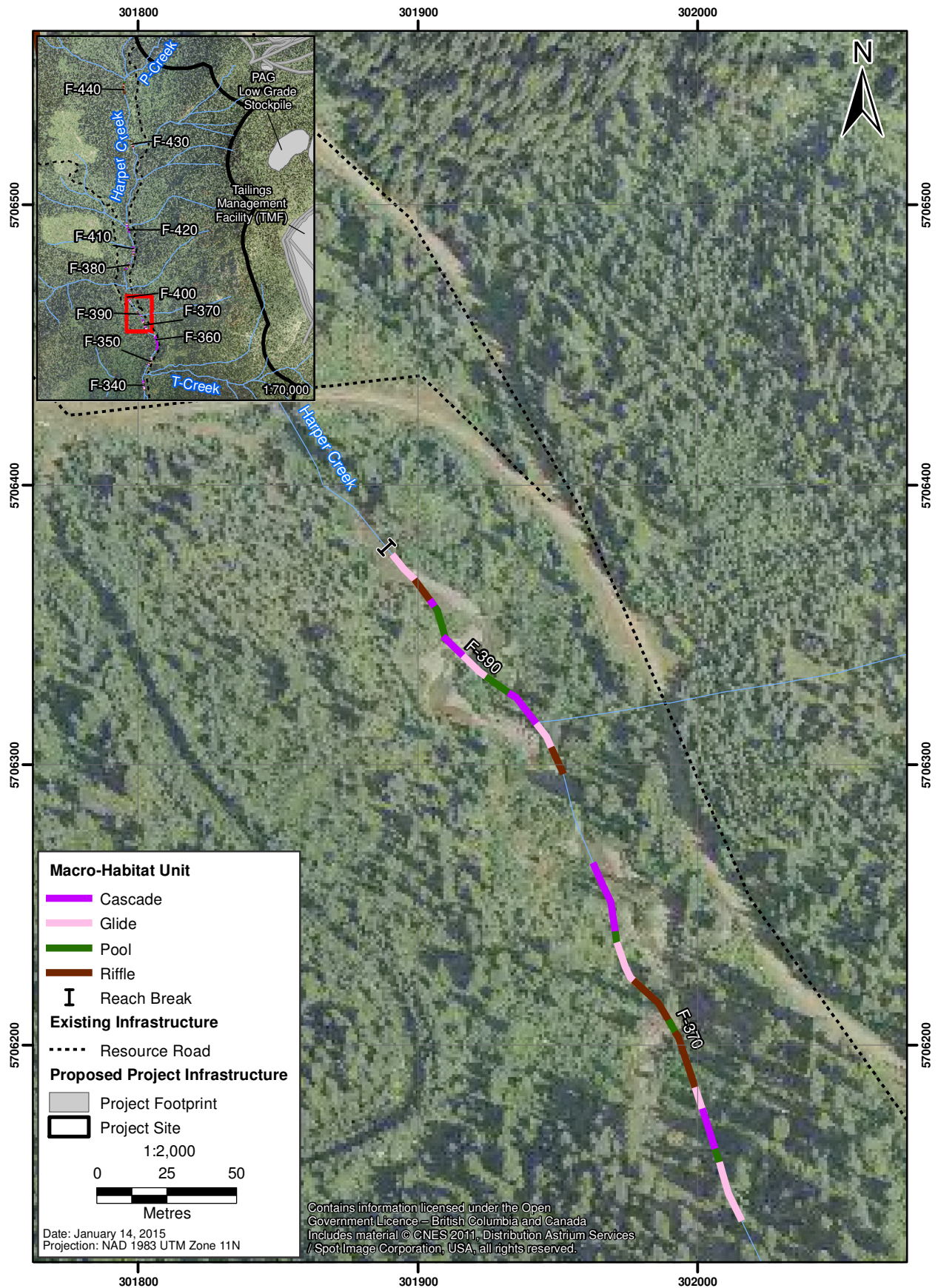
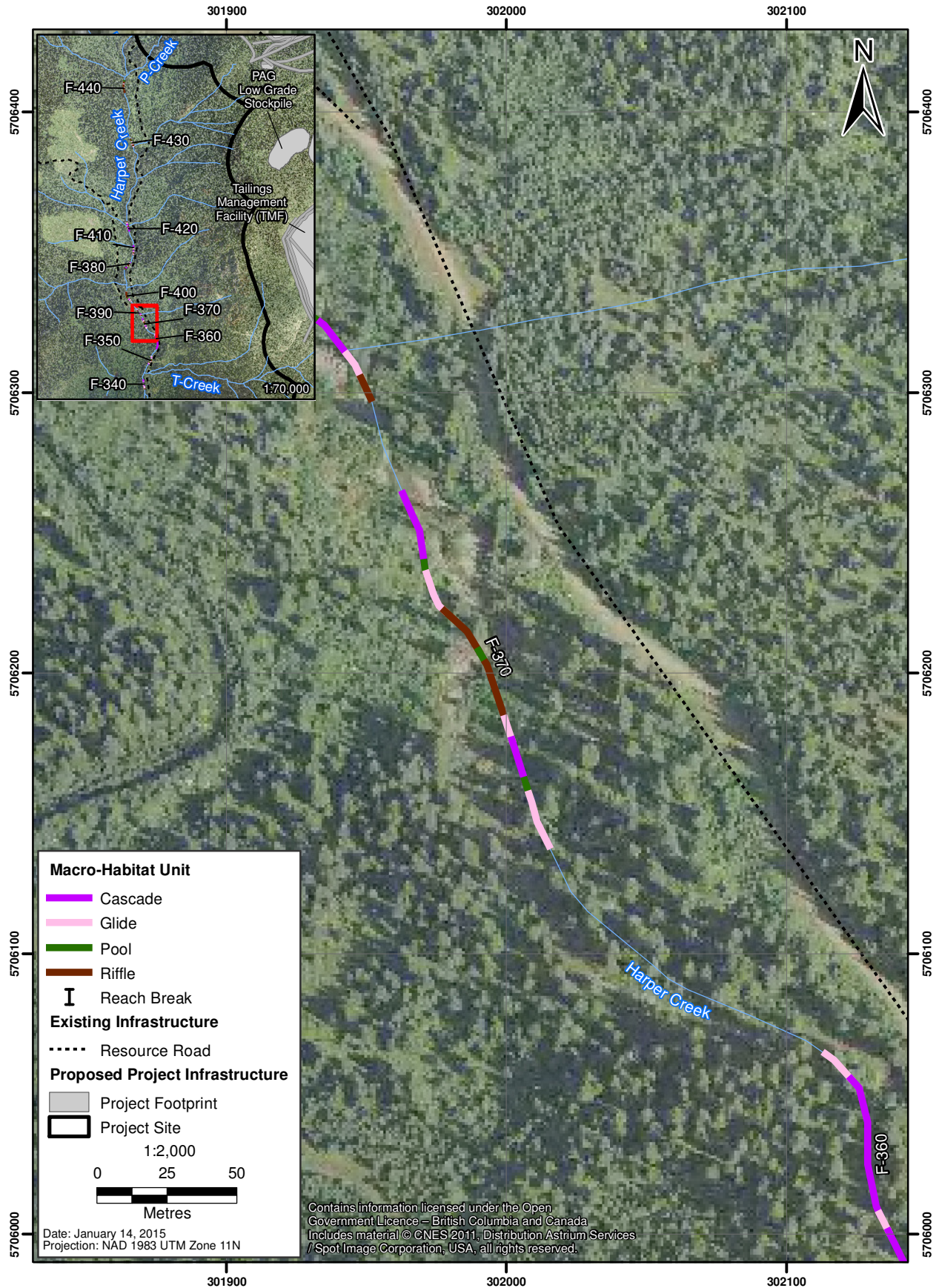


Figure 3.1-8

Macro-Habitat Units at Site HC F-370, Upper Harper Creek



Fish habitat was surveyed at two sites (HC F-360, HC F-350) within reach 13. Figures 3.1-9 and 3.1-10 show the distribution of habitat types at sites HC F-350 and HC F-360, respectively. A total of 324 m of fish habitat was divided into 14 habitat units, and classified as step-pool morphology. Habitat units ranged from 4 m to 130 m, with a mean of 22.3 m. This reach was characterized by steeper gradient, long cascades, and coarse substrate (boulder and cobble). Spawning gravel was typically limited to lower gradient habitat types such as glides and pools. Overall, habitat was variable, ranging from marginal (site HC F-360) to important (site HC F-350). Critical adfluvial Bull Trout spawning habitat was observed at glide habitat units within site HC F-350.

Reach 12 was surveyed at site HC F-340 near at the confluence of T and Harper creeks. Figure 3.1-11 shows the distribution of habitat types at site HC F-340. A total of 127 m of fish habitat was divided into 10 habitat units, and classified as riffle-pool morphology. Glide and cascade were the dominant and sub-dominant macro-habitat type, respectively. Habitat units ranged in length from 7 m to 28 m, with a mean of 12.7 m. Cobble (dominant) and gravel (sub-dominant) were the most commonly observed substrate types. Coarse gravel and spawning habitat was associated with glide and pool habitat units. Overhanging vegetation and large woody debris formed the majority of fish cover. Overall, habitat was rated as important, with critical adfluvial Bull Trout spawning habitat observed at glide and pools within this reach.

3.2 BULL TROUT REDD SURVEY

Data associated with each Bull Trout spawning redd are presented in Appendix C. A total of 11 adfluvial Bull Trout redds were observed in upper Harper Creek, between P and T creeks from September 11 to 13, 2014 (Table 3.2-1; Figure 3.2-1). The distance between P Creek and T Creek is roughly 4.1 km; however, a total of 1.5 km of fish habitat was surveyed. Thus, adfluvial Bull Trout redds were distributed approximately 1 redd per 138 m. Adfluvial Bull Trout redds were located in the highest density from the confluence of Harper and T Creek to approximately 1.5 km upstream on the Harper Creek mainstem (Figure 3.2-1). The timing, presence of adfluvial Bull Trout, and redd locations observed in September 2014 are similar to observations documented in Knight Piésold (2013).

Table 3.2-1. Bull Trout Redd Locations, 2014

Redd No.	UTM Location		
	Zone	Easting	Northing
F430-1	11U	301836	5708482
F380-1	11U	301756	5706916
F380-2	11U	301756	5706916
F400-1	11U	301763	5706563
F390-1	11U	301904	5706364
F370-1	11U	301990	5706228
F370-2	11U	302030	5706090
F350-1	11U	302082	5705794
F350-2	11U	302079	5705764
F350-3	11U	302079	5705764
F340-1	11U	301954	5705525

Figure 3.1-9

Macro-Habitat Units at Site HC F-360, Upper Harper Creek

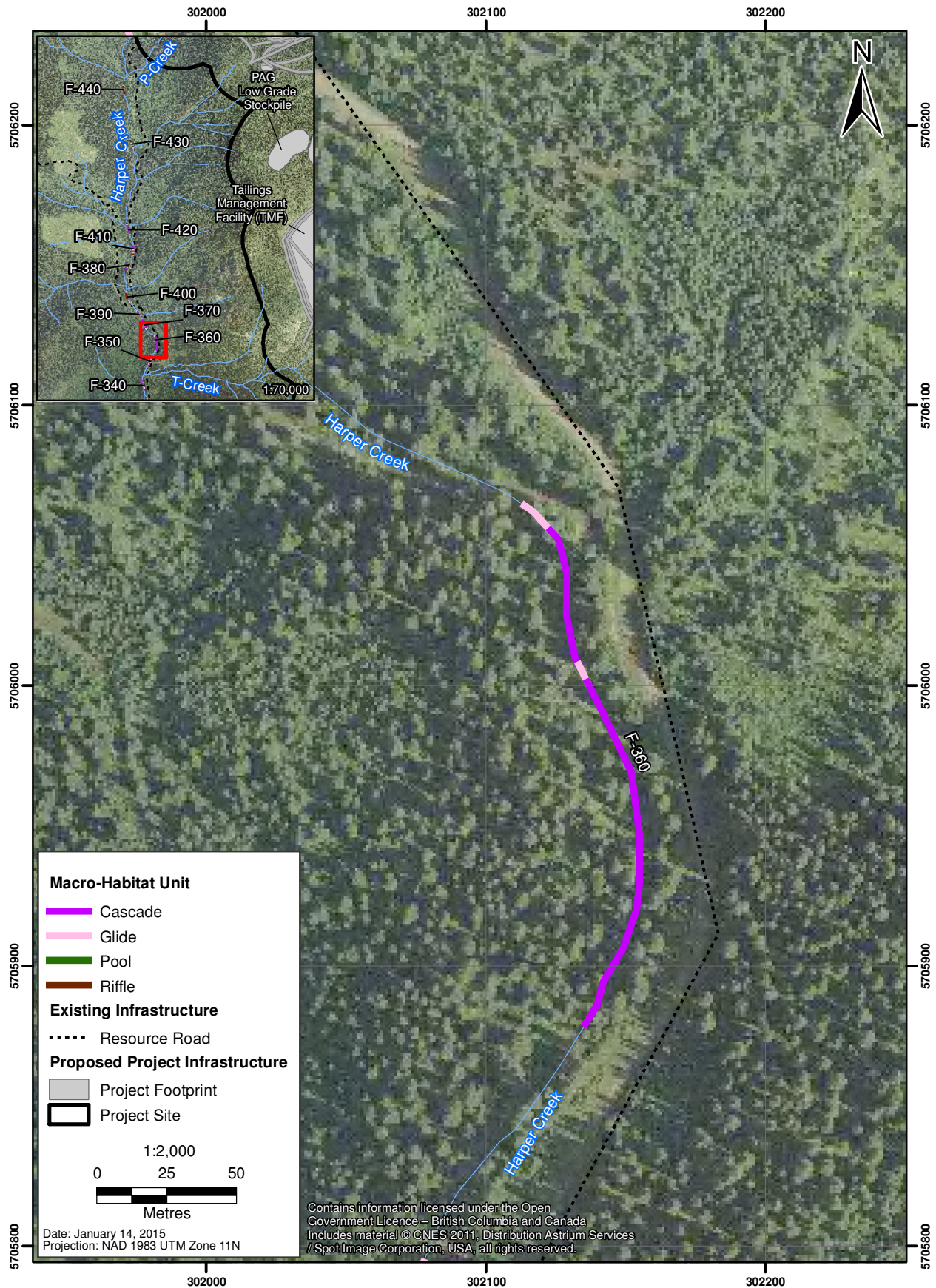


Figure 3.1-10

Macro-Habitat Units at Site HC F-350, Upper Harper Creek

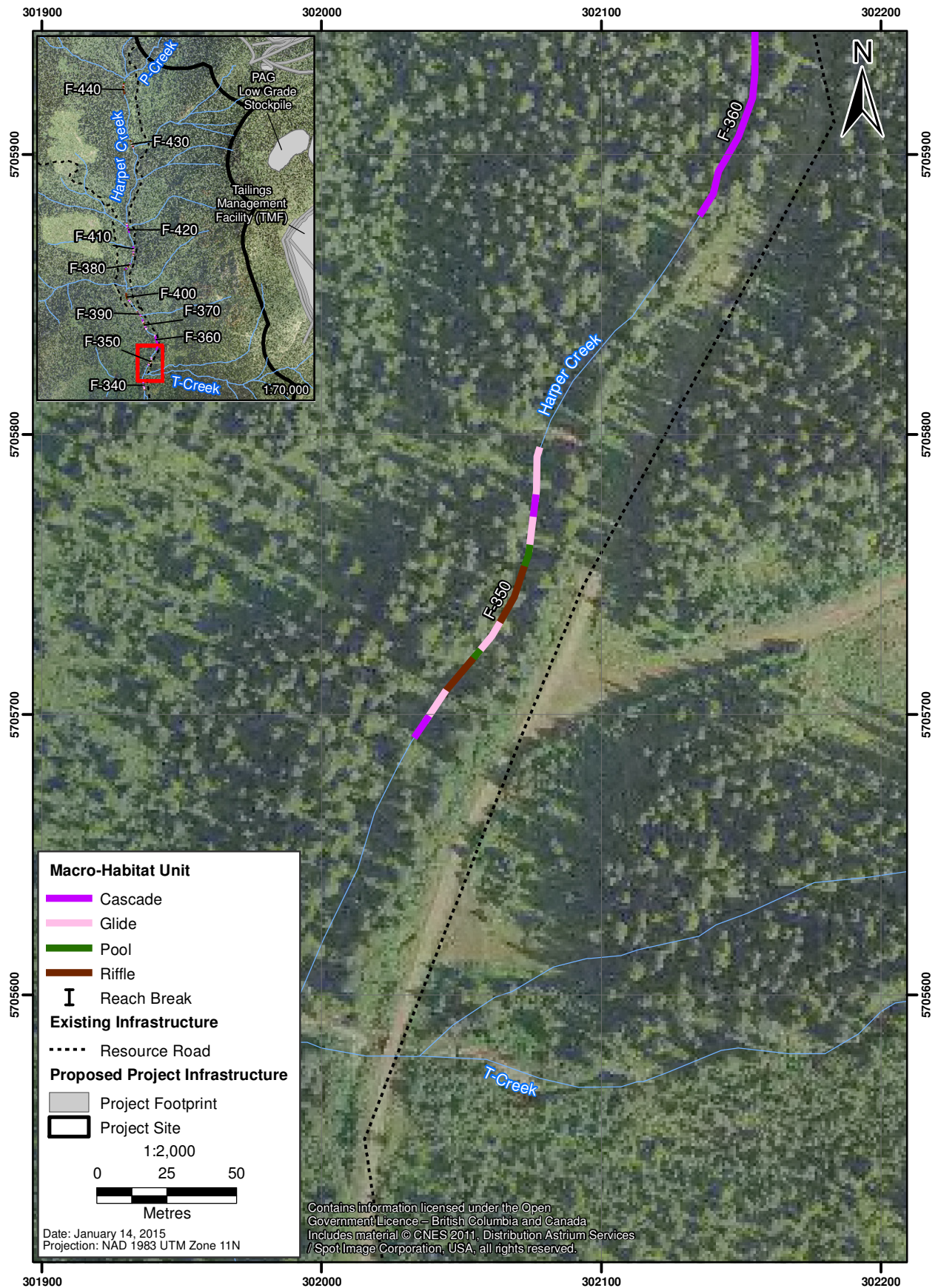


Figure 3.1-11

Macro-Habitat Units at Site HC F-340, Upper Harper Creek

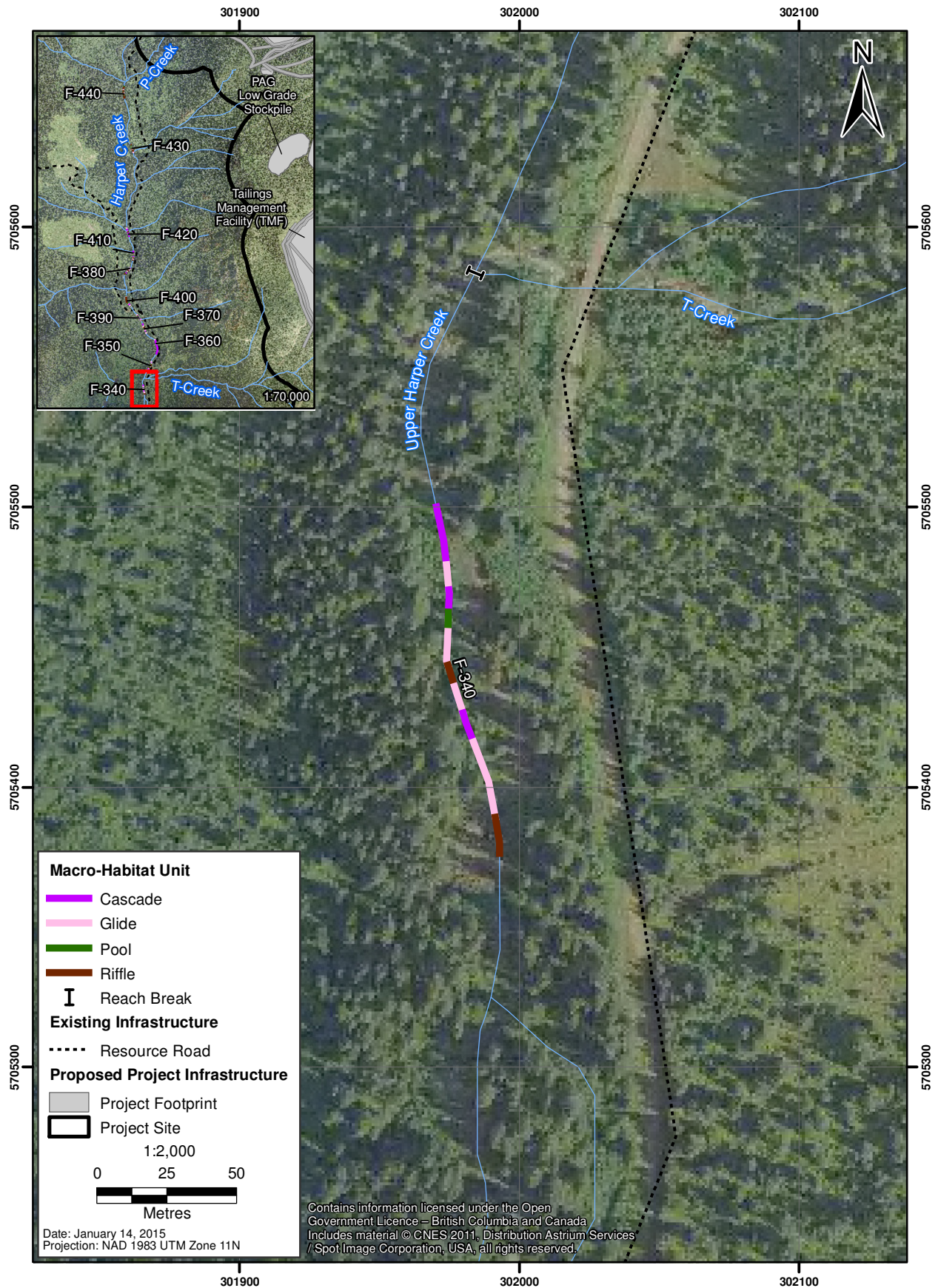
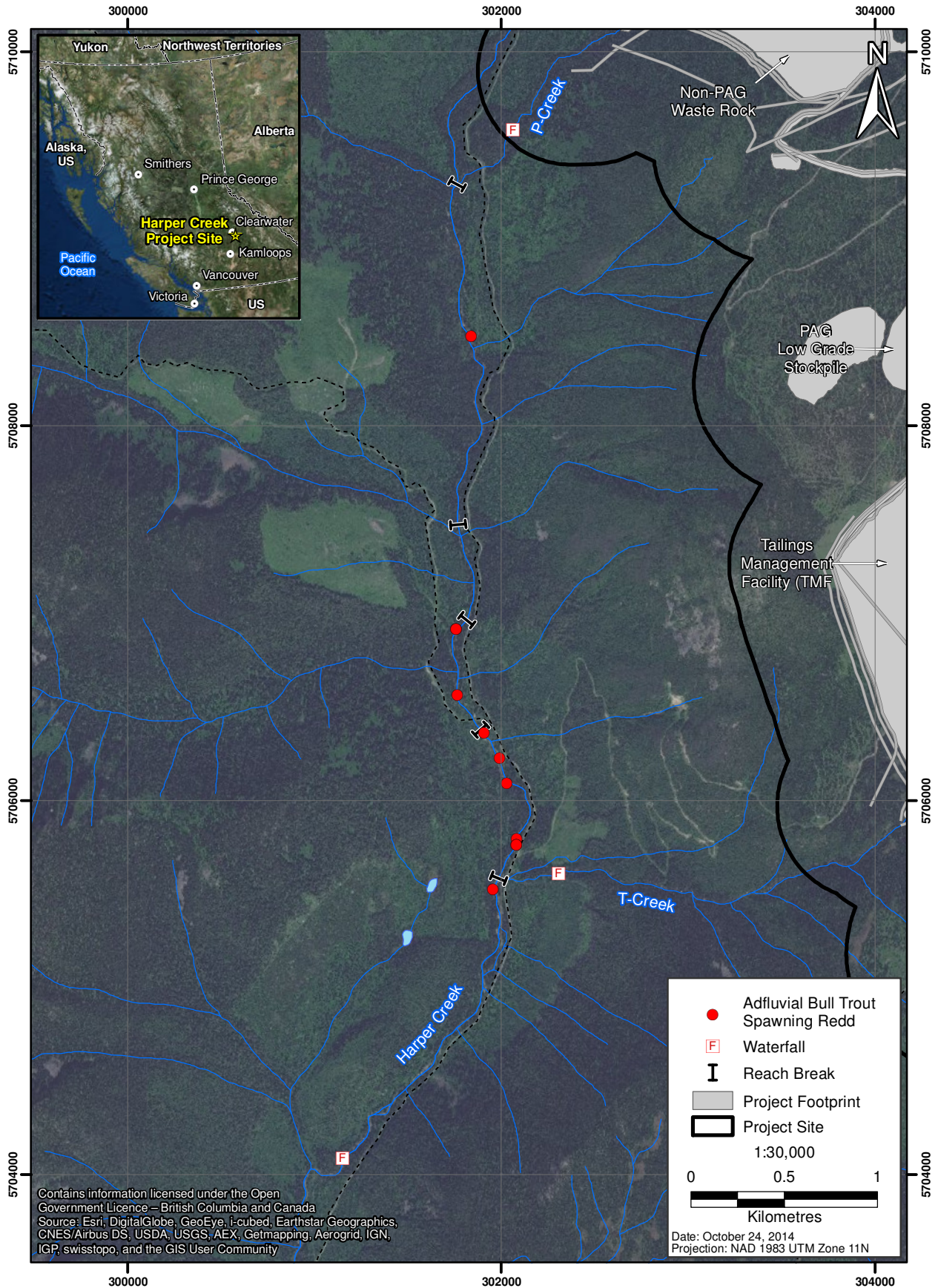


Figure 3.2-1

Bull Trout Redd Locations, 2014



All Bull Trout redd sites were associated with glide or pool tail-outs (which contain slow, laminar or upwelling flow; Plate 3.2-1), coarse gravel substrate, and overhanging cover (e.g., overhanging riparian vegetation, large woody debris, or undercut bank; Plate 3.2-2).



Plate 3.2-1. Pool tail-out located at site HC-F390 habitat unit 4, redd site F390-1, Upper Harper Creek, September 12, 2014.



Plate 3.2-2. Redd site F390-1, Upper Harper Creek, September 12, 2014.

The mean length and width of adfluvial Bull Trout redds measured 79 cm and 60 cm, respectively. The mean depth (measured at the centre of each redd) was 26 cm, and the crest depth (measured at the tail-out of each redd) was 11 cm. Adfluvial Bull Trout redds were most commonly located along the right bank, with a mean distance from the bank of 1.7 m. Water temperature during the survey ranged from 6°C to 8°C, with a mean of 7.2°C.

Adfluvial Bull Trout were observed in spawning colour (e.g., bright orange/red spots and belly, pronounced white leading fin rays; Plate 3.2-3), and holding on or in the vicinity of redd sites. Adfluvial Bull Trout spawning pairs were observed at two locations (F370-2; F390-1) holding on redd sites. A resident and adfluvial Bull Trout spawning pair were also observed at redd site F380-1. These observations indicate that both resident and adfluvial Bull Trout utilize upper Harper Creek for spawning and rearing habitat. In addition, resident and adfluvial Bull Trout may spawn together, causing population interaction and gene transfer between resident and adfluvial forms. Therefore, based upon the low frequency and availability of suitable spawning habitat in upper Harper Creek, Bull Trout redd sites were classified as critical habitat features.



Plate 3.2-3. A 52 cm adfluvial Bull Trout observed at redd site F390-1, Upper Harper Creek, September 12, 2014.

4. SUMMARY

The purpose of this program was to conduct fish habitat surveys following methods used by Knight Piésold (2013) at sites along upper Harper Creek, between P and T creeks. Detailed Level 1 fish habitat surveys and adfluvial Bull Trout redd surveys were conducted from September 11 to 13, 2014. Overall, fish habitat in upper Harper Creek, between P and T creeks, was variable, ranging from marginal to important, with critical habitat observed at Bull Trout redd locations. The surveyed reaches were classified as riffle-pool habitat, with diverse habitat complexes consisting of riffles, pools, cascades, and glides. Large woody debris and overhanging vegetation supplied abundant cover for fish. Cobble and gravel were the dominant and sub-dominant substrate types, respectively. Important or critical habitat was associated with Bull Trout spawning substrate and glide or pool habitat units.

A total of 11 adfluvial Bull Trout redds were observed over 4.1 km of the Harper Creek mainstem, between P and T creeks. The distance between P Creek and T Creek is roughly 4.1 km; however, a total of 1.5 km of fish habitat was surveyed. Thus, adfluvial Bull Trout redds were distributed approximately 1 redd per 138 m, with the highest density of redds occurring from the confluence of Harper and T Creek to approximately 1.5 km upstream on the Harper Creek mainstem. All Bull Trout redd sites were associated with glide or pool tail-outs (which contain slow, laminar or upwelling flow), coarse gravel substrate, and overhanging cover (e.g., overhanging riparian vegetation, large woody debris, or undercut bank). Based upon the low frequency and availability suitable spawning habitat in upper Harper Creek, Bull Trout redd sites were classified as critical habitat features.

REFERENCES

- Johnson, N.T. and P.A. Slaney. 1996. *Watershed Restoration Program Fisheries Habitat Assessment Procedures* (FHAP). Watershed Restoration Technical Circular No. 8 (BC Ministry of Environment, Lands and Parks, and Ministry of Forests, 1996).
- Knight Piésold. 2013. *Fish and Aquatic Habitat Baseline. Prepared for: Harper Creek Mining Corp.* by Knight Piésold Consulting, Vancouver, BC. March 2013.
- Simonson, T.D., J. Lyons, and P.D. Kanehl. 1994. Quantifying Fish Habitat in Streams: Transect Spacing, Sample Size, and a Proposed Framework. *North American Journal of Fisheries Management* 14 (3): p. 607-615.

Appendix A

Detailed Level 1 Fish Habitat Data, 2014

HARPER CREEK PROJECT

Harper Creek Fish Habitat Baseline Report

Appendix A. Detailed Level 1 Fish Habitat Data, 2014

Date: 13-Sep-14 Transparency: clear UTM Coordinates
 Site: HC F-340 Flow stage: low Upstream: 0301910 E, 5705500 N
 Crew: KE/GC Temperature: 8°C Downstream: 0301986 E, 5705463 N

Habitat Unit No.	Reach No.	Distance (m)	Habitat Unit		Length Gradient		Mean Depth		Mean Width		Pools Only				Bed Material Type				Functional LWD Tally				Cover Type				Riparian Veg		Canopy				Comments
			Type	Cat	(m)	%	Bankfull (m)	Wetted (m)	Bankfull (m)	Wetted (m)	Max (m)	Crest (m)	Residual (m)	Type (m)	Dom	SD	Spawning Gravel		Total	10-20 (cm)	20-50 (cm)	> 50 (cm)	Dom.	SD	Trace	Tot. %	Type	Structure	Closure	Barriers	Photos		
														Type	Amount																		
1	12	0	C	1	21	3	0.8	0.3	8	6	—	—	—	—	Cb	B	0	0	4	2	2	0	OV	LWD	—	20	Sh, T	YF	20	none	92		
2	12	21	G	1	9	1	1	0.4	6	5	—	—	—	—	Cb	Gr	C	5	2	2	0	0	OV	LWD	UC	30	Sh, T	YF	20	none	—		
3	12	30	C	1	8	3	0.6	0.2	7	5	—	—	—	—	Cb	B	0	0	2	0	1	1	LWD	—	—	10	Sh, T	YF	20	none	—		
4	12	38	P	1	7	1	0.6	0.7	10	7	0.96	0.2	—	S	Cb	Gr	P	15	12	5	6	1	LWD	P	—	80	Sh, T	YF	10	none	93		
5	12	45	G	1	12	0	0.9	0.3	19	12	—	—	—	—	Cb	Gr	C	40	2	1	1	0	LWD	—	—	10	Sh, T	YF	10	none	—	adfluvial BT redd F340-1	
6	12	57	R	1	8	3	0.8	0.2	18	11	—	—	—	—	Cb	Gr	0	0	0	0	0	0	—	—	—	0	Sh, T	YF	10	none	—		
7	12	65	G	1	10	1	0.6	0.3	10	7	—	—	—	—	Cb	B	C	10	0	0	0	0	OV	—	—	20	Sh, T	YF	20	none	—		
8	12	75	C	1	11	3	0.7	0.3	13	6	—	—	—	—	Cb	B	C	10	0	0	0	0	OV	—	—	20	Sh, T	YF	30	none	—		
9	12	86	G	1	28	1	0.5	0.5	11	8	—	—	—	—	Cb	F	C, P	20	4	4	0	0	OV	UC	—	60	Sh, T	YF	40	none	95		
10	12	114	R	1	13	3	0.8	0.2	14	11	—	—	—	—	Cb	Gr	C	50	3	1	2	0	OV	LWD	—	20	Sh, T	YF	0	none	—		

Overall Rating: Important, critical at H.U. 5

Spawning: Good, excellent at H.U. 5 adfluvial BT redd at H.U. 5 some areas with pool/glide depth and flow and coarse gravel substrate	Rearing: Good Abundant cover for juvenile BT	Overwintering: Fair, some deep pools present	Migration: Fair, LWD jams impeding fish movement
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Appendix A. Detailed Level 1 Fish Habitat Data, 2014

Date: 13-Sep-14 Transparency: clear UTM Coordinates
 Site: HC F-350 Flow stage: low Upstream: 0302082 E, 5705794 N
 Crew: KE/GC Temperature: 7°C Downstream: 0302042 E, 5705688 N

Habitat Unit No.	Reach No.	Distance (m)	Habitat Unit		Length Gradient		Mean Depth		Mean Width		Pools Only				Bed Material Type				Functional LWD Tally				Cover Type				Riparian Veg		Canopy				Comments
			Type	Cat	(m)	%	Bankfull (m)	Wetted (m)	Bankfull (m)	Wetted (m)	Max (m)	Crest (m)	Residual (m)	Type (m)	Dom	SD	Spawning Gravel		Total	10-20 (cm)	20-50 (cm)	> 50 (cm)	Dom.	SD	Trace	Tot. %	Type	Structure	Closure	Barriers	Photos		
																	Type	Amount															
1	13	0	G	1	17	2	0.7	0.2	7	6	—	—	—	—	Cb	Gr	C	10	3	1	1	1	LWD	OV	UC	50	Sh, T	YF	40	none	87	adfluvial BT redd F350-1 adfluvial BT redd F350-2 and F350-3	
2	13	17	C	1	8	3	0.7	0.2	8	6	—	—	—	—	Cb	B	0	0	1	1	0	0	OV	UC	—	10	Sh, T	YF	40	none	—		
3	13	25	G	1	10	1	0.8	0.2	8	7	—	—	—	—	Cb	Gr	C	50	4	3	0	1	OV	LWD	—	40	Sh, T	YF	40	none	88		
4	13	35	P	1	8	0	0.6	0.6	9	7	0.9	0.26	—	S	F	Gr	C	10	3	0	2	1	P	OV	LWD	80	Sh, T	YF	40	none	90		
5	13	43	R	1	22	3	0.8	0.2	8	6	—	—	—	—	Cb	Gr	0	0	1	1	0	0	OV	UC	—	20	Sh, T	YF	40	none	—		
6	13	65	G	1	12	2	0.7	0.6	8	4	—	—	—	—	Cb	Gr	C	5	1	1	0	0	OV	UC	—	10	Sh, T	YF	60	none	—		
7	13	87	P	1	4	0	0.7	0.6	10	8	0.9	0.23	—	S	Cb	Gr	C	10	2	0	0	2	LWD	P	—	80	Sh, T	YF	40	none	—		
8	13	91	R	1	15	3	0.8	0.2	9	8	—	—	—	—	Cb	Gr	C	5	2	2	2	0	OV	UC	—	20	Sh, T	YF	40	none	—		
9	13	106	G	1	11	1	0.3	0.3	9	8	—	—	—	—	Gr	Cb	P	60	4	4	0	0	OV	UC	—	50	Sh, T	YF	40	none	91		
10	13	117	C	1	7	4	0.4	0.2	7	6	—	—	—	—	Cb	Gr	0	0	7	3	3	1	LWD	OV	—	30	Sh, T	YF	20	none	—		

Overall Rating: Important, critical at H.U. 1 and 3

Spawning:
 Good, excellent at H.U. 1 and 3
 adfluvial BT redd at H.U. 1 and 3

Rearing:
 Good
 Abundant cover for juvenile BT

Overwintering:
 Good, pool > 1 m present

Migration:
 Good, few LWD jams

Appendix A. Detailed Level 1 Fish Habitat Data, 2014

Date: 13-Sep-14 Transparency: clear UTM Coordinates
 Site: HC F-360 Flow stage: low Upstream: 0302118 E, 5706069 N
 Crew: KE/GC Temperature: 7°C Downstream: poor GPS reception

Habitat Unit No.	Reach No.	Distance (m)	Habitat Unit		Length Gradient		Mean Depth		Mean Width		Pools Only				Bed Material Type				Functional LWD Tally				Cover Type				Riparian Veg		Canopy			Comments
			Type	Cat	(m)	%	Bankfull (m)	Wetted (m)	Bankfull (m)	Wetted (m)	Max (m)	Crest (m)	Residual (m)	Type (m)	Dom	SD	Spawning Gravel		Total	10-20 (cm)	20-50 (cm)	> 50 (cm)	Dom.	SD	Trace	Tot. %	Type	Structure	Closure	Barriers	Photos	
															Type	Amount																
1	13	0	G	1	13	2	0.6	0.3	8	7	—	—	—	—	Cb	Gr	0	0	1	1	0	0	OV	UC	LWD	50	Sh, T	YF	50	none		
2	13	13	C	1	50	4	0.7	0.3	7	4	—	—	—	—	B	Cb	0	0	3	3	2	0	B	OV	LWD	10	Sh, T	YF	50	none	83, 84	
3	13	63	G	1	7	1	0.6	0.5	6	5	—	—	—	—	B	Cb	0	0	1	0	1	0	B	OV	LWD	10	Sh, T	YF	30	none		
4	13	70	C	1	130+	4	1	0.2	9	8	—	—	—	—	B	Cb	0	0	2	0	2	0	B	OV		10	Sh, T	YF	40	none	85	

Overall Rating: Marginal

Spawning: None
 No redds or spawning BT observed

Rearing: Good
 Cascade and boulder cover

Overwintering: None

Migration: Good, no LWD jams

Appendix A. Detailed Level 1 Fish Habitat Data, 2014

Date: 12-Sep-14 Transparency: clear UTM Coordinates
 Site: HC F-370 Flow stage: low Upstream: 0301966 E, 5706264 N
 Crew: KE/GC Temperature: 7°C Downstream: 0301991 E, 5706156 N

Habitat Unit No.	Reach No.	Distance (m)	Habitat Unit		Length (m)	Gradient %	Mean Depth		Mean Width		Pools Only				Bed Material Type		Functional LWD Tally				Cover Type				Riparian Veg		Canopy Closure	Barriers	Photos	Comments				
			Type	Cat			Bankfull (m)	Wetted (m)	Bankfull (m)	Wetted (m)	Max (m)	Crest (m)	Residual (m)	Type (m)	Dom	SD	Type	Amount	Total	10-20 (cm)	20-50 (cm)	> 50 (cm)	Dom.	SD	Trace	Tot. %					Type	Structure		
1	14	0	C	1	26	3	0.6	0.2	7	4	—	—	—	—	Cb	B	0	0	6	3	3	0	LWD	OV	—	30	Sh, T	YF	30	none	77			
2	14	26	P	1	4	1	0.5	0.5	7	5	0.55	0.23	—	S	Cb	Gr	P	5	4	3	1	0	LWD	OV	P		Sh, T	YF	50	none	—			
3	14	30	G	1	15	1	0.6	0.2	9	6	—	—	—	—	Cb	Gr	C, P	40	2	1	1	0	LWD	OV	—	10	Sh, T	YF	10	none	78	adfluvial BT redd F370-1; spawning pair; photo 79		
4	14	45	R	1	19	3	0.8	0.2	10	5	—	—	—	—	Cb	Gr	C	10	5	4	1	0	OV	LWD	—	50	Sh, T	YF	50	none	—			
5	14	64	P	1	5	0	0.5	0.6	12	8	0.8	0.2	—	LWD	Gr	B	C	30	15	7	7	1	LWD	P	OV	90	Sh, T	YF	90	none	—			
6	14	69	R	1	21	2	0.8	0.3	8	6	0.6	—	0.66	S	Cb	Gr	0	0	0	0	0	0	0	0	OV	SWD	—	50	Sh, T	YF	50	none	—	
7	14	90	G	1	8	2	0.5	0.4	11	5	—	—	—	—	Cb	Gr	C	5	5	0	0	0	OV	UC	—	20	Sh, T	YF	20	none	—			
8	14	98	C	1	15	3	0.7	0.3	8	5	—	—	—	—	Cb	Gr	0	0	0	1	0	2	LWD	OV	—	10	Sh, T	YF	10	none	—			
9	14	113	P	1	5	0	1	0.6	6	5	0.8	0.25	—	LWD	Gr	Cb	C	10	10	1	3	2	LWD	P	—	70	Sh, T	YF	70	none	80			
10	14	118	G	1	20	1	0.9	0.3	7	5	—	—	—	—	CB	Gr	C	20	20	3	1	0	LWD	OV	UC	50	Sh, T	YF	50	none	—			

Overall Rating: Important, critical at H.U. 3

Spawning:
 Good, excellent at H.U. 3
 adfluvial BT redd at H.U. 3
 located in glude tail-out

Rearing:
 Good
 Abundant cover for juvenile BT

Overwintering:
 Fair, pools > 1 m not present

Migration:
 Fair, fewLWD jams and steps created by functional LWD

Appendix A. Detailed Level 1 Fish Habitat Data, 2014

Date: 12-Sep-14 Transparency: clear UTM Coordinates
 Site: HC F-390 Flow stage: low Upstream: 0301883 E, 5706374 N
 Crew: KE/GC Temperature: 7.5°C Downstream: 0301922 E, 5706315 N

Habitat Unit No.	Reach No.	Distance (m)	Habitat Unit		Length Gradient		Mean Depth		Mean Width		Pools Only				Bed Material Type				Functional LWD Tally				Cover Type				Riparian Veg		Canopy				Comments
			Type	Cat	(m)	%	Bankfull (m)	Wetted (m)	Bankfull (m)	Wetted (m)	Max (m)	Crest (m)	Residual (m)	Type (m)	Dom	SD	Spawning Gravel		Total	10-20 (cm)	20-50 (cm)	> 50 (cm)	Dom.	SD	Trace	Tot. %	Type	Structure	Closure	Barriers	Photos		
																	Type	Amount															
1	15	0	G	1	12	1	0.5	0.2	7	6	—	—	—	—	Cb	B	MP	1	3	2	1	0	OV	B	LWD	25	Sh, T	YF	5	none	60		
2	15	12	R	1	9	3	0.5	0.2	10	9	—	—	—	—	Cb	Gr	0	0	0	0	0	0	OV	B	—	5	Sh, T	YF	5	none	—		
3	15	21	C	1	3	4	0.8	0.2	8	7	—	—	—	—	Cb	Gr	0	0	1	1	0	0	OV	UC	—	5	Sh, T	YF	5	none	—		
4	15	24	P	1	11	0	0.6	0.6	8	6	0.8	0.25	—	S	Cb	GR	C	15	3	1	2	0	P	B	UC	70	Sh, T	YF	10	none	61, 66	adfluvial BT redd F390-1; spawning pair observed; female ~52 cm in length	
5	15	35	C	1	10	4	0.9	0.2	8	4	—	—	—	—	Cb	Gr	0	0	0	0	1	0	OV	UC	—	20	Sh, T	YF	0	none	—		
6	15	45	G	1	11	1	0.7	0.6	14	11	—	—	—	—	Cb	F	0	0	2	0	0	2	OV	LWD	—	5	Sh, T	YF	0	none	—		
7	15	56	P	1	10	1	1	0.8	12	10	1.3	0.02	—	S	Cb	Gr	MP	1	9	5	2	2	LWD	P	OV	80	Sh, T	YF	0	none	62		
8	15	66	C	1	15	4	0.4	0.2	15	4	—	—	—	—	Cb	Gr	0	0	3	2	1	0	OV	LWD	—	20	Sh, T	YF	0	none	—		
9	15	81	G	1	10	2	1	0.3	12	4	—	—	—	—	Cb	Gr	0	0	1	1	0	0	SWD	LWD	OV	5	Sh, T	YF	0	none	—		
10	15	91	R	1	8	3	1.2	0.2	8	5	—	—	—	—	Cb	B	0	0	1	0	0	1	LWD	UC	OV	20	Sh, T	YF	0	none	65		
99																																	

Overall Rating: Important, critical at H.U. 4

Spawning: Good, spawning gravel in pools and glides
 adfluvial BT spawning pair at H.U. 4
 redd located in H.U. 4 pool tail-out

Rearing: Good
 Abundant cover for juvenile BT

Overwintering: Good, large and deep pool present

Migration: Fair, fewLWD jams and steps created by functional LWD

Appendix A. Detailed Level 1 Fish Habitat Data, 2014

Date: 12-Sep-14 Transparency: clear UTM Coordinates
 Site: HC F-400 Flow stage: low Upstream: 0301758 E, 5706613 N
 Crew: KE/GC Temperature: 8°C Downstream: 0301833 E, 5706481 N

Habitat Unit No.	Reach No.	Distance (m)	Habitat Unit		Length Gradient		Mean Depth		Mean Width		Pools Only				Bed Material Type				Functional LWD Tally				Cover Type				Riparian Veg		Canopy				Comments
			Type	Cat	(m)	%	Bankfull (m)	Wetted (m)	Bankfull (m)	Wetted (m)	Max (m)	Crest (m)	Residual (m)	Type (m)	Dom	SD	Spawning Gravel		Total	10-20 (cm)	20-50 (cm)	> 50 (cm)	Dom.	SD	Trace	Tot. %	Type	Structure	Closure	Barriers	Photos		
																	Type	Amount															
1	15	0	P	1	6	0	0.8	0.6	7	5	0.8	0.3	—	S	F	Gr	P	10	7	2	5	0	LWD	P	—	60	Sh, T	YF	20	none	53		
2	15	6	G	1	8	1	0.7	0.3	9	5	—	—	—	—	B	Gr	P	30	2	2	0	0	LWD	OV	B	40	Sh, T	YF	20	none	—		
3	15	14	R	1	78	3	0.5	0.2	9	5.5	—	—	—	—	Cb	B	MP	2	6	6	0	0	OV	B	LWD	20	Sh, T	YF	20	none	56		
4	15	92	P	1	11	1	0.7	0.6	8	7	0.75	0.2	—	S	B	Cb	P	20	4	2	2	0	P	LWD	B	60	Sh, T	YF	30	none	54, 55	adfluvial BT redd F400-1	
5	15	103	R	1	5	2	0.7	0.2	7.5	7	—	—	—	—	Cb	Gr	MP	5	3	3	0	0	OV	LWD	—	10	Sh, T	YF	10	none	—		
6	15	108	G	1	8	1	0.7	0.5	8	8	—	0.2	0.8	S	Cb	B	0	0	1	1	0	0	OV	B	—	20	Sh, T	YF	0	none	—		
7	15	116	C	1	15	4	0.4	0.2	7	5	—	—	—	—	Cb	B	0	0	7	1	6	0	LWD	OV	—	20	Sh, T	YF	10	none	58		
8	15	131	G	1	21	1	0.5	0.4	8	5	—	—	—	—	Cb	Gr	0	0	8	4	4	0	OV	UC	LWD	20	Sh, T	YF	0	none	—		
9	15	152	P	1	5	0	0.5	0.8	6	6	0.9	0.3	—	S	Cb	B	0	0	6	1	5	1	P	LWD	UC	100	Sh, T	YF	30	none	59		
10	15	157	G	1	6	1	0.4	0.3	8	6	—	—	—	—	Cb	Gr	MP	1	1	1	0	0	OV	SWD	LWD	10	Sh, T	YF	10	none	—		

Overall Rating: Important

Spawning:

Fair, isolated patches of spawning gravel
 adfluvial BT redd observed at H.U. 4

Rearing:

Good
 Abundant cover for juvenile BT

Overwintering:

Fair, some deep pools present

Migration:

Fair, fewLWD jams and steps created by functional LWD

Appendix A. Detailed Level 1 Fish Habitat Data, 2014

Date: 12-Sep-14 Transparency: clear UTM Coordinates
 Site: HC F-380 Flow stage: low Upstream: 0301813 E, 5706965 N
 Crew: KE/GC Temperature: 8°C Downstream: 0301753 E, 5706876 N

Habitat Unit No.	Reach No.	Distance (m)	Habitat Unit		Length Gradient		Mean Depth		Mean Width		Pools Only				Bed Material Type				Functional LWD Tally				Cover Type				Riparian Veg		Canopy			
			Type	Cat	(m)	%	Bankfull (m)	Wetted (m)	Bankfull (m)	Wetted (m)	Max (m)	Crest (m)	Residual (m)	Type (m)	Dom	SD	Spawning Gravel		Total	10-20 (cm)	20-50 (cm)	> 50 (cm)	Dom.	SD	Trace	Tot. %	Type	Structure	Closure	Barriers	Photos	Comments
																	Type	Amount														
1	15	0	C	1	10	3	0.5	0.2	8	4	—	—	—	—	B	Cb	MP	2	1	1	0	0	LWD	OV	B	30	Sh, T	YF	20	none	37	
2	15	10	G	1	8	2	0.3	0.3	6	4	—	—	—	—	B	Cb	MP	5	1	1	0	0	OV	LWD	—	20	Sh, T	YF	20	none		
3	15	18	P	1	3	1	0.5	0.4	7	5	0.5	0.4	—	S	Cb	Gr	P	10	5	3	2	0	LWD	P	—	50	Sh, T	YF	50	none		
4	15	21	G	1	18	1	0.4	0.3	9	8	—	—	—	—	Cb	Gr	P	10	8	2	6	0	LWD	OV	B	20	Sh, T	YF	40	none		
5	15	39	R	1	20	2	0.4	0.2	8	6	—	—	—	—	Cb	Gr	P	20	0	0	0	0	OV	UC	—	20	Sh, T	YF	20	none	38	20 cm resident BT observed
6	15	59	G	1	10	2	0.5	0.4	10	4	—	—	—	—	Cb	Gr	P	30	4	1	3	0	LWD	SWD	UC	25	Sh, T	YF	20	none		
7	15	69	P	1	10	1	0.3	0.6	6	4	0.7	—	—	S	Gr	F	P	80	9	7	2	0	P	LWD	OV	80	Sh, T	YF	40	none	39, 40, 50	2 adfluvial BT redds F380-1 and F380-2; spawning pair observed
8	15	79	C	1	20	5	0.3	0.2	6	5	—	—	—	—	Gr	Cb	P, An	50	22	10	12	0	LWD	SWD	—	80	Sh, T	YF	50	none	51	
9	15	99	P	1	7	1	0.7	0.5	7	4	0.62	0.15	—	S	F	B	0	0	6	4	2	0	P	LWD	UC	80	Sh, T	YF	30	none	52	
10	15	106 117	R	1	11	3	0.3	0.2	7	5	—	—	—	—	Cb	B	0	0	3	3	0	0	OV	LWD	—	50	Sh, T	YF	20	none		

Overall Rating: Important, critical at H.U. 7

Spawning: Good, excellent at H.U. 7 abundance of spawning gravel 2 adfluvial BT redds at H.U. 7 BT spawning pair observed at H.U. 7	Rearing: Good Abundant cover for juvenile BT	Overwintering: Fair, pools > 1 m not present	Migration: Fair, fewLWD jams and steps created by functional LWD
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Appendix A. Detailed Level 1 Fish Habitat Data, 2014

Date: 12-Sep-14 Transparency: clear UTM Coordinates
 Site: HC F-410 Flow stage: low Upstream: 0301847 E, 5707177 N
 Crew: KE/GC Temperature: 8°C Downstream: 0301851 E, 5707057 N

Habitat Unit No.	Reach No.	Distance (m)	Habitat Unit		Length Gradient		Mean Depth		Mean Width		Pools Only				Bed Material Type				Functional LWD Tally				Cover Type				Riparian Veg		Canopy			Comments
			Type	Cat	(m)	%	Bankfull (m)	Wetted (m)	Bankfull (m)	Wetted (m)	Max (m)	Crest (m)	Residual (m)	Type (m)	Dom	SD	Spawning Gravel		Total	10-20 (cm)	20-50 (cm)	> 50 (cm)	Dom.	SD	Trace	Tot. %	Type	Structure	Closure	Barriers	Photos	
																	Type	Amount														
1	15	0	C	1	28	3	0.6	0.3	5	4	—	—	—	—	B	Cb	0	0	2	0	1	1	B	LWD	—	50	Sh, T	YF	70	none	33	
2	15	28	G	1	16	2	0.6	0.3	12	4	—	—	—	—	B	Cb	MP	5	2	2	0	0	UC	LWD	—	20	Sh, T	YF	30	none	34	
3	15	44	R	1	6	3	0.4	0.1	11	8	—	—	—	—	Gr	Cb	0	0	1	0	0	0	OV	UC	—	10	Sh, T	YF	40	none	—	
4	15	50	G	1	6	2	0.3	0.3	8	3	—	—	—	—	Gr	F	Pea	60	1	0	1	1	SWD	UC	—	10	Sh, T	YF	20	none	35	
5	15	56	P	1	9	0	0.3	0.4	11	9	0.65	0.1	—	S	Gr	F	Pea	40	2	0	1	1	LWD	P	—	40	Sh, T	YF	0	none	—	
6	15	65	C	1	11	3	0.9	0.2	8	4	—	—	—	—	B	Cb	MP	1	3	3	0	0	B	OV	—	20	Sh, T	YF	10	none	—	
7	15	76	G	1	9	1	0.7	0.3	7	4	—	—	—	—	B	Gr	MP	5	7	4	3	3	LWD	OV	—	50	Sh, T	YF	50	none	—	
8	15	85	R	1	18	3	0.6	0.2	8	6	—	—	—	—	B	Cb	0	0	3	0	0	0	B	OV	—	20	Sh, T	YF	50	none	—	
9	15	103	G	1	13	1	0.9	0.3	8	5	—	—	—	—	B	Cb	Pea	10	3	2	1	1	B	OV	UC	80	Sh, T	YF	40	none	36	
10	15	116	R	1	9	3	0.3	0.2	9	5	—	—	—	—	B	Cb	MP	1	3	2	0	0	B	OV	LWD	20	Sh, T	YF	10	none	—	
		125																														

Overall Rating: Important

Spawning:

Good
 abundance of pea gravel
 no redds or BT observed

Rearing:

Good
 Abundant cover for juvenile BT

Overwintering:

None, pools > 1 m not present

Migration:

Good, few LWD jams and steps created by functional LWD

Appendix A. Detailed Level 1 Fish Habitat Data, 2014

Date: 12-Sep-14 Transparency: clear UTM Coordinates
 Site: HC F-420 Flow stage: low Upstream: 0301766 E, 5707473 N
 Crew: KE/GC Temperature: 8°C Downstream: 0301789 E, 5707354 N

Habitat Unit No.	Reach No.	Distance (m)	Habitat Unit		Length Gradient		Mean Depth		Mean Width		Pools Only				Bed Material Type				Functional LWD Tally				Cover Type				Riparian Veg		Canopy				Comments
			Type	Cat	(m)	%	Bankfull (m)	Wetted (m)	Bankfull (m)	Wetted (m)	Max (m)	Crest (m)	Residual (m)	Type (m)	Dom	SD	Spawning Gravel		Total	10-20 (cm)	20-50 (cm)	> 50 (cm)	Dom.	SD	Trace	Tot. %	Type	Structure	Closure	Barriers	Photos		
																	Type	Amount															
1	16	0	R	1	9	4	0.4	0.2	10	6	—	—	—	—	B	Cb	0	0	1	1	0	0	SWD	LWD		30	Sh, T	YF	30	none			
2	16	9	G	1	16	1	0.3	0.6	8	4	—	—	—	—	B	Gr	Pea	10	0	0	0	0	UC	OV		40	Sh, T	YF	60	none			
3	16	25	C	1	22	5	0.4	0.3	6	3.5	—	—	—	—	B	Cb	0	0	32	16	13	3	LWD	B		30	Sh, T	YF	40	none	29, 30		
4	16	47	G	1	10	2	0.6	0.5	7	4	—	—	—	—	B	Cb	MP	1	1	1	0	0	B			20	Sh, T	YF	30	none			
5	16	57	R	1	15	3	0.5	0.2	9	7	—	—	—	—	Cb	B	MP	1	1	1	0	0	OV	V		10	Sh, T	YF	20	none	31		
6	16	72	C	1	20	3	0.5	0.2	10	4	—	—	—	—	B	Cb	0	0	2	2	0	0	B	UC		30	Sh, T	YF	20	none			
7	16	92	G	1	5	2	0.4	0.3	6	4	—	—	—	—	B	Cb	MP	5	1	1	0	0	B	OV		50	Sh, T	YF	20	none			
8	16	97	C	1	9	3	0.7	0.3	10	3	—	—	—	—	B	Cb	MP	10	0	0	0	0	B	OV	UC	40	Sh, T	YF	40	none			
9	16	106	P	1	4	1	0.7	0.6	10	3	0.74	0.08	—	S	B	F	0	0	3	2	1	0	LDW	P	UC	70	Sh, T	YF	40	none	32		
10	16	127	C	1	17	4	0.7	0.2	11	9	—	—	—	—	Cb	B	0	0	3	0	3	0	LWD	B		20	Sh, T	YF	20	none			
		144																															

Overall Rating: Important

Spawning: Poor
 No redds or BT observed

Rearing: Good
 Abundant cover for juvenile BT

Overwintering: None, pools > 1 m not present

Migration: Fair, LWD jams and steps created by functional LWD

Appendix A. Detailed Level 1 Fish Habitat Data, 2014

Date: 11-Sep-14 Transparency: clear UTM Coordinates
 Site: HC F-430 Flow stage: low Upstream: 0301814 E, 5708505 N
 Crew: KE/GC Temperature: 8°C Downstream: 0301868 E, 5708420 N

Habitat Unit No.	Reach No.	Distance (m)	Habitat Unit		Length Gradient		Mean Depth		Mean Width		Pools Only				Bed Material Type				Functional LWD Tally				Cover Type				Riparian Veg		Canopy				Comments
			Type	Cat	(m)	%	Bankfull (m)	Wetted (m)	Bankfull (m)	Wetted (m)	Max (m)	Crest (m)	Residual (m)	Type (m)	Dom	SD	Spawning Gravel		Total	10-20 (cm)	20-50 (cm)	> 50 (cm)	Dom.	SD	Trace	Tot. %	Type	Structure	Closure	Barriers	Photos		
																	Type	Amount															
1	16	0	R	1	12	3	0.4	0.1	8	8	—	—	—	—	Cb	Gr	0	0	4	2	1	1	SWD	LWD	—	20	Sh, T	YF	10	none	20		
2	16	12	P	1	9	1	1.3	0.4	10	7	0.74	0.15	0.39	S	Gr	F	Pea	10	13	7	4	2	LWD	—	—	50	Sh, T	YF	5	none	21		
3	16	21	R	1	8	2	0.6	0.2	8	3	—	—	—	—	Gr	F	Pea	20	2	2	0	0	SWD	OV	—	50	Sh, T	YF	0	none			
4	16	29	P	1	10	0	0.6	0.6	8	6	1	0.2	—	S	Gr	F	Pea	100	10	6	4	0	LWD	P	—	100	Sh, T	YF	0	none			
5	16	39	G	1	7	1	0.4	0.2	11	6	—	—	—	—	Gr	Cb	Coarse	100	2	2	0	0	OV	—	—	30	Sh, T	YF	0	none	22, 23	Adfluvial BT redd F430-1	
6	16	46	P	1	12	0	0.6	0.6	8	7	0.78	0.08	—	S	F	Gr	Pea	20	6	2	3	1	P	OV	LWD	90	Sh, T	YF	0	none			
7	16	58	R	1	11	2	0.6	0.2	8	8	—	—	—	—	Gr	F	Pea	10	9	7	2	0	UC	OV	LWD	20	Sh, T	YF	20	none			
8	16	69	G	1	11	0	0.4	0.4	10	10	—	—	—	—	F	Gr	Pea	10	13	8	5	0	OV	LWD	—	80	Sh, T	YF	10	none			
9	16	80	R	1	20	3	0.3	0.2	7	3	—	—	—	—	Gr	F	Pea	10	16	12	4	0	OV	LWD	—	70	Sh, T	YF	10	none			
10	16	100	G	1	16	1	0.3	0.3	8	6	—	—	—	—	F	Gr	Pea	10	7	6	1	0	LWD	OV	UC	80	Sh, T	YF	30	none			
		116																															

Overall Rating: Important, critical habitat at H.U. 5

Spawning: Good
 BT redd observed at H.U. 5 areas with abundant gravel substrate

Rearing: Good
 Abundant cover for juvenile BT

Overwintering: Fair, some deep pools ~ 1 m

Migration: Poor, LWD jams and steps created by functional LWD

Appendix A. Detailed Level 1 Fish Habitat Data, 2014

Date: 11-Sep-14 Transparency: clear UTM Coordinates
 Site: HC F-440 Flow stage: low Upstream: 0301723 E, 5709233 N
 Crew: KE/GC Temperature: 8°C Downstream: no coordinate due to poor GPS reception

Habitat Unit No.	Reach No.	Distance (m)	Habitat Unit		Length Gradient		Mean Depth		Mean Width		Pools Only				Bed Material Type		Functional LWD Tally				Cover Type				Riparian Veg		Canopy			Comments		
			Type	Cat	(m)	%	Bankfull (m)	Wetted (m)	Bankfull (m)	Wetted (m)	Max (m)	Crest (m)	Residual (m)	Type (m)	Dom	SD	Spawning Gravel		Total	10-20 (cm)	20-50 (cm)	> 50 (cm)	Dom.	SD	Trace	Tot. %	Type	Structure	Closure		Barriers	Photos
																	Type	Amount														
1	16	0	P	1	15	1	0.6	0.3	7	4	0.4	0.1	—	S	Cb	Gr	P	10	8	4	4	0	LDW	OV	—	80	Sh, T	YF	10	none	24	
2	16	15	R	1	25	4	0.7	0.1	5	2	—	—	—	—	Cb	B	0	0	1	1	0	0	OV	—	—	10	Sh, T	YF	10	none	—	
3	16	40	G	1	12	1	0.5	0.2	6	2	—	—	—	—	Cb	B	0	0	2	2	0	0	LWD	OV	UC	15	Sh, T	YF	20	none	—	
4	16	52	R	1	16	2	0.4	0.1	7	5	—	—	—	—	Cb	Gr	P	2	5	0	5	0	LWD	OV	—	80	Sh, T	YF	80	none	25	
5	16	68	P	1	3	1	0.5	0.3	6	4	0.7	0.02	—	S	Cb	Gr	P	5	5	3	2	0	LWD	OV	P	50	Sh, T	YF	40	none	—	
6	16	71	R	1	17	3	0.8	0.1	5.5	3	—	—	—	—	Cb	B	0	0	2	2	0	0	LWD	OV	—	10	Sh, T	YF	5	none	26	
7	16	87	G	1	13	1	0.8	0.2	5	4	—	—	—	—	Cb	Gr	P	MP	2	2	0	0	LWD	OV	—	80	Sh, T	YF	70	none	—	
8	16	100	R	1	20	3	0.7	0.1	6	2	—	—	—	—	Cb	Gr	0	0	6	3	3	0	LWD	OV	—	60	Sh, T	YF	80	none	—	
9	16	120	P	1	5	1	0.6	0.4	6	6	—	—	—	—	Gr	Cb	P	50	11	7	2	2	LWD	P	OV	90	Sh, T	YF	20	none	27	
10	16	125	R	1	34	3	0.9	0.1	15	2.5	—	—	—	—	Cb	Gr	An	10	16	7	7	1	LWD	—	—	30	Sh, T	YF	5	none	28	
		160																														

Overall Rating: Marginal

Spawning: Poor
 Pea gravel patches for BT spawning

Rearing: Good, abundant cover

Overwintering: None, no pools > 1 m

Migration: Good, no barriers

Appendix B

Selected Site and Habitat Unit Photographs, 2014

HARPER CREEK PROJECT

Harper Creek Fish Habitat Baseline Report

**APPENDIX B. SELECTED SITE AND HABITAT UNIT
PHOTOGRAPHS, 2014**

SITE HC F-340



Habitat Unit No.1



Habitat Unit No.4



Habitat Unit No.9

SITE HC F-350



Habitat Unit No.1



Habitat Unit No. 3



Habitat Unit No.4



Habitat Unit No.9

SITE HC F-360



Habitat Unit No.2



Habitat Unit No.4

SITE HC F-370



Habitat Unit No.1



Habitat Unit No.3



Habitat Unit No.9

SITE HC F-390



Habitat Unit No.1



Habitat Unit No.4



Habitat Unit No.7



Habitat Unit No.10

SITE HC F-400



Habitat Unit No.3



Habitat Unit No.4



Habitat Unit No.7

SITE HC F-380



Habitat Unit No.5



Habitat Unit No.7



Habitat Unit No.8

SITE HC F-410



Habitat Unit No.2



Habitat Unit No.4



Habitat Unit No.9

SITE HC F-420



Habitat Unit No.3



Habitat Unit No.5



Habitat Unit No.8

SITE HC F-430



Habitat Unit No. 1



Habitat Unit No. 2



Habitat Unit No. 5

SITE HC F-440



Habitat Unit No. 1



Habitat Unit No. 6



Habitat Unit No. 9



Habitat Unit No. 10

Appendix C

Bull Trout Spawning Redd Data, 2014

HARPER CREEK PROJECT

Harper Creek Fish Habitat Baseline Report

Appendix C. Bull Trout Spawning Redd Data, 2014

Redd No.	Date	UTM Location			Length (cm)	Width (cm)	Redd Depth (cm)	Crest Depth (cm)	Bank Location (LB/RB/C)	Distance from Bank (m)	Cover Type	Substrate	Macro-habitat Type	Water Temp. (°C)	Bull Trout		
		Zone	Easting	Northing											Observations	Photos	Comments
F430-1	11-Sep	11U	301836	5708482	50	40	30	20	LB	1.5	OV	coarse gravel	glide tail-out	8	none	22, 23	
F380-1	12-Sep	11U	301756	5706916	70	50	60	40	LB	1	OV, LWD	pea gravel	pool tail-out	7.5	spawning pair	39 to 49	video of BT spawning pair, male appears to be smaller resident BT and female larger adfluvial BT
F380-2	12-Sep	11U	301756	5706916	50	40	50	40	LB	1	OV, LWD	pea gravel	pool tail-out	7.5	none	39 to 49	redds F380-1 and -2 immediately adjacent to each other
F400-1	12-Sep	11U	301763	5706563	100	50	20	10	RB	0.5	LWD, UC	coarse and pea gravel	deep riffle	7.5	none	54, 55	side gravel bar
F390-1	12-Sep	11U	301904	5706364	70	40	19	9	RB	0.6	OV, UC	coarse gravel	pool tail-out	7.5	spawning pair	62, 63; 68-76	female BT measured 52 cm total length
F370-1	13-Sep	11U	301990	5706228	130	76	30	11	RB	1.8	LWD	coarse gravel	glide tail-out	6	none	78, 79	water temp measured in early morning
F370-2	13-Sep	11U	302030	5706090	90	64	36	16	RB	1.2	OV	fine round gravel, with sand	glide tail-out	7	single > 60 cm BT	81, 82	very soft, deep substrate
F350-1	13-Sep	11U	302082	5705794	58	52	20	7	RB	3	LWD, OV	coarse gravel	glide	7	none	87	glide behind LWD jam, LDW overhead cover
F350-2	13-Sep	11U	302079	5705764	58	57	27	14	C	2	OV	coarse gravel	glide tail-out	7	none	88, 89	laminar upwelling flow, centre of wetted channel
F350-3	13-Sep	11U	302079	5705764	60	57	26	12	RB	3	OV	coarse gravel	glide tail-out	7	none	88, 89	laminar upwelling flow, adjacent to redd F350-2
F340-1	13-Sep	11U	301954	5705525	85	76	22	8	RB	0.1	SWD	coarse and pea gravel	glide tail-out	7.5	none	94	immediately adjacent to RB with overhead SWD cover
Mean					79	60	26	11		1.7	OV (D), LWD (SD)	Coarse gravel (D, Pea gravel (SD)	Glide (D), Pool (SD)	7.2			

Notes:

Shaded cells indicate visual estimate

Bank Location: LB = left bank, RB = right bank, C = centre of wetted channel

Cover Type: LWD = large woody debris, OV = overhanging vegetation, SWD = small woody debris, UC = undercut bank

BT = Bull Trout