Memorandum

Refer to File: C.1- 0215644 (Wetland Classification Expanded LSA_TL Access Roads).docx

Date: November 12, 2015

To: Ryan Todd (New Gold)

From: Wade Brunham and Ben Andrew

Cc: Anne Currie and Nicole Bishop

Subject: **Blackwater Gold Project - Wetland Classification and Mapping in the Transmission Line Access Roads Expanded LSA**

1. INTRODUCTION

This memo details the methods and results of wetland surveys, classification, and mapping completed within the transmission line access roads expanded Local Study Area (the expanded LSA). The memo provides wetland classifications to the site association level (MacKenzie and Moran 2004) for all wetland in the expanded LSA. A list, from the BC Conservation Data Centre records, of rare and sensitive wetland ecosystems site associations was produced based on the forest district and biogeoclimatic zones overlapping the expanded LSA. This list was compared to the mapped wetlands to identify rare and sensitive wetlands in the expanded LSA.

2. METHODOLOGY

The following assumptions informed the work described in this memo:

- Where wetlands in the first decile were greater than 50%, the polygon area was assumed to be wetlands. For example, where a one hectare Predictive Ecosystem Mapping (PEM) polygon was mapped as 70% Ws07 swamp and 30% associated riparian or wet forest, the area used to generate wetland size for this memo was one hectare as opposed to 0.7 ha. This assumption yields a conservative wetland area.
- Photo documentation and notes from the aerial survey was used to identify cases where polygon boundaries were not reflective of ecological site differences (i.e. only one wetland polygon exists in reality). Where both polygons represented the same site association, they were attributed with the same label. For example, where the PEM identified two wetland polygons adjacent to one another and one was classified as Ws07 and the other was classified as Ws, the photo documentation and notes were used to confirm similar site and structural characteristics, and the assumption was made that the Ws was an extension of the Ws07.
- Where species lists were similar for two wetland associations and one was a listed wetland, the listed wetland association was selected to be conservative.

- Listed wetlands were identified by cross referencing red- and blue-listed wetlands in the Engelmann Spruce - Subalpine Fir (ESSF) and Sub-boreal Spruce (SBS) Biogeoclimatic (BEC) zones of the Vanderhoof Forest District using Conservation Data Centre (CDC) records (BC MOE 2015). To be conservative, rather than relying on BEC subzone differentiation, BEC zones were used to ensure all potentially red- or blue-listed wetlands that could occur in the LSA were identified.

The following methods were used to complete wetland classification and mapping:

- A base mapping layer was prepared using the modified predictive ecosystem mapping (PEM) completed for the Blackwater Gold Project (Project). These data were queried to identify ecosystem polygons containing only wetland class information and not site association classification. These polygons were targeted for visual inspections and field survey inspections.
- A visual inspection of all wetlands within the expanded LSA by helicopter was conducted on October 22, 2015. Wetlands were located using a GPS, and information for each wetland was recorded in a laminated map book. Each wetland was photo documented from the air and pertinent site attributes and wetland site associations were recorded.
- Wetland field plots were established in select wetlands. Wetland forms were completed for each plot (Appendix 1) and data were collected in accordance with ERM's wetland survey standard operating procedures (Appendix 2). Wetland Habitat Information forms were also completed at each wetland. Wetland classifications to site association level communities, consistent with MacKenzie and Moran (2004), were recorded at each plot. This information, along with adjacent TEM plot information, was used to update wetland mapping so all wetland polygons were attributed to site associations.
- A wetland polygon layer was refined using the modified PEM polygons, aerial wetland delineations, and TRIM wetlands. The refined polygons were attributed with federal wetland class and provincial site associations based on the visual inspections and plot results and informed by the original classifications. The resultant mapping contains provincial wetland site association classifications (MacKenzie and Moran 2004) for all wetlands in the expanded LSA.

3. RESULTS

3.1 Wetland Site Association Mapping

A total of 57 wetlands were visually inspected from the air and photo documented using the base mapping layer. Following the visual inspection, 11 wetland field plots were completed. In total there were 96 polygons inspected in 128 plots from previous surveys and this survey (*Appendix 5.1.3.3A - Vegetation 2011 – 2013 Baseline Report* (AMEC 2015) of the Application for an Environmental Assessment Certificate). This resulted in a TEM Resource Inventory Standard (RIC 1998) survey intensity level (SIL) of 5 for the expanded LSA for the modified PEM mapping (8% of polygons inspected). The SIL for wetland polygons in the expanded LSA is level 4 (25% of all polygons inspected). The Application Information Requirements identify a SIL of 5 for linear project components, with an inspection rate of 5 to 14%.

The total wetland area in the expanded LSA (including previously mapped and revised wetland mapping) is 425.5 ha[1] (Table 3.1-1) and has 11 site associations. All five federal wetland classes were observed (Warner and Rubec 1997). However, shallow open water wetlands were not included as a standalone wetland polygon; they were incorporated into larger wetland complexes as deciled components.

Table 3.1-1. Wetland Associations and Area in the Transmission Line Access Road Expanded LSA

Federal Wetland Class	Wetland Site Association	Number	Area (ha)
Bog	Wb01	1	5.4
Bog	Wb05	8	13.0
Bog	Wb08	3	4.2
Fen	Wf01	16	25.0
Fen	Wf04	1	1.0
Swamp	Willow-Sedge	1	0.2
Marsh	Wm01	4	1.7
Swamp	Ws03	1	2.5
Swamp	Ws04	3	11.8
Swamp	Ws07	201	359.0
Swamp	Ws08	1	1.7
Total		**240**	**425.5**

Wetland locations, classes, and associations within the expanded LSA are presented in Figures 3.1-1 through 3.1-17 (Appendix 3). Photographs at wetland plots are presented in Appendix 4.

3.2 Listed Wetlands

A summary of listed wetlands, their conservation status, and area that could be affected by construction or operation of the transmission line or access road right-of-way (ROWs) and that occur in the expanded LSA is presented in Table 3.2-1. To identify listed wetland ecosystems in the expanded LSA, a list was generated by the BC Conservation Data Centre (BC MOE 2015) of listed wetland associations in the ESSF and SBS BEC Zones within the Vanderhoof Forest District.

[1] Based on the conservative assumption that the entire polygon area was wetland when the first decile was greater than 50% of the polygon area, the total wetland area reported in this memo is greater than the 386 ha area reported in the Supplemental Report on the Transmission Line Access Roads (September 2015).

In total, 5.4 ha of blue-listed Black spruce – Creeping – snowberry – Peat-moss (Wb01) and 2.5 ha of blue-listed Bebb's willow – Bluejoint (Ws03) occur in the expanded LSA. Less than 0.1 ha of Wb01 and 0.2 ha of Ws03 intersect the access road ROW.

Although Table 3.2-1 shows that some blue-listed wetlands exist in the expanded LSA, it is important to recognize that subtle differences in sedge and willow composition can result in changes to the Wb01 and Ws04 classifications. Notably, no red-listed wetland communities were identified in the expanded LSA. These communities contain easily identifiable and unique plant assemblages.

Table 3.2-1. BC Conservation Data Centre Listed Wetlands Potentially Occurring in the Transmission Line Access Road ROWs and Expanded LSA

		Transmission Line Access Roads ROW (ha)				
Listed Wetland Association	Conservation Status	Upgraded Roads	New Roads	Combined	Transmission Line ROW (ha)	Expanded Transmission Line Access Roads LSA Total Area (ha)
Wf02	Blue	0	0	0	0	0
Wf05	Blue	0	0	0	0	0
Wf06	Blue	0	0	0	0	0
Wf08	Blue	0	0	0	0	0
Wf09	**Red**	**0**	**0**	**0**	**0**	**0**
Wf10	**Red**	**0**	**0**	**0**	**0**	**0**
Wf11	Blue	0	0	0	0	0
Northern Mannagras Fen	Blue	0	0	0	0	0
Wb01	Blue	0	<0.1	<0.1	1.6	5.4
Wb09	Blue	0	0	0	0	0
Wb10	Blue	0	0	0	0	0
Wb11	Blue	0	0	0	0	0
Wb12	Blue	0	0	0	0	0
Wb13	Blue	0	0	0	0	0
Tamarack, Low birch, blue joint	**Red**	**0**	**0**	**0**	**0**	**0**
Wm02	Blue	0	0	0	0	0
Wm04	Blue	0	0	0	0	0
Wm06	Blue	0	0	0	0	0
Ws03	Blue	0	0.2	0.2	0.6	2.5
Ws05	Blue	0	0	0	0	0
Total Listed Wetlands			0.2	0.2	1.2	7.9

Note: Red-listed wetlands are bolded.

Prepared by:

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Principal Consultant, Branch Manager
ERM

REFERENCES

AMEC. 2015. *Appendix 5.1.3.3A - Vegetation 2011 – 2013 Baseline Report* Prepared for New Gold by AMEC:

BC MOE. 2015. *BC Conservation Data Centre Home Page*. http://www.env.gov.bc.ca/cdc/index.html (accessed November 2015).

MacKenzie, W. H. and J. R. Moran. 2004. *Wetlands of British Columbia: A Guide to Identification*. Land Management Handbook 52. BC Ministry of Forests Research Branch: Victoria, BC.

RIC. 1998. *Standard for Terrestrial Ecosystem Mapping in British Columbia*. Terrestrial Ecosystems Taskforce, Ecosystems Working Group, Resources Inventory Committee: Victoria, BC.

Warner, B. G. and C. D. A. Rubec. 1997. *The Canadian Wetland Classification System*. 2nd ed. n.p.: National Wetlands Working Group, Wetlands Research Centre, University of Waterloo.

— Appendix 1 —

Wetland Field Data Cards

WETLAND HABITAT INFORMATION FORM

W ☐ T ☐	PHOTO 91-109	X:	Y:	DATE Oct 22
PROJECT ID Buckhorn		SURV. WB, PETE		
MAPSHEET		PLOT # BW001		
UTM ZONE 9	NORTH 5820 31	EAST 590864		
ASPECT -1		ELEVATION 927 m		
SLOPE 0 %	SMR VD	HDI S1	SNR 6	

MESO SLOPE POSITION	☐ Crest ☐ Upper slope	☐ Mid slope ☐ Lower slope ☐ Toe	☐ Depression ☑ Level
HYDROGEO-MORPHIC POSITION	☐ Estuarine ☑ Fluvial	☐ Lacustrine ☐ Ponds & Potholes	☐ Basins & Hollows ☐ Seepage Slopes
DRAINAGE - MINERAL SOILS	☐ Very rapidly ☐ Rapidly	☐ Well ☐ Mod. well ☐ Imperfectly	☐ Poorly ☑ Very poorly
MINERAL SOIL TEXTURE	☐ Sandy (LS,S) ☐ Loamy (SL,L,SCL,FSL)	☐ Silty (SiL,Si) ☑ Clayey (SiCL,CL,SC,SiC,C)	
MOISTURE SUBCLASSES ORGANIC SOIL	☐ Aqueous ☐ Peraquic	☐ Aquic ☐ Subaquic	☐ Perhumid ☐ Humid

ORGANIC SOIL TEXTURE			SURF. ORGANIC HORIZON THICKNESS
☐ Fibric	☐ Mesic	☑ Humic	10 cm
HUMUS FORM			ROOTING DEPTH
☐ Mor	☑ Moder	☐ Mull	Depth ___ cm Type ___

VON POST

1 2 (3) 4 5 6 7 8 9 10

COARSE FRAGMENT CONTENT

☑ < 20% ☐ 20-35% ☐ 35-70% ☐ > 70%

ECOSYSTEM COMPONENT: ☐ WL1 ☐ WL2 ☐ WL3

BGC UNIT Wetland	WETLAND CLASS Swamp
SITE SERIES -	ASSOCIATION Agriculture
STRUCTURAL STAGE	MODIFIER Land

WETLAND POLYGON SUMMARY

	%	CLASS	ASSOCIATION
WL1			
WL2			
WL3			

DOMINANT / INDICATOR PLANT SPECIES

TOTAL %	TALL TREE	TREE / SHRUB	FORB	BRYOP.
	0	30	100	0

TREE / SHRUB	%	FORB	%	FORB cont'd	%
SALIX DRUM?		CAREX ROS ?			
		EPILOBIUM ?			
		TUFTED GRASSES ?			
		↓ CALAM. CANA ?			
		↓ POA PAL ?		BRYOP.	%

☐ COMPLETE ☑ PARTIAL

WATER COLOUR		
	☐ Tea Coloured	☐ Green-Brown Turbid
	☐ Yellow-Deep Brown Turbid	☐ Blue-Green Clear
	☑ Green-Brown Clear	

pH	CONDUCTIVITY	% OPEN WATER	DEPTH TO WATER
7.87	202		4.56

SOIL PROFILE	WILDLIFE OBSERVATIONS	
	SPECIES	FEATURE
ORGANIC		
~~ 15cm		
CLAY		
↓		
?		

Adapted from Ground Inspection Form: FS FS212-2(1) HRE 98/5-7610000694

WETLAND MAP

TOO LARGE TO DRAW

VERY LARGE AREA

FOUND SOMETHING THAT LOOKS LIKE TRIC. SP.

MOSSES ARE DEEP / HOOK MOSS

POSSIBLE W/ 10/11 BUT DOUBTFUL

SOIL NOT CONNECT THROUGH MAY BE BECAUSE OF LOCAL FLOODING.

Features to include: North arrow, wildlife features, open water, slope, vegetation communities, wetland boundary, direction of water flow, soil core locations.

OBSERVED WETLAND FUNCTION INDICATORS	
HYDROLOGICAL	
Groundwater Discharge	***Potential Flood Mitigation***
☐ Minerotrophic Species UK	☐ Evidence of Flooding
☐ Basin & Hollows HGMP	☑ Fluvial or Lacustrine HGMP
☐ Seepage Slopes HGMP	☐ Downstream Infrastructure UK
Groundwater Recharge	***Erosion Mitigation***
☑ Von Post < 6	☐ No Exposed Soils
☐ Ponds & Potholes HGMP	☐ Sediment Deposition Observed
Permafrost Maintenance	☑ Floodplain
☐ Depth to Permafrost ____ cm	
BIOCHEMICAL	
Nutrient Sink	***Water Quality***
☐ WC - Brown/Turbid	☑ Emergent Vegetation
☐ Basin & Hollows HGMP	☑ Upstream of Drinking Water Intake
☐ Ponds & Potholes HGMP	
Nutrient Export	***Carbon Sequestration***
☑ Discharge to Surface Water	☑ Von Post < 4
☑ Fluvial or Lacustrine HGMP	☐ Organic Soils > 1 m
ECOLOGICAL	
☐ Source Wetland	☑ Wetland Ecosystem > 5 ha
☐ Unique Wetland	☐ Connected to SOW
☐ High Vegetation Species Diversity	☐ Isolated Wetland Complex
☐ BMI Observed	☑ Connected Wetland Complex
HABITAT	
☑ Wildlife Use Observed	☐ Importance to Migration
☐ Listed Wildlife Species Observed	☐ Structural Diversity
NOTES	
FISH PRESENT	

WETLAND HABITAT INFORMATION FORM

W ☐ T ☐	PHOTO	X:	Y:	DATE Oct 22
PROJECT ID Blackwater		SURV. WB, Pete		
MAPSHEET		PLOT # BW002		
UTM ZONE	NORTH 387960	EAST 591809		
ASPECT - 1		ELEVATION 998		
SLOPE 0%	SMR W	HDI D4	SNR	

MESO SLOPE POSITION	☐ Crest ☐ Upper slope	☐ Mid slope ☑ Lower slope ☐ Toe	☐ Depression ☐ Level
HYDROGEO-MORPHIC POSITION	☐ Estuarine ☑ Fluvial	☐ Lacustrine ☐ Ponds & Potholes	☐ Basins & Hollows ☐ Seepage Slopes
DRAINAGE - MINERAL SOILS	☐ Very rapidly ☐ Rapidly	☑ Well ☐ Mod. well ☐ Imperfectly	☐ Poorly ☐ Very poorly
MINERAL SOIL TEXTURE	☑ Sandy (LS,S) ☐ Loamy (SL,L,SCL,FSL)	☐ Silty (SiL,Si) ☐ Clayey (SiCL,CL,SC,SiC,C)	
MOISTURE SUBCLASSES ORGANIC SOIL	☐ Aqueous ☐ Peraquic	☐ Aquic ☐ Subaquic	☐ Perhumid ☐ Humid

ORGANIC SOIL TEXTURE			SURF. ORGANIC HORIZON THICKNESS
☐ Fibric	☑ Mesic	☐ Humic	____ cm
HUMUS FORM			ROOTING DEPTH
☐ Mor	☐ Moder	☐ Mull	Depth ____ cm Type ____

VON POST

1 2 3 4 5 6 7 8 9 10

COARSE FRAGMENT CONTENT

☐ < 20% ☐ 20-35% ☑ 35-70% ☐ > 70%

ECOSYSTEM	COMPONENT: ☐ WL1 ☐ WL2 ☐ WL3
BGC UNIT Riparian	WETLAND CLASS
SITE SERIES	ASSOCIATION
STRUCTURAL STAGE	MODIFIER

WETLAND POLYGON SUMMARY

	%	CLASS	ASSOCIATION
WL1			
WL2			
WL3			

DOMINANT / INDICATOR PLANT SPECIES

TOTAL %	TALL TREE	TREE / SHRUB	FORB	BRYOP.

TREE / SHRUB	%	FORB	%	FORB cont'd	%
PICEA		EQU ARV			
LEDO GRV		CARex			
GAUL HIS		KNIGHTS PLUME			
EMPETRUM					
ROSA SP				BRYOP.	%
SALIX SP				PLEURIUM SP.	
				PLEU SCHR	

☐ COMPLETE ☐ PARTIAL

WATER COLOUR		
	☐ Tea Coloured	☐ Green-Brown Turbid
	☐ Yellow-Deep Brown Turbid	☐ Blue-Green Clear
	☐ Green-Brown Clear	

pH	CONDUCTIVITY	% OPEN WATER	DEPTH TO WATER

SOIL PROFILE		WILDLIFE OBSERVATIONS	
NORTH	SOUTH	SPECIES	FEATURE
DEEP WOODY PEAT VP 6/7	SAND		

Adapted from Ground Inspection Form: FS FS212-2(1) HRE 98/5-7610000694

WETLAND MAP

NORTH SIDE OF THE ROAD CLASSED AS PSS07. IT IS CONNECTED TO CLASSIFICATION. PHOTO 114-118

SOUTH SIDE OF ROAD IS RIPARIAN & SANDY SOILS PHOTO # 118-126

Features to include: North arrow, wildlife features, open water, slope, vegetation communities, wetland boundary, direction of water flow, soil core locations.

OBSERVED WETLAND FUNCTION INDICATORS	
HYDROLOGICAL	
Groundwater Discharge	***Potential Flood Mitigation***
☐ Minerotrophic Species	☐ Evidence of Flooding
☐ Basin & Hollows HGMP	☑ Fluvial or Lacustrine HGMP
☐ Seepage Slopes HGMP	☐ Downstream Infrastructure
Groundwater Recharge	***Erosion Mitigation***
☐ Von Post < 6	☐ No Exposed Soils
☐ Ponds & Potholes HGMP	☐ Sediment Deposition Observed
Permafrost Maintenance	☑ Floodplain
☐ Depth to Permafrost ____ cm	
BIOCHEMICAL	
Nutrient Sink	***Water Quality***
☐ WC - Brown/Turbid	☑ Emergent Vegetation
☐ Basin & Hollows HGMP	☐ Upstream of Drinking Water Intake
☐ Ponds & Potholes HGMP	
Nutrient Export	***Carbon Sequestration***
☑ Discharge to Surface Water	☐ Von Post < 4
☑ Fluvial or Lacustrine HGMP	☐ Organic Soils > 1 m
ECOLOGICAL	
☐ Source Wetland	☐ Wetland Ecosystem > 5 ha
☐ Unique Wetland	☑ Connected to SOW
☐ High Vegetation Species Diversity	☐ Isolated Wetland Complex
☐ BMI Observed	☐ Connected Wetland Complex
HABITAT	
☐ Wildlife Use Observed	☐ Importance to Migration
☐ Listed Wildlife Species Observed	☑ Structural Diversity
NOTES	

WETLAND HABITAT INFORMATION FORM

W ☐ T ☐	PHOTO	X:	Y:	DATE Oct 22
PROJECT ID Buckinghorse		SURV. WB / Pete		
MAPSHEET		PLOT # BW0063		
UTM ZONE 9	NORTH 389903	EAST 5913275		
ASPECT ~1		ELEVATION 1091		
SLOPE 0 %	SMR W	HDI B.1	SNR B	

MESO SLOPE POSITION	☐ Crest ☐ Upper slope	☐ Mid slope ☐ Lower slope ☐ Toe	☐ Depression ☑ Level
HYDROGEO-MORPHIC POSITION	☐ Estuarine ☐ Fluvial	☐ Lacustrine ☐ Ponds & Potholes	☑ Basins & Hollows ☐ Seepage Slopes
DRAINAGE - MINERAL SOILS	☐ Very rapidly ☐ Rapidly	☐ Well ☐ Mod. well ☐ Imperfectly	☐ Poorly ☑ Very poorly
MINERAL SOIL TEXTURE	☐ Sandy (LS,S) ☐ Loamy (SL,L,SCL,FSL)	☐ Silty (SiL,Si) ☑ Clayey (SiCL,CL,SC,SiC,C)	
MOISTURE SUBCLASSES ORGANIC SOIL	☐ Aqueous ☑ Peraquic	☐ Aquic ☐ Subaquic	☐ Perhumid ☐ Humid

ORGANIC SOIL TEXTURE			SURF. ORGANIC HORIZON THICKNESS
☐ Fibric	☐ Mesic	☑ Humic	60 cm
HUMUS FORM			ROOTING DEPTH
☑ Mor	☐ Moder	☐ Mull	Depth ___ cm Type ___

VON POST

1 2 3 4 5 6 7 (8) 9 10

COARSE FRAGMENT CONTENT

☑ < 20% ☐ 20-35% ☐ 35-70% ☐ > 70%

ECOSYSTEM

COMPONENT: ☐ WL1 ☐ WL2 ☐ WL3

BGC UNIT Wetland2	WETLAND CLASS FEN
SITE SERIES 101	ASSOCIATION Wf01
STRUCTURAL STAGE	MODIFIER

WETLAND POLYGON SUMMARY

	%	CLASS	ASSOCIATION
WL1			
WL2			
WL3			

WB-RES13-01

250413

DOMINANT / INDICATOR PLANT SPECIES

TOTAL %	TALL TREE	TREE / SHRUB	FORB	BRYOP.
	0	0	60	INT.

TREE / SHRUB	%	FORB	%	FORB cont'd	%
		Common			
		Poa Pra ?			
		Cane grass ?			
		Cirsium arvense			
		Potentilla sp.		BRYOP.	%
* CANT ID STUFF					

☐ COMPLETE ☑ PARTIAL

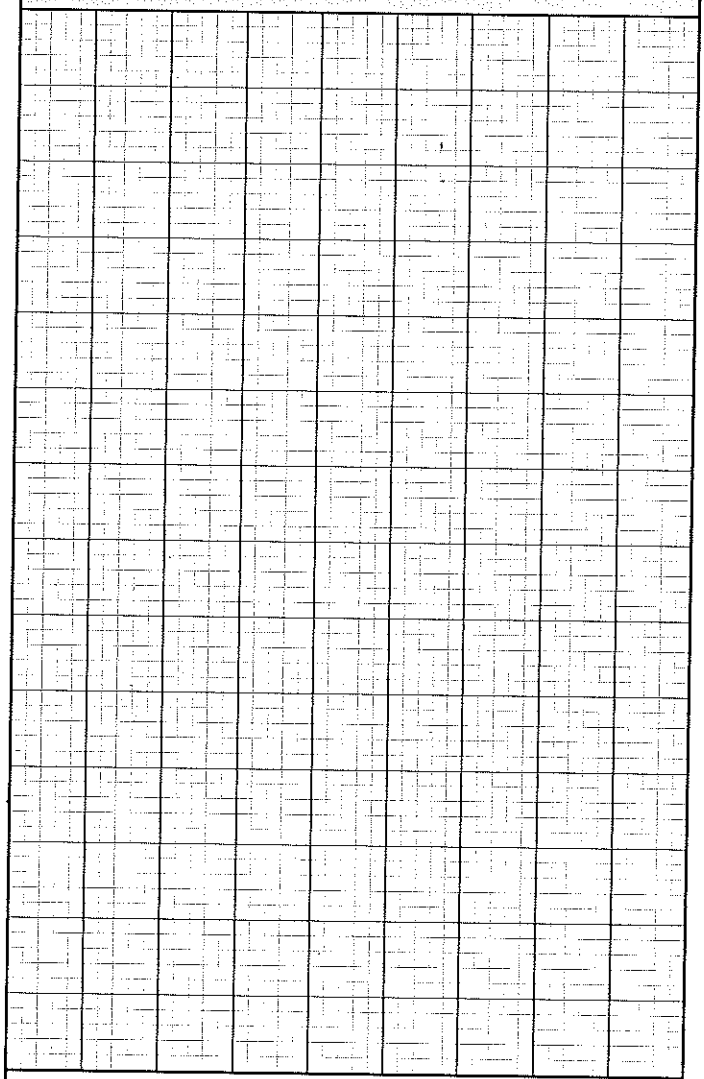
WATER COLOUR		
	☐ Tea Coloured	☐ Green-Brown Turbid
	☐ Yellow-Deep Brown Turbid	☐ Blue-Green Clear
	☐ Green-Brown Clear	NO WATER

pH	CONDUCTIVITY	% OPEN WATER	DEPTH TO WATER
N/A			

SOIL PROFILE		WILDLIFE OBSERVATIONS	
		SPECIES	FEATURE
	Well Decomposed Peat		
60 cm			
Clay			

Adapted from Ground Inspection Form: FS FS212-2(1) HRE 98/5-7610000694

WETLAND MAP



Features to include: North arrow, wildlife features, open water, slope, vegetation communities, wetland boundary, direction of water flow, soil core locations.

OBSERVED WETLAND FUNCTION INDICATORS

HYDROLOGICAL

Groundwater Discharge	*Potential Flood Mitigation*
☑ Minerotrophic Species	☐ Evidence of Flooding
☑ Basin & Hollows HGMP	☐ Fluvial or Lacustrine HGMP
☐ Seepage Slopes HGMP	☐ Downstream Infrastructure
Groundwater Recharge	***Erosion Mitigation***
☐ Von Post < 6	☐ No Exposed Soils
☐ Ponds & Potholes HGMP	☐ Sediment Deposition Observed
Permafrost Maintenance	☐ Floodplain
☐ Depth to Permafrost ____ cm	

BIOCHEMICAL

Nutrient Sink	*Water Quality*
☐ WC - Brown/Turbid	☑ Emergent Vegetation
☑ Basin & Hollows HGMP	☐ Upstream of Drinking Water Intake
☐ Ponds & Potholes HGMP	
Nutrient Export	***Carbon Sequestration***
☐ Discharge to Surface Water	☐ Von Post < 4
☐ Fluvial or Lacustrine HGMP	☐ Organic Soils > 1 m

ECOLOGICAL

☐ Source Wetland	☐ Wetland Ecosystem > 5 ha
☐ Unique Wetland	☐ Connected to SOW
☐ High Vegetation Species Diversity	☐ Isolated Wetland Complex
☐ BMI Observed	☐ Connected Wetland Complex

HABITAT

☐ Wildlife Use Observed	☐ Importance to Migration
☐ Listed Wildlife Species Observed	☑ Structural Diversity

NOTES

ISOLATED FEN WETLAND.

WETLAND HABITAT INFORMATION FORM

W☐ T☐	PHOTO 34-145	X:	Y:	DATE Oct 22
PROJECT ID Blackwater		SURV. WB / Pete		
MAPSHEET		PLOT # BW0001		
UTM ZONE 9	NORTH 391877	EAST 591655		
ASPECT -1		ELEVATION 1388		
SLOPE 0%	SMR W	HDI 5	SNR B	

MESO SLOPE POSITION	☐ Crest ☑ Upper slope	☐ Mid slope ☐ Lower slope ☐ Toe	☐ Depression ☐ Level
HYDROGEO-MORPHIC POSITION	☐ Estuarine ☐ Fluvial	☐ Lacustrine ☐ Ponds & Potholes	☑ Basins & Hollows ☐ Seepage Slopes
DRAINAGE - MINERAL SOILS	☐ Very rapidly ☐ Rapidly	☐ Well ☐ Mod. well ☐ Imperfectly	☐ Poorly ☐ Very poorly
MINERAL SOIL TEXTURE	☐ Sandy (LS,S) ☐ Loamy (SL,L,SCL,FSL)	☐ Silty (SiL,Si) ☐ Clayey (SiCL,CL,SC,SiC,C)	
MOISTURE SUBCLASSES ORGANIC SOIL	☐ Aqueous ☐ Peraquic	☐ Aquic ☐ Subaquic	☐ Perhumid ☐ Humid

ORGANIC SOIL TEXTURE			SURF. ORGANIC HORIZON THICKNESS
☐ Fibric	☐ Mesic	☑ Humic	130 cm
HUMUS FORM			ROOTING DEPTH
☐ Mor	☑ Moder	☐ Mull	Depth ___ cm Type ___

VON POST

1 2 3 4 5 6 (7) 8 9 10

COARSE FRAGMENT CONTENT

☑ < 20% ☐ 20-35% ☐ 35-70% ☐ > 70%

ECOSYSTEM COMPONENT: ☐ WL1 ☐ WL2 ☐ WL3

BGC UNIT Wetland		WETLAND CLASS Fen	
SITE SERIES		ASSOCIATION ?	
STRUCTURAL STAGE		MODIFIER	

WETLAND POLYGON SUMMARY

	%	CLASS	ASSOCIATION
WL1			
WL2			
WL3			

DOMINANT / INDICATOR PLANT SPECIES

TOTAL %	TALL TREE	TREE / SHRUB	FORB	BRYOP.
	0	10	80	90

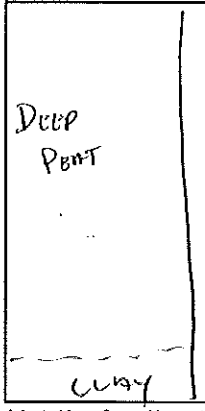
TREE / SHRUB	%	FORB	%	FORB cont'd	%
Betu nana		Calt lep			
Sali Bna ?		Erio ang ?			
		*Smna ore			
		*Eleo ?			
				BRYOP.	%
				*Sphagnum	

☐ COMPLETE ☑ PARTIAL

WATER COLOUR		
	☐ Tea Coloured	☐ Green-Brown Turbid
	☐ Yellow-Deep Brown Turbid	☐ Blue-Green Clear
	☑ Green-Brown Clear	

pH	CONDUCTIVITY	% OPEN WATER	DEPTH TO WATER
7.98	143	0	15 cm

SOIL PROFILE



WILDLIFE OBSERVATIONS

SPECIES	FEATURE
Moose	Tracks

Adapted from Ground Inspection Form: FS FS212-2(1) HRE 98/5-7610000694

WETLAND MAP

Map Book 15 6,000

Features to include: North arrow, wildlife features, open water, slope, vegetation communities, wetland boundary, direction of water flow, soil core locations.

OBSERVED WETLAND FUNCTION INDICATORS

HYDROLOGICAL

Groundwater Discharge	*Potential Flood Mitigation*
☑ Minerotrophic Species 7	☐ Evidence of Flooding
☑ Basin & Hollows HGMP	☐ Fluvial or Lacustrine HGMP
☐ Seepage Slopes HGMP	☐ Downstream Infrastructure
Groundwater Recharge	***Erosion Mitigation***
☐ Von Post < 6	☐ No Exposed Soils
☐ Ponds & Potholes HGMP	☐ Sediment Deposition Observed
Permafrost Maintenance	☐ Floodplain
☐ Depth to Permafrost ____ cm	

BIOCHEMICAL

Nutrient Sink	*Water Quality*
☐ WC - Brown/Turbid	☑ Emergent Vegetation
☑ Basin & Hollows HGMP	☐ Upstream of Drinking Water Intake
☐ Ponds & Potholes HGMP	
Nutrient Export	***Carbon Sequestration***
☐ Discharge to Surface Water	☐ Von Post < 4
☐ Fluvial or Lacustrine HGMP	☑ Organic Soils > 1 m

ECOLOGICAL

☑ Source Wetland	☐ Wetland Ecosystem > 5 ha
☐ Unique Wetland	☐ Connected to SOW
☐ High Vegetation Species Diversity	☑ Isolated Wetland Complex
☐ BMI Observed	☐ Connected Wetland Complex

HABITAT

☑ Wildlife Use Observed	☐ Importance to Migration
☐ Listed Wildlife Species Observed	☑ Structural Diversity

NOTES

I CANT IDENTIFY PLANTS THEY ARE TOO FAR GONE

THIS IS A FEN THOUGH NOT SURE IF ITS WFOM, WFOY, WFIZ

WETLAND HABITAT INFORMATION FORM

W ☐ T ☐	PHOTO 157-159	X:	Y:	DATE Oct 22
PROJECT ID Blackwater		SURV. WB / Pew		
MAPSHEET		PLOT # BW005		
UTM ZONE	NORTH 396047		EAST 5920970	
ASPECT -1		ELEVATION 101		
SLOPE 0 %	SMR VW	HDI S1		SNR

MESO SLOPE POSITION	☐ Crest ☐ Upper slope	☐ Mid slope ☐ Lower slope ☐ Toe	☑ Depression ☐ Level
HYDROGEO-MORPHIC POSITION	☐ Estuarine ☐ Fluvial	☐ Lacustrine ☐ Ponds & Potholes	☑ Basins & Hollows ☐ Seepage Slopes
DRAINAGE - MINERAL SOILS	☐ Very rapidly ☐ Rapidly	☐ Well ☐ Mod. well ☐ Imperfectly	☐ Poorly ☑ Very poorly
MINERAL SOIL TEXTURE	☐ Sandy (LS,S) ☐ Loamy (SL,L,SCL,FSL)	☐ Silty (SiL,Si) ☑ Clayey (SiCL,CL,SC,SiC,C)	
MOISTURE SUBCLASSES ORGANIC SOIL	☐ Aqueous ☑ Peraquic	☐ Aquic ☐ Subaquic	☐ Perhumid ☐ Humid

ORGANIC SOIL TEXTURE			SURF. ORGANIC HORIZON THICKNESS
☐ Fibric	☑ Mesic	☐ Humic	110 cm
HUMUS FORM			ROOTING DEPTH
☐ Mor	☑ Moder	☐ Mull	Depth ___ cm Type ___

VON POST

1 2 3 4 (5) 6 7 8 9 10

COARSE FRAGMENT CONTENT

☑ < 20% ☐ 20-35% ☐ 35-70% ☐ > 70%

ECOSYSTEM COMPONENT: ☐ WL1 ☐ WL2 ☐ WL3

BGC UNIT	WETLAND CLASS Fen
SITE SERIES	ASSOCIATION Wf01
STRUCTURAL STAGE	MODIFIER

WETLAND POLYGON SUMMARY

	%	CLASS	ASSOCIATION
WL1			
WL2			
WL3			

DOMINANT / INDICATOR PLANT SPECIES

TOTAL %	TALL TREE	TREE / SHRUB	FORB	BRYOP.
	0	35	75	

TREE / SHRUB	%	FORB	%	FORB cont'd	%
SALIX BRA ?		CAREX VIR			
		POTAMOGETON			
		COMM. PAL			
		EQUI HYM			
				BRYOP.	%

☐ COMPLETE ☒ PARTIAL

WATER COLOUR		
	☐ Tea Coloured	☐ Green-Brown Turbid
	☐ Yellow-Deep Brown Turbid	☐ Blue-Green Clear
	☐ Green-Brown Clear	

pH	CONDUCTIVITY	% OPEN WATER	DEPTH TO WATER
6.46	72		3.8°C

SOIL PROFILE		WILDLIFE OBSERVATIONS	
		SPECIES	FEATURE
MIX W LITTER	15cm		
UNIFORM PEAT			
	110		
GLEYED CLAY			

Adapted from Ground Inspection Form: FS FS212-2(1) HRE 98/5-7610000694

WETLAND MAP

USE MAP BOOK

Features to include: North arrow, wildlife features, open water, slope, vegetation communities, wetland boundary, direction of water flow, soil core locations.

OBSERVED WETLAND FUNCTION INDICATORS

HYDROLOGICAL

Groundwater Discharge	*Potential Flood Mitigation*
☑ Minerotrophic Species	☐ Evidence of Flooding
☑ Basin & Hollows HGMP	☐ Fluvial or Lacustrine HGMP
☐ Seepage Slopes HGMP	☐ Downstream Infrastructure
Groundwater Recharge	***Erosion Mitigation***
☐ Von Post < 6	☐ No Exposed Soils
☐ Ponds & Potholes HGMP	☐ Sediment Deposition Observed
Permafrost Maintenance	☐ Floodplain
☐ Depth to Permafrost ____ cm	

BIOCHEMICAL

Nutrient Sink	*Water Quality*
☐ WC - Brown/Turbid	☑ Emergent Vegetation
☑ Basin & Hollows HGMP	☐ Upstream of Drinking Water Intake
☐ Ponds & Potholes HGMP	
Nutrient Export	***Carbon Sequestration***
☐ Discharge to Surface Water	☐ Von Post < 4
☐ Fluvial or Lacustrine HGMP	☑ Organic Soils > 1 m

ECOLOGICAL

☐ Source Wetland	☐ Wetland Ecosystem > 5 ha
☐ Unique Wetland	☐ Connected to SOW
☐ High Vegetation Species Diversity	☑ Isolated Wetland Complex
☐ BMI Observed	☐ Connected Wetland Complex

HABITAT

☐ Wildlife Use Observed	☐ Importance to Migration
☐ Listed Wildlife Species Observed	☑ Structural Diversity

NOTES

LOW SP DIVERSITY.
MOSTLY BURNED SNAGS

WETLAND HABITAT INFORMATION FORM

W ☐ T ☐	PHOTO 160-168	X:	Y:	DATE Oct 23	
PROJECT ID		SURV. WADE B / Fraser Timber			
MAPSHEET		PLOT # BW006			
UTM ZONE	NORTH 398383	EAST 5972440			
ASPECT		ELEVATION 1095			
SLOPE %	SMR VD	HDI M	SNR		
MESO SLOPE POSITION	☐ Crest ☐ Upper slope	☐ Mid slope ☐ Lower slope ☐ Toe	☐ Depression ☐ Level		
HYDROGEO-MORPHIC POSITION	☐ Estuarine ☐ Fluvial	☐ Lacustrine ☐ Ponds & Potholes	☑ Basins & Hollows ☐ Seepage Slopes		
DRAINAGE - MINERAL SOILS	☐ Very rapidly ☐ Rapidly	☐ Well ☐ Mod. well ☐ Imperfectly	☐ Poorly ☐ Very poorly		
MINERAL SOIL TEXTURE	☐ Sandy (LS,S) ☐ Loamy (SL,L,SCL,FSL)	☐ Silty (SiL,Si) ☐ Clayey (SiCL,CL,SC,SiC,C)			
MOISTURE SUBCLASSES ORGANIC SOIL	☐ Aqueous ☑ Peraquic	☐ Aquic ☐ Subaquic	☐ Perhumid ☐ Humid		
ORGANIC SOIL TEXTURE			SURF. ORGANIC HORIZON THICKNESS		
☐ Fibric	☑ Mesic	☐ Humic	>60 cm		
HUMUS FORM			ROOTING DEPTH		
☐ Mor	☑ Moder	☐ Mull	Depth ___ cm Type ___		
VON POST					
1	2	3	4	5	6	7	8	9	10
COARSE FRAGMENT CONTENT					
☑ < 20%	☐ 20-35%	☐ 35-70%	☐ > 70%		
ECOSYSTEM	COMPONENT: ☐ WL1	☐ WL2	☐ WL3		
BGC UNIT		WETLAND CLASS Bog			
SITE SERIES		ASSOCIATION Wb05			
STRUCTURAL STAGE		MODIFIER Stream (Tributary)			

WETLAND POLYGON SUMMARY

	%	CLASS	ASSOCIATION
WL1			
WL2			
WL3			

DOMINANT / INDICATOR PLANT SPECIES

TOTAL %	TALL TREE	TREE / SHRUB	FORB	BRYOP.
	0	15	75	INF

TREE / SHRUB	%	FORB	%	FORB cont'd	%
BETU NANA		CARE AQU			
SALI BEB		COMM PAL			
PICE MAR					
				BRYOP.	%

☐ COMPLETE ☐ PARTIAL

WATER COLOUR		
	☐ Tea Coloured	☐ Green-Brown Turbid
	☐ Yellow-Deep Brown Turbid	☐ Blue-Green Clear
	☑ Green-Brown Clear	

pH	CONDUCTIVITY	% OPEN WATER	DEPTH TO WATER
7.9	145	25%	2.6

SOIL PROFILE

V. FIBRIC

MESIC

↓

+60

WILDLIFE OBSERVATIONS

SPECIES	FEATURE

Adapted from Ground Inspection Form: FS FS212-2(1) HRE 98/5-7610000694

WETLAND MAP

UPDATE USING MAP
BLEND 2 POLY- INTO 1
WB05 IN TXT FROM NOTES
IN MXD 2004

Features to include: *North arrow, wildlife features, open water, slope, vegetation communities, wetland boundary, direction of water flow, soil core locations.*

OBSERVED WETLAND FUNCTION INDICATORS	
HYDROLOGICAL	
Groundwater Discharge	***Potential Flood Mitigation***
☑ Minerotrophic Species	☐ Evidence of Flooding
☑ Basin & Hollows HGMP	☑ Fluvial or Lacustrine HGMP
☐ Seepage Slopes HGMP	☑ Downstream Infrastructure
Groundwater Recharge	***Erosion Mitigation***
☐ Von Post < 6	☐ No Exposed Soils
☐ Ponds & Potholes HGMP	☐ Sediment Deposition Observed
Permafrost Maintenance	☐ Floodplain
☐ Depth to Permafrost ____ cm	
BIOCHEMICAL	
Nutrient Sink	***Water Quality***
☐ WC - Brown/Turbid	☑ Emergent Vegetation
☐ Basin & Hollows HGMP	☐ Upstream of Drinking Water Intake
☐ Ponds & Potholes HGMP	
Nutrient Export	***Carbon Sequestration***
☑ Discharge to Surface Water	☐ Von Post < 4
☐ Fluvial or Lacustrine HGMP	☑ Organic Soils > 1 m
ECOLOGICAL	
☑ Source Wetland	☐ Wetland Ecosystem > 5 ha
☐ Unique Wetland	☐ Connected to SOW
☐ High Vegetation Species Diversity	☐ Isolated Wetland Complex
☑ BMI Observed LIKELY	☑ Connected Wetland Complex
HABITAT	
☐ Wildlife Use Observed	☐ Importance to Migration
☐ Listed Wildlife Species Observed	☐ Structural Diversity
NOTES	

WETLAND HABITAT INFORMATION FORM

W ☐ T ☐	PHOTO 185-195	X:	Y:	DATE Oct 23
PROJECT ID BLACKWATER		SURV. WB / FT		
MAPSHEET		PLOT # B1XXXX		
UTM ZONE	NORTH 5890346		EAST 5942853	
ASPECT 230		ELEVATION 952		
SLOPE 2 %	SMR W	HDI MD		SNR C

MESO SLOPE POSITION	☐ Crest ☐ Upper slope	☐ Mid slope ☐ Lower slope ☐ Toe	☒ Depression ☐ Level
HYDROGEO-MORPHIC POSITION	☐ Estuarine ☒ Fluvial	☐ Lacustrine ☐ Ponds & Potholes	☐ Basins & Hollows ☐ Seepage Slopes
DRAINAGE - MINERAL SOILS	☐ Very rapidly ☐ Rapidly	☐ Well ☒ Mod. well ☐ Imperfectly	☐ Poorly ☐ Very poorly
MINERAL SOIL TEXTURE	☐ Sandy (LS,S) ☐ Loamy (SL,L,SCL,FSL)	☒ Silty (SiL,Si) ☐ Clayey (SiCL,CL,SC,SiC,C)	
MOISTURE SUBCLASSES ORGANIC SOIL	☐ Aqueous ☐ Peraquic	☐ Aquic ☐ Subaquic	☐ Perhumid ☐ Humid

ORGANIC SOIL TEXTURE			SURF. ORGANIC HORIZON THICKNESS
☐ Fibric	☐ Mesic	☐ Humic	____ cm
HUMUS FORM			ROOTING DEPTH
☐ Mor	☐ Moder	☐ Mull	Depth ____ cm Type ____

VON POST

1 2 3 4 5 6 7 8 9 10

COARSE FRAGMENT CONTENT

☐ < 20% ☒ 20-35% ☐ 35-70% ☐ > 70%

ECOSYSTEM COMPONENT: ☐ WL1 ☐ WL2 ☐ WL3

BGC UNIT SBS	WETLAND CLASS Swamp
SITE SERIES	ASSOCIATION Ws07
STRUCTURAL STAGE	MODIFIER Creek

WETLAND POLYGON SUMMARY

	%	CLASS	ASSOCIATION
WL1			
WL2			
WL3			

DOMINANT / INDICATOR PLANT SPECIES

TOTAL %	TALL TREE	TREE / SHRUB	FORB	BRYOP.
	15	25	90	UNK.

TREE / SHRUB	%	FORB	%	FORB cont'd	%
Picea		Grass mix			
Lonj inv		Hem Lian			
Alnus inc		Epil ang			
Rosa		Equi hyem		BRYOP.	%
Salix		Calla Lino			
Pinus		Streptopus amplex			
		Cornu Sto			
		Petasites			

☐ COMPLETE ☑ PARTIAL

WATER COLOUR		
	☐ Tea Coloured	☐ Green-Brown Turbid
	☐ Yellow-Deep Brown Turbid	☐ Blue-Green Clear
	☑ Green-Brown Clear	

pH	CONDUCTIVITY	% OPEN WATER	DEPTH TO WATER
8.6	139.5	5%	2.8 'C
		↓ in channel	

SOIL PROFILE	WILDLIFE OBSERVATIONS	
	SPECIES	FEATURE
Heavily Mottled 60 cm Gleyed Sandy	Moose	Bed Trees Scat

Adapted from Ground Inspection Form: FS FS212-2(1) HRE 98/5-7610000694

WETLAND MAP

Location mapping Connect
its a swamp on either side of
the creek

Features to include: North arrow, wildlife features, open water, slope, vegetation communities, wetland boundary, direction of water flow, soil core locations.

OBSERVED WETLAND FUNCTION INDICATORS

HYDROLOGICAL

Groundwater Discharge	*Potential Flood Mitigation*
☐ Minerotrophic Species	☑ Evidence of Flooding
☐ Basin & Hollows HGMP	☑ Fluvial or Lacustrine HGMP
☐ Seepage Slopes HGMP	☑ Downstream Infrastructure Roads
Groundwater Recharge	***Erosion Mitigation***
☐ Von Post < 6	☐ No Exposed Soils
☐ Ponds & Potholes HGMP	☐ Sediment Deposition Observed
Permafrost Maintenance	☐ Floodplain
☐ Depth to Permafrost ____ cm	

BIOCHEMICAL

Nutrient Sink	*Water Quality*
☐ WC - Brown/Turbid	☐ Emergent Vegetation
☐ Basin & Hollows HGMP	☐ Upstream of Drinking Water Intake
☐ Ponds & Potholes HGMP	
Nutrient Export	***Carbon Sequestration***
☑ Discharge to Surface Water	☐ Von Post < 4
☑ Fluvial or Lacustrine HGMP	☐ Organic Soils > 1 m

ECOLOGICAL

☑ Source Wetland	☐ Wetland Ecosystem > 5 ha
☐ Unique Wetland	☐ Connected to SOW
☐ High Vegetation Species Diversity	☐ Isolated Wetland Complex
☑ BMI Observed Likely	☑ Connected Wetland Complex

HABITAT

☑ Wildlife Use Observed	☐ Importance to Migration
☐ Listed Wildlife Species Observed	☑ Structural Diversity

NOTES

Dow ☑

WETLAND HABITAT INFORMATION FORM

W ☐ T ☐	PHOTO 202-211	X:	Y:	DATE Oct 23
PROJECT ID	BLACKWATER	SURV. WB / FT		
MAPSHEET		PLOT # B50011		
UTM ZONE 9	NORTH 397442	EAST 5947182		
ASPECT E-1		ELEVATION 1010		
SLOPE 0 %	SMR W	SNR D		

MESO SLOPE POSITION	☐ Crest ☐ Upper slope	☑ Mid slope ☐ Lower slope ☐ Toe	☐ Depression ☐ Level
HYDROGEO-MORPHIC POSITION	☐ Estuarine ☐ Fluvial	☐ Lacustrine ☐ Ponds & Potholes	☑ Basins & Hollows ☐ Seepage Slopes
DRAINAGE - MINERAL SOILS	☐ Very rapidly ☐ Rapidly	☐ Well ☐ Mod. well ☐ Imperfectly	☐ Poorly ☐ Very poorly
MINERAL SOIL TEXTURE	☐ Sandy (LS,S) ☐ Loamy (SL,L,SCL,FSL)	☐ Silty (SiL,Si) ☐ Clayey (SiCL,CL,SC,SiC,C)	
MOISTURE SUBCLASSES ORGANIC SOIL	☐ Aqueous ☑ Peraquic	☐ Aquic ☐ Subaquic	☐ Perhumid ☐ Humid

ORGANIC SOIL TEXTURE			SURF. ORGANIC HORIZON THICKNESS
☐ Fibric	☐ Mesic	☑ Humic	+100 cm
HUMUS FORM			ROOTING DEPTH
☐ Mor	☐ Moder	☐ Mull	Depth ___ cm Type ___

VON POST

1 2 3 4 5 6 (7) 8 9 10

COARSE FRAGMENT CONTENT

☑ < 20% ☐ 20-35% ☐ 35-70% ☐ > 70%

ECOSYSTEM COMPONENT: ☐ WL1 ☐ WL2 ☐ WL3

BGC UNIT	WETLAND CLASS Swamp
SITE SERIES	ASSOCIATION Ws03
STRUCTURAL STAGE	MODIFIER Logging

WETLAND POLYGON SUMMARY

	%	CLASS	ASSOCIATION
WL1			
WL2			
WL3			

DOMINANT / INDICATOR PLANT SPECIES

TOTAL %	TALL TREE	TREE / SHRUB	FORB	BRYOP.
	25	30	95	INR

TREE / SHRUB	%	FORB	%	FORB cont'd	%
ALNUS (INC)		POA PRA			
PIWO (OW)		CAREX (INC)			
PICEA		GROOM MAC			
LONI INC					
				BRYOP.	%

☐ COMPLETE ☒ PARTIAL

WATER COLOUR		
	☐ Tea Coloured	☐ Green-Brown Turbid
	☐ Yellow-Deep Brown Turbid	☐ Blue-Green Clear
	☒ Green-Brown Clear	

pH	CONDUCTIVITY	% OPEN WATER	DEPTH TO WATER
7.4	147.2	25	4.26

SOIL PROFILE	WILDLIFE OBSERVATIONS	
	SPECIES	FEATURE
DEEP UNIFORM HUMIC PEAT	MOOSE	SIGN

Adapted from Ground Inspection Form: FS FS212-2(1) HRE 98/5-7610000694

WETLAND MAP

LOCATION MAP IS GOOD

PROBABLE W-03 BOT I CANT ID THE WILLOW ALMOST ALL ALNUS INC

SOME SPRUCE REGEN

Features to include: North arrow, wildlife features, open water, slope, vegetation communities, wetland boundary, direction of water flow, soil core locations.

OBSERVED WETLAND FUNCTION INDICATORS

HYDROLOGICAL

Groundwater Discharge	*Potential Flood Mitigation*
☑ Minerotrophic Species	☐ Evidence of Flooding
☑ Basin & Hollows HGMP	☑ Fluvial or Lacustrine HGMP
☐ Seepage Slopes HGMP	☑ Downstream Infrastructure Road
Groundwater Recharge	***Erosion Mitigation***
☐ Von Post < 6	☐ No Exposed Soils
☐ Ponds & Potholes HGMP	☐ Sediment Deposition Observed
Permafrost Maintenance	☐ Floodplain
☐ Depth to Permafrost ____ cm	

BIOCHEMICAL

Nutrient Sink	*Water Quality*
☐ WC - Brown/Turbid	☑ Emergent Vegetation
☑ Basin & Hollows HGMP	☐ Upstream of Drinking Water Intake
☐ Ponds & Potholes HGMP	
Nutrient Export	***Carbon Sequestration***
☑ Discharge to Surface Water	☐ Von Post < 4
☐ Fluvial or Lacustrine HGMP	☑ Organic Soils > 1 m

ECOLOGICAL

☑ Source Wetland	☐ Wetland Ecosystem > 5 ha
☐ Unique Wetland	☐ Connected to SOW
☐ High Vegetation Species Diversity	☑ Isolated Wetland Complex
☐ BMI Observed	☐ Connected Wetland Complex

HABITAT

☑ Wildlife Use Observed	☐ Importance to Migration
☐ Listed Wildlife Species Observed	☑ Structural Diversity

NOTES

Dow

BW0007

BIG BEND MEADOW NOT A WETLAND

MOST IS RIPARIAN + BEAVER

CONTROLLED.

398187 5972394 989m

169 - 178

BW0008

BIG BEND CREEK. FLOWS COMPANY

CANOT ID WILLOWS

BEAVER CONTROLLED

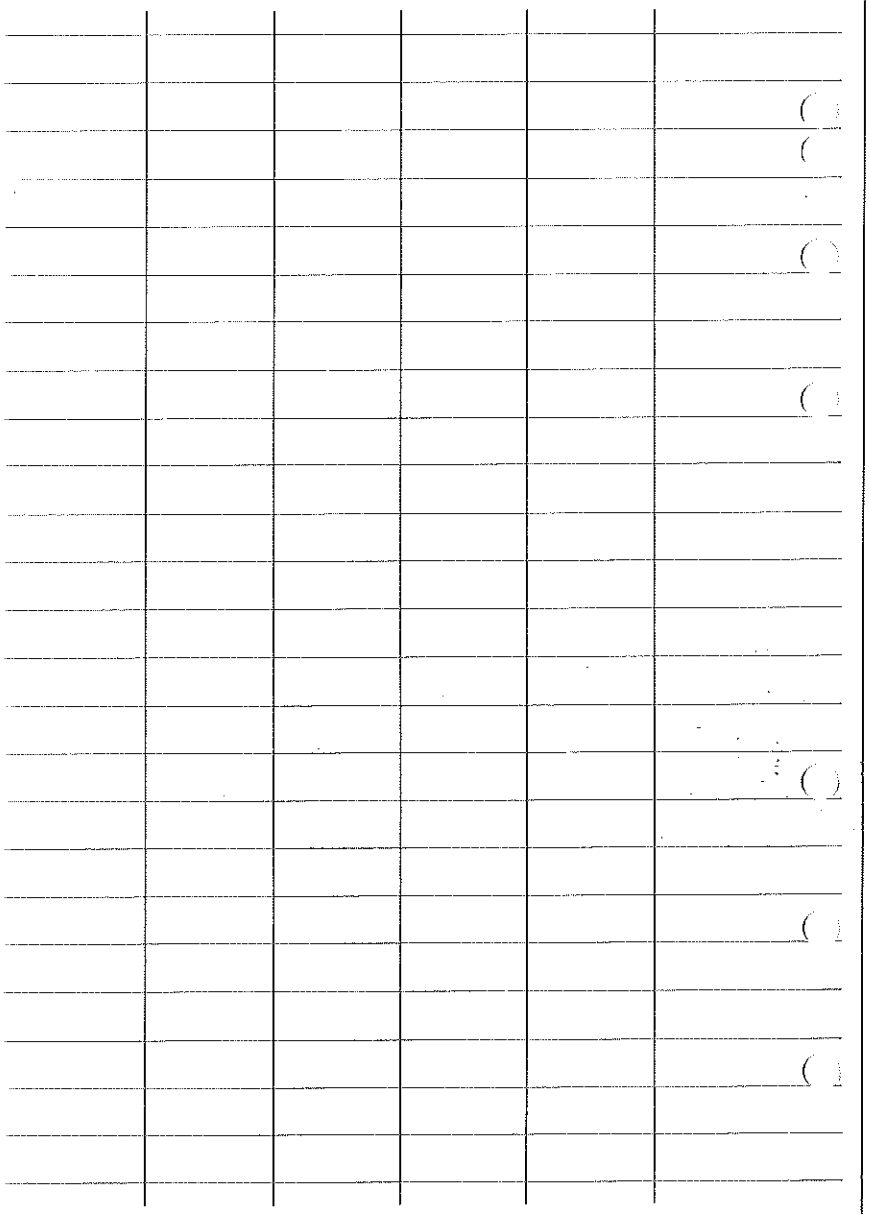
125 - 178

394835 5932598 912

BW0010

- DESCRIBED ON MAP BOOK

FIELD



— Appendix 2 —

Wetland Habitat Information Management (WHIM)
Standard Operating Procedure (SOP)

WHIM-SOP

Wetland Habitat Information Management (WHIM) Standard Operating Procedure (SOP)

June 1, 2015

Brief Description:
Methods of data collection, review, processing and storage for wetland data.

Key Contact:
Wade Burnham M.Sc. PWS, EP, Wetland Specialist

ERM
PO Box 3669 - 3790 Alfred Avenue
Smithers, BC
Canada V0J 2N0
T: (250) 877-7838
F: (250) 877-7833

WHIM-SOP

Wetland Habitat Information Management (WHIM) Standard Operating Procedure (SOP)

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LIST OF FIGURES

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1. OBJECTIVES

The objectives for wetland studies are to map the distribution and class of wetlands, conduct wetland surveys to ground-truth existing remote mapping, and describe wetlands according to their biophysical properties, landscape position, structure, and inferred function for the purpose of classification and assessment.

2. APPLICABLE STANDARDS AND GUIDELINES

The standards and guidelines for wetland field inventories are based upon a variety of federal, provincial and international published standards for wetland identification, classification, and assessment.

Wetlands Class:

Warner, B. G. and C. D. A. Rubec, eds. 1997. The Canadian wetland classification system: The national wetlands working group. Waterloo, ON: Wetlands Research Centre. University of Waterloo.

Wetland Association:

MacKenzie, W. H., and J. R. Moran. 2004. Wetlands of British Columbia: a guide to identification. Res. Br., B.C. Min. For., Victoria, B.C. Land Manage. Handb. No. 52.

Soil moisture regime (SMR), soil nutrient regime (SNR) and wetland hydrodynamic index (HDI):

MacKenzie, W.H. 1999. *Field Description of Wetlands and Related Ecosystems in British Columbia*. Ministry of Forest Research Program. Victoria, B.C.

MacKenzie, W. H., and J. R. Moran. 2004. Wetlands of British Columbia: a guide to identification. Res. Br., B.C. Min. For., Victoria, B.C. Land Manage. Handb. No. 52.

RISC (1998). Standard for Digital Terrestrial Ecosystem Mapping (TEM) Data Capture in British Columbia Ecosystem Technical Standards and Database Manual. R. I. S. Commitee, Province of British Columbia.

Mineral soil drainage classes, mineral soil texture, and soil moisture subclass for organic soils adapted from:

MacKenzie, W.H. 1999. *Field Description of Wetlands and Related Ecosystems in British Columbia*. Ministry of Forest Research Program. Victoria, B.C.

Ministry of Forests (MOF). 1998. Field Manual for Describing Terrestrial Ecosystems. B.C. Min. Env., Lands and Parks and B.C. Min. of For., Land Manage. Handb. No. 25.. Victoria, B.C.

Descriptor for Litter, Fiber, and Humic layers on the soil surface adapted from:

Ministry of Forests (MOF). 1998. Field Manual for Describing Terrestrial Ecosystems. B.C. Min. Env., Lands and Parks and B.C. Min. of For., Land Manage. Handb. No. 25.. Victoria, B.C.

UBC. 2004 Soilweb: Soil Classification. 3.2 Forest Humus forms. Access from: http://www.landfood.ubc.ca/soil200/classification/soil_horizon.htm#3.2humus.

Von Post description of organic soils adapted from:

Ekono. 1981. Report on energy use of peat. Contribution to U.N. Conference on New and Renewable Sources of Energy, Nairobi.

Wetland Function:

Almas, A. R. and B. R. Singh. 2001. Plant Uptake of Cadmium-109 and Zinc-65 at Different Temperature and Organic Matter Levels. J. Environ. Qual. 30: 869-877

Brunham, W.G., L. Bendell. 2010. The Effect of Temperature on the Accumulation of Cadmium, Copper, Zinc, and Lead by *Scirpus acutus* and *Typha latifolia*: A Comparative Analysis. Water Air Soil Pollut (2011) 219: 417-428.

Hanson, A., L. Swanson, D. Ewing, G. Graba, S. Meyer, L. Ross, W. M., and J. Kirby. 2008. *Wetland Ecological Functions Assessment and Overview of Approaches*. Environment Canada Technical Report Series No. 497: Atlantic Region.

Lausen, C. (2006). Bat Survey of Nahanni National Park Reserve and Surrounding Areas, Northwest Territories. N.p., Prepared for Parks Canada and Canadian Parks and Wilderness Society.

Milko, R. 1998. *Wetlands environmental assessment guideline*. Minister of Public Works and Government Services Canada: n.p.

Wetlands Habitat Form modified from:

BC Forestry Ground Inspection Form: FS FS212-2(1) HRE 98/5-7610000694.

3. REQUIRED TRAINING AND COMPETENCY

Field Leader: Requires a minimum of a BSc in Biology, Ecology or a related study, and a combination of course work and field experience in biology, ecology, botany, hydrology, conservation, soil science, wetland identification, wetland delineation, wetland functional assessment, forestry, chemistry, demonstrating ability to identify and assess wetland habitats.

Field assistant: Not required to have specific educational training; the Rescan field leader will provide on-the-job training to the field assistant for required tasks. However, it is desirable that the field assistant have experience in wetland identification, vegetation identification or wetland delineation *or* suitable educational background to support knowledge in plant identification, soil, hydrology, geographic field surveys or habitat inventories.

All field workers are required to have certified First Aid training and receive in-house training for other field safety related topics including driving, use of helicopters and bear awareness.

4. METHODS

4.1 WETLAND SURVEY

4.1.1 Equipment Preparation

Prior to field surveys, all equipment and field clothing are cleaned using a 1% Virkon solution to prevent the spread of *Batrachochytrium dendrobatidis* between wetland sites (Plate 4.1-1). *B. dendrobatidis* is a pathogen for amphibians.

Plate 4.1-1. Application of Virkon prior to and between wetland sites.

4.1.2 Selecting Wetland Survey Locations

Potential survey locations are selected by first examining in the office all data available from remote sensing techniques such as satellite imagery and Light Detection and Ranging (LIDAR) surveys, and by examining ecosystem classification maps. These preselected sites are then examined in the field to ensure they contain hydrophytic vegetation and/or water. If the site has either appropriate vegetation or water then a wetland survey is conducted.

Survey plots are established in areas of uniform vegetation in large wetlands (>400 m^2) or at the centre of wetlands smaller than 400 m^2. The edges of small wetlands are used as the survey plot boundary. The survey plot may include different levels of vegetation complexity and open water; however, each individual vegetation community within the wetland is described.

4.1.3 Physical Site Properties

Once a survey location has been selected a Wetland Habitat Information Form (WHIF) is completed (Figure 4.1-1). Two levels of survey intensity are used: complete and partial. A completed WHIF is required for a complete survey because this form contains fields for the vegetation, soil, and water properties of wetlands at the level necessary for classification. The partial survey intensity is only used to record the locations of continuously occurring ecosystems previously recorded during multiple complete wetland surveys.

At a minimum, the project ID, names of survey personnel, plot number, survey date, GPS coordinates, elevation, photograph numbers, dominant vegetation, and permanence class are recorded. The photograph numbers are the unique identification number used by a camera after a digital image is saved. A minimum of eight photographs must be taken at every survey location. The first photograph is taken facing true north and then again by turning clockwise and taking a picture every 45^{o}. Photographs of significant features such as soil, water, vegetation, and wildlife are also taken.

A clinometer and a compass adjusted to the appropriate declination are used to measure the slope and aspect of a survey location. An aspect of 0 and slope of -1 indicates level ground. Next, the meso-slope position is recorded. The meso-slope position is the position of the plot relative to the local catchment area (Table 4.1-1).

Table 4.1-1. Meso-Slope Position Descriptions

Meso-slope Position	Definition
Crest	Uppermost portion of a hill, convex in all directions, no distinct aspect.
Upper Slope	Generally the convex upper portion of the slope immediately below the crest of a hill; has a specific aspect.
Middle Slope	Area between the upper and lower slope has a straight or somewhat sigmoid surface profile with a specific aspect.
Lower Slope	The area toward the base of a slope; generally has a concave surface profile with a specific aspect.
Toe	The area demarcated from the lower slope by an abrupt decrease in slope gradient; seepage is typically present.
Depression	Any area, concave in all directions; may be at the base of a meso-scale slope or in a generally level area.
Level	Any level meso-scale area.

Adapted from BC MOF (1998).

The hydrogeomorphic position, which describes the topographic position and hydrology of a site, is then recorded (Table 4.1-2).

The previously described data represent the physical properties of each site and are used to support wetland classification and identification of wetland function.

Figure 4.1-1. Wetland Habitat Information Form (WHIF)

WETLAND HABITAT INFORMATION FORM

W ☐ T ☐	PHOTO	X:	Y:	DATE
PROJECT ID		SURV.		
MAPSHEET		PLOT #		
UTM ZONE	NORTH	EAST		
ASPECT		ELEVATION		
SLOPE %	SMR	HDI	SNR	

MESO SLOPE POSITION	☐ Crest ☐ Upper slope	☐ Mid slope ☐ Lower slope ☐ Toe	☐ Depression ☐ Level
HYDROGEO-MORPHIC POSITION	☐ Estuarine ☐ Fluvial	☐ Lacustrine ☐ Ponds & Potholes	☐ Basins & Hollows ☐ Seepage Slopes
DRAINAGE - MINERAL SOILS	☐ Very rapidly ☐ Rapidly	☐ Well ☐ Mod. well ☐ Imperfectly	☐ Poorly ☐ Very poorly
MINERAL SOIL TEXTURE	☐ Sandy (LS,S) ☐ Loamy (SL,L,SCL,FSL)	☐ Silty (SiL,Si) ☐ Clayey (SiCL,CL,SC,SiC,C)	
MOISTURE SUBCLASSES ORGANIC SOIL	☐ Aqueous ☐ Peraquic	☐ Aquic ☐ Subaquic	☐ Perhumid ☐ Humid

ORGANIC SOIL TEXTURE		SURF. ORGANIC HORIZON THICKNESS
☐ Fibric	☐ Mesic ☐ Humic	_____ cm
HUMUS FORM		ROOTING DEPTH
☐ Mor	☐ Moder ☐ Mull	Depth _____ cm Type _____

VON POST

1 2 3 4 5 6 7 8 9 10

COARSE FRAGMENT CONTENT

☐ < 20% ☐ 20-35% ☐ 35-70% ☐ > 70%

ECOSYSTEM COMPONENT: ☐ WL1 ☐ WL2 ☐ WL3

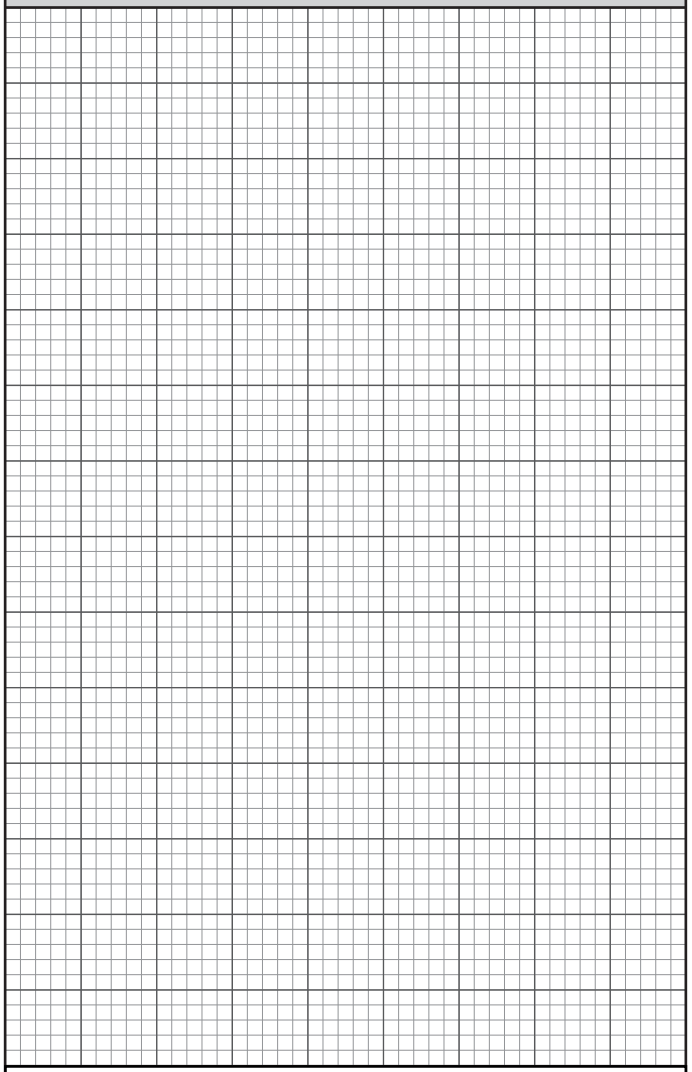
BGC UNIT	WETLAND CLASS
SITE SERIES	ASSOCIATION
STRUCTURAL STAGE	MODIFIER

WETLAND POLYGON SUMMARY

	%	CLASS	ASSOCIATION
WL1			
WL2			
WL3			

WB-RES13-01 250413

WETLAND MAP



Features to include: North arrow, wildlife features, open water, slope, vegetation communities, wetland boundary, direction of water flow, soil core locations.

Table 4.1-2. Hydrogeomorphic Position Descriptions

Hydrogeomorphic Position	Definition
Estuarine	Sites at the confluence of fluvial and marine environments.
Fluvial	Sites associated with flowing water, subject to flooding, erosion, and sedimentation.
Lacustrine	Sites at lakeside.
Basins and Hollows	Sites in depressions or topographic low points, receive water from groundwater or precipitation.
Ponds and Potholes	Sites associated with small water-bodies.
Seepage slopes	Sloping sites with near surface groundwater seepage.

4.1.4 Adapted from MacKenzie and Moran (2004).Wetland Soil Survey

No less than three soil test pits or holes are established within a survey plot. The preferred method is to use an EDELMAN Dutch Auger (Plate 4.1-2). The soil test holes are established to a minimum depth of 40 cm or where significant contact with lithic, parent material, an impermeable layer, or water is made. As the test hole is established, lengths of soil collected in the auger barrel are pulled from the hole and arranged such that the profile of the soil can be examined (Plate 4.1-3).

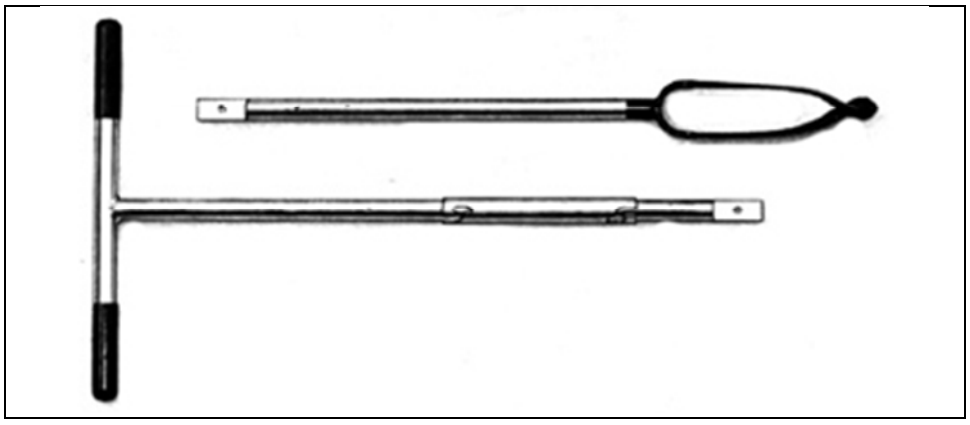


Plate 4.1-2. EDELMAN Dutch Auger

Plate 4.1-3. Soil core example.

Once the soil test holes have been established and the multiple cores have been examined, a representative core is selected for data collection. The soil moisture regime (SMR) is determined (Table 4.1-3).

Table 4.1-3. Soil Moisture Regime Descriptions

Soil Moisture Regime	Code	Definition
Moist	M	No water deficit (demand doesn't exceed supply), temporary groundwater table may be present. Generally supports forest.
Very Moist	VM	Rooting zone groundwater present during growing season. Groundwater table greater than 30 cm below ground surface. Can support limited forest.
Wet	W	Rooting zone groundwater present throughout the year. Groundwater table less than 30 cm below ground surface. Supports forest only on elevated micro-sites.
Very Wet	VW	Sites in depressions or topographic low points, receive water from groundwater or precipitation.

Adapted from MacKenzie and Moran (2004).

The Hydrodynamic Index (HDI) is then determined (Table 4.1-4).

Table 4.1-4. Hydrodynamic Index Descriptions

Hydrodynamic Index	Code	Definition/Indicators
Stagnant	St	Stagnant to very slow moving soil water, vertical fluctuations minimal, no evidence of flooding; lots of organic matter and high bryophyte cover.
Sluggish	Sl	Gradual groundwater movement; patterned fens; brief periods of surface aeration.
Mobile	Mo	Distinct flooding; open water tracks such as rivulets/ponds/potholes; well decomposed peat; patchy bryophyte cover.
Dynamic	Dy	Significant lateral flow and/or strong vertical fluctuations; pothole wetlands in arid climates; riparian/oxbow sites; little organic accumulation.
Very Dynamic	VD	Highly dynamic surface water; exposed tidal sites; shallow potholes that dry completely; no organic matter accumulation or bryophytes.

Adapted from MacKenzie and Moran (2004).

The soil nutrient regime (SNR) is determined (Table 4.1-5).

Table 4.1-5. Soil Nutrient Regime Descriptions

Soil Nutrient Regime	Code	Indicators
Very Poor	A	HDI St, von post 1-3, tea coloured or yellowish water, pH < 5
Poor	B	HDI St-Sl, von post 3-6, tea coloured or yellowish water, possibly green-brown or clear, pH 4.5 - 6
Medium	C	HDI St-Mo, von post 4-7, tea coloured, yellowish, green-brown, or clear water, pH 5-6.5
Rich	D	HDI Sl-Dy, von post 7-10, green-brown and turbid water, pH 6-7.4
Very Rich	E	HDI Mo-Dy, von post 8-10, green-brown and turbid water, pH 6.5-8
Hyper	F	Excess salt accumulation, pH > 8, high conductivity

Adapted from MacKenzie and Moran (2004).

The presence of mineral soils is determined by identifying indicators of mineralization such as gleying, mottling, oxidization, or mineral soil texture (silt, sand, or clay). The mineral soil drainage class is identified (Table 4.1-6).

Table 4.1-6. Drainage Class for Mineral Soils

Drainage Class	Description
Very Rapid	Water is removed from the soil very rapidly in relation to supply. Water source is precipitation and available water storage capacity following precipitation is essentially nil. Soils are typically fragmental or skeletal, shallow, or both.
Rapid	Water is removed from the soil rapidly in relation to supply. Excess water flows downward if underlying material is pervious. Sub-surface flow may occur on steep gradients during heavy rainfall. Water source is precipitation. Soils are generally coarse textured.
Well	Water is removed from the soil readily, but not rapidly. Excess water flows downward readily into underlying pervious material or laterally as sub-surface flow. Water source is precipitation. On slopes, sub-surface flow may occur for short durations, but additions are equalled by losses. Soils are generally intermediate in texture and lack restricting layers.
Mod. Well	Water is removed from the soil somewhat slowly in relation to supply because of imperviousness or lack of gradient. Precipitation is the dominant water source in medium- to fine-textured soils; precipitation and significant additions by sub-surface flow are necessary in coarse-textured soils.
Imperfectly	Water is removed from the soil sufficiently slowly in relation to supply to keep the soil wet for a significant part of the growing season. Excess water moves slowly downward if precipitation is the major source. If sub-surface water or groundwater (or both) is the main source, the flow rate may vary but the soil remains wet for a significant part of the growing season. Precipitation is the main source if available water storage capacity is high; contribution by sub-surface or groundwater flow (or both) increases as available water storage capacity decreases. Soils generally have a wide range of texture, and some mottling is common.
Poorly	Water is removed so slowly in relation to supply that the soil remains wet for much of the time that it is not frozen. Excess water is evident in the soil for a large part of the time. Sub-surface or groundwater flow (or both), in addition to precipitation, are the main water sources. A perched water table may be present. Soils are generally mottled and/or gleyed.
Level	Water is removed from the soil so slowly that the water table remains at or near the surface for most of the time the soil is not frozen. Groundwater flow and sub-surface flow are the major water sources. Precipitation is less important, except where there is a perched water table with precipitation exceeding evapotranspiration. Typically associated with wetlands.

Adapted from BC MOF (1998).

If mineral soils are present within the top 40 cm of the soil surface, then the mineral soil texture is determined using the soil texture triangle (Plate 4.1-4).

If organic soils are present (i.e., no mineral soil indicators within top 40 cm of soil surface), then the moisture sub-class of organic soils is identified (Table 4.1-7).

The organic soil texture is recorded (Table 4.1-8).

The depth of the surface organic layer is measured and recorded. Where the depth of the organic layer exceeds the test pit a plus sign (+) is used. For example, an organic soil depth of +120 cm indicates that 120 cm of organic soil was measured but the organic layer extends beyond that depth.

The humus form is recorded (Table 4.1-9).

The depth to the bottom of the rooting zone and the von post level of decomposition are measured and recorded (Table 4.1-10).

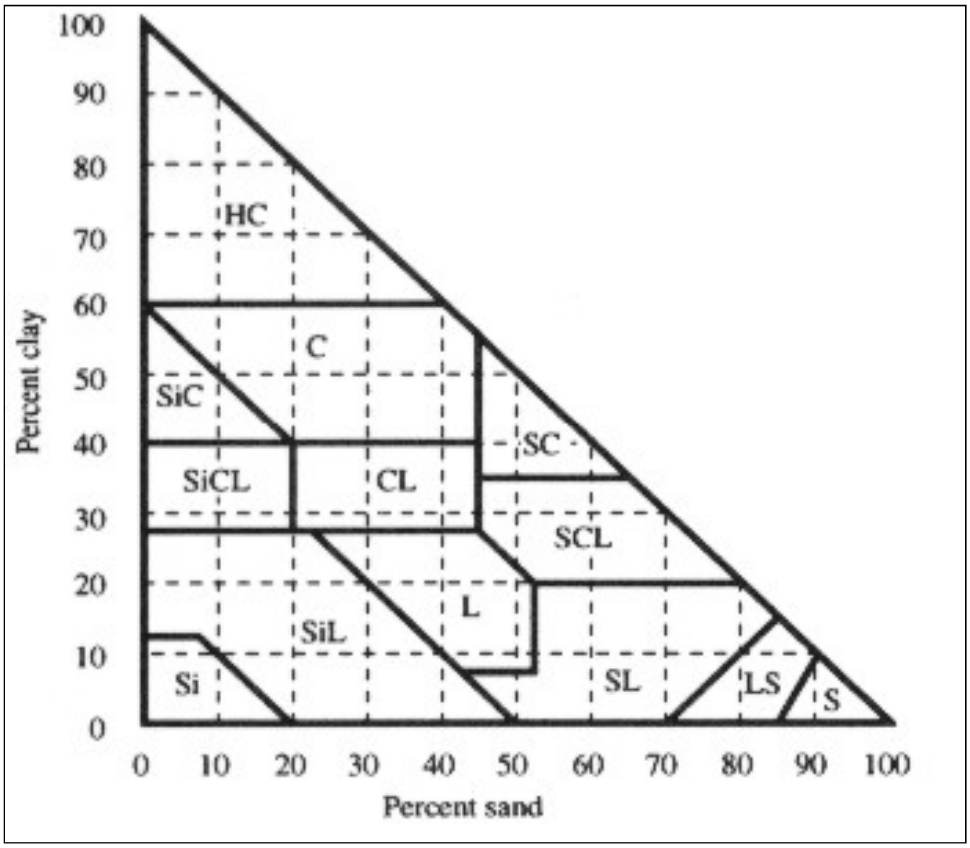


Plate 4.1-4. Soil texture triangle (BC MOF 1998).

Table 4.1-7. Moisture Sub-Class of Organic Soils

Moisture Sub-class	Description	Saturation Period (months)
Aqueous	Free surface water	11.5 to 12
Peraquic	Soils saturated for very long periods	>10
Aquic	Soils saturated for moderately long periods	4-10
Subaquic	Soils saturated for short periods	<4
Perhumid	No significant water deficits in growing season	<2
Humid	Very slight deficit in growing season water availability	<0.5

Adapted from BC MOF (1998).

Table 4.1-8. Organic Soil Texture

Texture	Description	Corresponding Von Post
Fibric	Visible and identifiable plant part, soil water clear	1-3
Mesic	Some visible plant parts, soil water slightly coloured	4-7
Humic	Indiscernible plant parts, dark greasy soil	8-10

Table 4.1-9. Descriptions of Humus Form

Humus Form	LFH Horizons		Transition to Overlying Horizon
	L/F	*H*	
Mull	*Thin or absent*	*Absent*	Gradual
Moder	*Moderate*	*Moderate*	Not abrupt
Mor	*Matted and thick*	*Thin*	Very abrupt

LFH is the breakdown of the Litter, Fiber, and Humic layers on the soil surface.
Adapted from BC MOF (1998) and UBC (2004).

Table 4.1-10. Von Post Description

Von Post	Description
1	Completely undecomposed peat which, when squeezed, releases almost clear water. Plant remains easily identifiable. No amorphous material present.
2	Almost entirely undecomposed peat which, when squeezed, releases clear or yellowish water. Plant remains still easily identifiable. No amorphous material present.
3	Very slightly decomposed peat which, when squeezed, releases muddy brown water, but from which no peat passes between the fingers. Plant remains still identifiable, and no amorphous material present.
4	Slightly decomposed peat which, when squeezed, releases very muddy dark water. No peat is passed between the fingers but the plant remains are slightly pasty and have lost some of their identifiable features.
5	Moderately decomposed peat which, when squeezed, releases very "muddy" water with a very small amount of amorphous granular peat escaping between the fingers. The structure of the plant remains is quite indistinct although it is still possible to recognize certain features. The residue is very pasty.
6	Moderately highly decomposed peat with a very indistinct plant structure. When squeezed, about one-third of the peat escapes between the fingers. The residue is very pasty but shows the plant structure more distinctly than before squeezing.
7	Highly decomposed peat. Contains a lot of amorphous material with very faintly recognizable plant structure. When squeezed, about one-half of the peat escapes between the fingers. The water, if any is released, is very dark and almost pasty.
8	Very highly decomposed peat with a large quantity of amorphous material and very indistinct plant structure. When squeezed, about two-thirds of the peat escapes between the fingers. A small quantity of pasty water may be released. The plant material remaining in the hand consists of residues such as roots and fibres that resist decomposition.
9	Practically fully decomposed peat in which there is hardly any recognizable plant structure. When squeezed it is a fairly uniform paste.
10	Completely decomposed peat with no discernible plant structure. When squeezed, all the wet peat escapes between the fingers.

Adapted from Ekono (1981).

The soil description is completed by estimating the percentage of coarse fragments, measuring the depth of soil horizons (depth of organic layer, depth of mineral layer, depth to water, and rooting depth). A soil profile is drawn in the appropriate location on the WHIF and depth to all features is indicated.

4.1.5 Wetland Vegetation Survey

Vegetation species within the survey plot are identified and their seven letter acronym is recorded in the appropriate section of the field form. For example, common cattail (*Typha latifolia*) is recorded as TYPHLAT in the forb section.

The percent cover of each individual species and species guilds (Tall Tree, Tree/Shrub, Forb, and Bryophyte) are estimated. A tall tree is a tree standing over 5 m. A tree/shrub is a tree less than 5 m tall or any multiple stemmed woody vegetation. A forb is any herbaceous plant including graminoids, *Equisetum*, and club-mosses. Bryophytes are mosses and lichens. The level of vegetation survey is indicated as complete or partial. A complete vegetation list is not essential; however, it is imperative that the dominant and sub-dominant vegetation (upland, emergent, submerged aquatic, and floating-leaved aquatic) be recorded.

4.1.6 Wetland Water Survey

Measurements and documentation of the optical and chemical characteristics of water within the wetland survey location are made. The WHIF includes space for data from up to three water features. The colour of the water is described as: (1) Tea Coloured, (2) Yellow-Deep Brown Turbid, (3) Green-Brown Clear, (4) Green-brown Turbid, or (5) Blue-green Clear.

The pH of open water is measured using a handheld sonde such as an Oakton Instruments pH Testr 10 (Plate 4.1-5). The conductivity of open water is also measured using a handheld sonde such as an Oakton Instruments TDSTestr Low.

Plate 4.1-5. Oakton Instruments pH Testr 10 measuring pH of shallow groundwater in a soil test hole.

4.1.7 Wetland Classification

The water, soils, and vegetation information collected during the field surveys are used to classify the wetlands to federal class (Warner and Rubec 1997) and association type (Thompson and Hansen 2001). Wetland sites are initially assigned to one of five federal classes (Table 4.1-11), in accordance with the Canadian Wetland Classification System (Warner and Rubec 1997). Wetland class is based on general site characteristics such as soil type and the extent and quality of predominant vegetation cover.

Table 4.1-11. Description of Federal Wetland Classes

Federal Wetland Class	Description
Bog	Nutrient poor peatland, receiving water exclusively from precipitation.
Fen	Nutrient medium peatland, receiving water from groundwater and precipitation.
Marsh	Nutrient rich mineral wetland; vegetation dominated by graminoids, forbs, shrubs and emergent plants.
Swamp	Nutrient rich mineral wetland; vegetation dominated by woody plants > 1 m in height.
Shallow open water	Wetland with free surface water up to 2 m depth; less than 25% of surface area occluded by emergent or woody plants.

Source: Warner and Rubec (1997).

Wetland association classification is based on the specific vegetation composition characteristics of a given site. The environmental conditions at a wetland influence the development of plant communities, thereby affecting species reproduction and the floristic diversity throughout the vegetation layers. Thus, sites with similar environmental conditions develop similar vegetation communities.

The dominant vegetation species recorded during the field surveys are matched to an association type described in the classification system prepared by MacKenzie and Moran (2004). The list of species, identified at some sites, may not always match a particular association type. In such cases, sub-dominant vegetation species are used to aid classification.

4.2 WETLAND FUNCTION STUDIES

The determination of wetland function is central to the process of wetland effects analysis. The primary wetland functions within a study area are determined by comparing wetland classification and hydrogeomorphic position data to a list of functions associated with wetland classes prepared by Hanson et. al (2008). Additionally, specific studies are conducted at a sample of wetlands to establish baseline data on the vegetation tissue metal concentrations and wetland hydrology. Milko (1998) identifies four primary functions, and Table 4.2-1 identifies which data are used to support descriptions of these functions.

4.2.1 Vegetation Sampling

Plant tissue samples are collected in triplicate at select wetlands within the study area to establish baseline metal concentrations. Sample sites are chosen ensuring a variety wetland sizes and permanence are reflected in the sampling.

Table 4.2-1. Wetland Functions and Supporting Data

Wetland Function	Description (Environment Canada 1998)	Supporting Data
Hydrological	Contribution of the wetland to the quantity of surface water and groundwater	Static and continuous hydrology survey; Wetland permanence classification
Biogeochemical	Contribution of the wetland to the quality of surface water and groundwater	Water quality data (pH and Conductivity), Vegetation tissue samples
Habitat	Relative abundance of terrestrial and aquatic habitat and connectivity to surrounding ecosystem	Wildlife observations and Association classification
Ecological	Role of the wetland in the surrounding ecosystem	Association classifications Wetland complex, size, Open water area and permanence

Samples are collected by collecting above ground portions of the plant and placing them in individual 1 L Ziploc bags. The individual collecting the samples must wear latex gloves to reduce potential of contamination from one sample to the next. At each site three bags are filled, each containing multiple individuals from three distinct areas within the wetland site. This method ensures adequate individual and geographic variability in sample collection.

Samples are stored in a cool, dark, environment until shipped to ALS Environment in Vancouver, BC, for analysis. Table 4.2-2 lists the analytical parameters and their detection limits.

Table 4.2-2. Metal Analysis and Associated Detection Limits for Plant Tissue Samples

Metal	Abbreviation	Dry Weight Detection Limit (mg/kg)	Average Wet Weight Detection Limit (mg/Wkg)
Aluminum	Al	10	2.7
Antimony	Sb	0.05	0.0135
Arsenic	As	0.05	0.0135
Barium	Ba	0.05	0.0135
Beryllium	Be	0.3	0.135
Bismuth	Bi	0.3	0.0405
Cadmium	Cd	0.03	0.00675
Calcium	Ca	10	2.7
Chromium	Cr	0.5	0.135
Cobalt	Co	0.1	0.027
Copper	Cu	0.05	0.0135
Lead	Pb	0.1	0.027
Lithium	Li	0.5	0.135
Magnesium	Mg	3	1.35
Manganese	Mn	0.05	0.0135
Mercury	Hg	0.005	0.001
Molybdenum	Mo	0.05	0.0135

(continued)

Table 4.2-2. Metal Analysis and Associated Detection Limits for Plant Tissue Samples (completed)

Metal	Abbreviation	Dry Weight Detection Limit (mg/kg)	Average Wet Weight Detection Limit (mg/Wkg)
Nickel	Ni	0.5	0.135
Selenium	Se	1	0.27
Strontium	Sr	0.05	0.0135
Thallium	Tl	0.03	0.0135
Tin	Sn	0.2	0.0675
Uranium	U	0.01	0.0027
Vanadium	V	0.5	0.135
Zinc	Zn	0.5	0.135

All metals with more than 50% of samples below the method detection limit are excluded from further analysis. For the remaining metals, all values below detection limits are replaced by one-half the detection limit. General descriptive statistics of the remaining metals are calculated. Variability is assessed for each wetland site using the coefficient of variation (CV = [Standard Deviation/Mean] x 100).

5. DATA RECORDING, PROCESSING AND STORAGE

Once field data surveys are complete, data sheets are scanned to a pdf document which is stored on the Rescan intranet and data are then entered into MS Excel spreadsheets. The physical site data, soil information, and classification data are entered into a wetland ecosystem master datasheet. The vegetation species list and relative percent cover are entered into a separate sheet, as are any wildlife observations. The wetland ecosystem master sheet is the base information used to generate GIS maps of wetlands.

Wetlands are delineated in ArcGIS 10.0 using available digital spatial data, wetland survey locations, and high resolution satellite imagery. A point file of the wetland ecosystem master data are added to the data view and wetland polygons are delineated by tracing wetland features visible on the satellite image. The area of delineated wetland polygons are then calculated using the geometry function in ArcGIS 10.0. The spatial database containing the delineated wetland polygon information is joined to the ecosystem database through the spatial join function in ArcGIS 10.0.

The electronic files are regularly uploaded to Rescan's intranet and stored in a dedicated folder which is backed up on a daily basis.

6. QA/QC

6.1 DATA QUALITY PROGRAM

Data are entered into an established Excel data sheet with standardized fields to reduce the possibility of transcription errors. Data are screened using pivot table functions within Excel to determine that parameters such as von post, align with SNR, and vegetation species. Ecosystem data are related and can be used to identify transcription or field identification errors. Whenever clarification is required on specific points, the WHIF will be returned to the field crew for editing and will be accepted after the necessary changes are made.

Regular instrument calibration of the pH and conductivity sondes ensures good data quality collected during field recording of pH and conductivity.

Vegetation tissue samples are collected in triplicate to reduce the likelihood of contaminated samples biasing the data from a single wetland. ALS is an accredited laboratory and provides replicate analysis to ensure consistency during the data analysis stage.

6.2 QUALITY INDICATORS

The following Quality Indicators will be measured to track the overall success of the wetlands program:

- the wetlands surveyed are spatially representative of the study area.

6.3 CONTINUAL IMPROVEMENT

The science of wetlands is continuously evolving, resulting in improvements in the techniques of mapping and field data collection. During these projects, predictive models using LIDAR and basin depth structure will be explored to better classify wetland permanence of sites prior to field investigations.

The procedures outlined in this manual will be reviewed and updated annually to account for changes in regulatory requirements, technological advances, and to adhere to the best current scientific practices.

— Appendix 3 —

Wetland Mapping

Figure 3.1-1

Blackwater Gold Project: Wetland Classification and Mapping in the Transmission Line Access Roads Expanded LSA Map 1

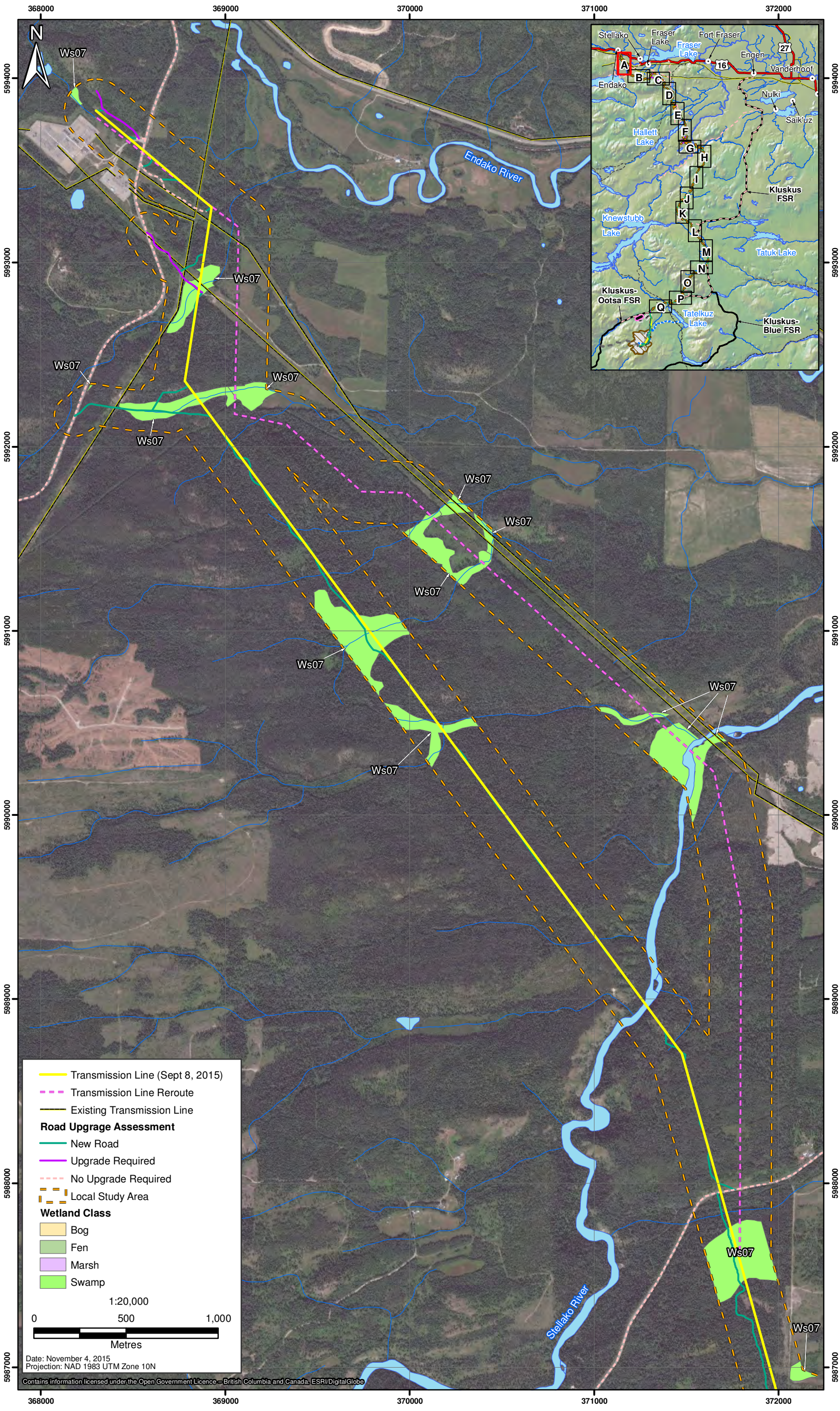


Figure 3.1-2
Blackwater Gold Project: Wetland Classification and Mapping in the Transmission Line Access Roads Expanded LSA Map 2

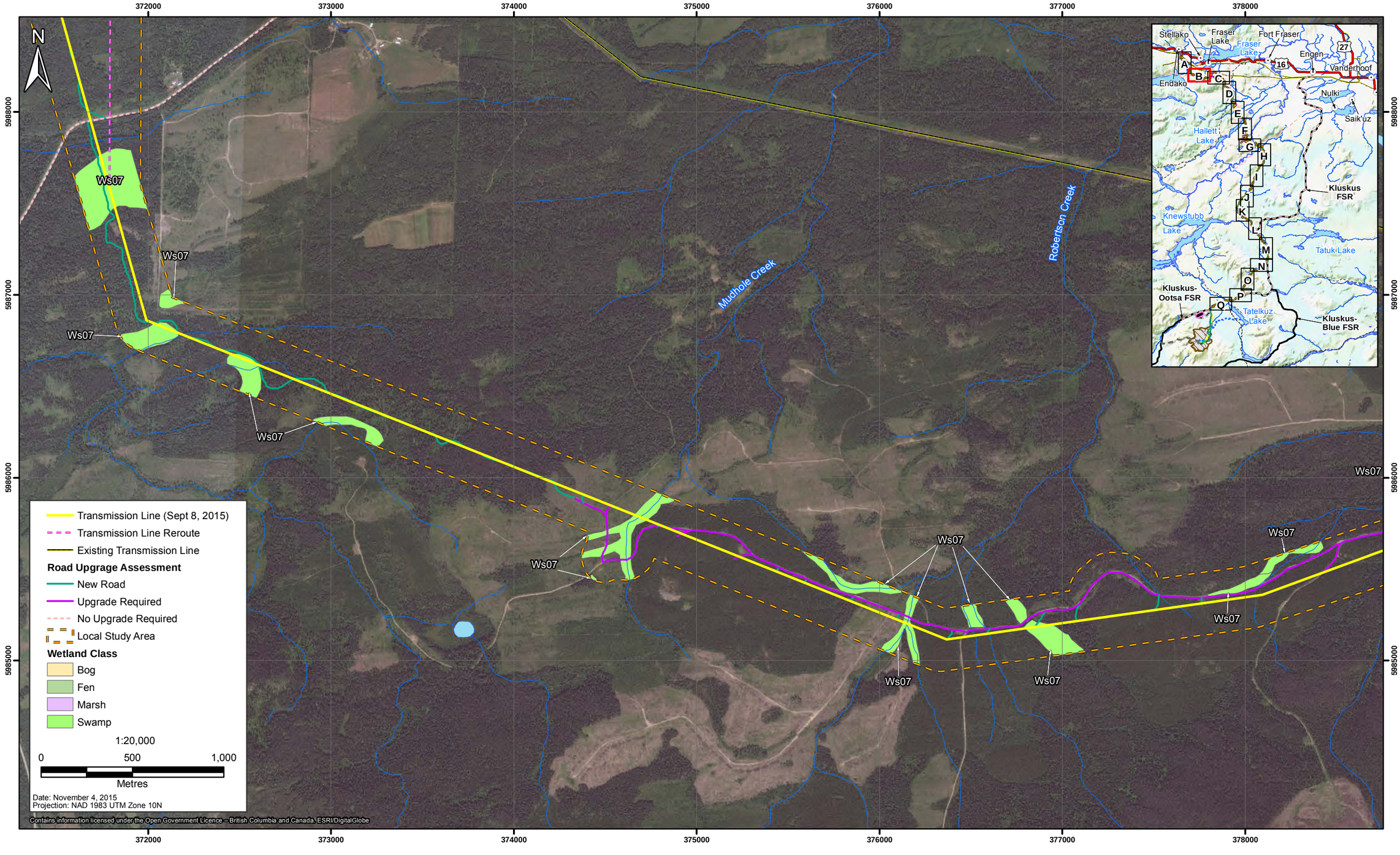


Figure 3.1-3
Blackwater Gold Project: Wetland Classification and Mapping in the Transmission Line Access Roads Expanded LSA Map 3

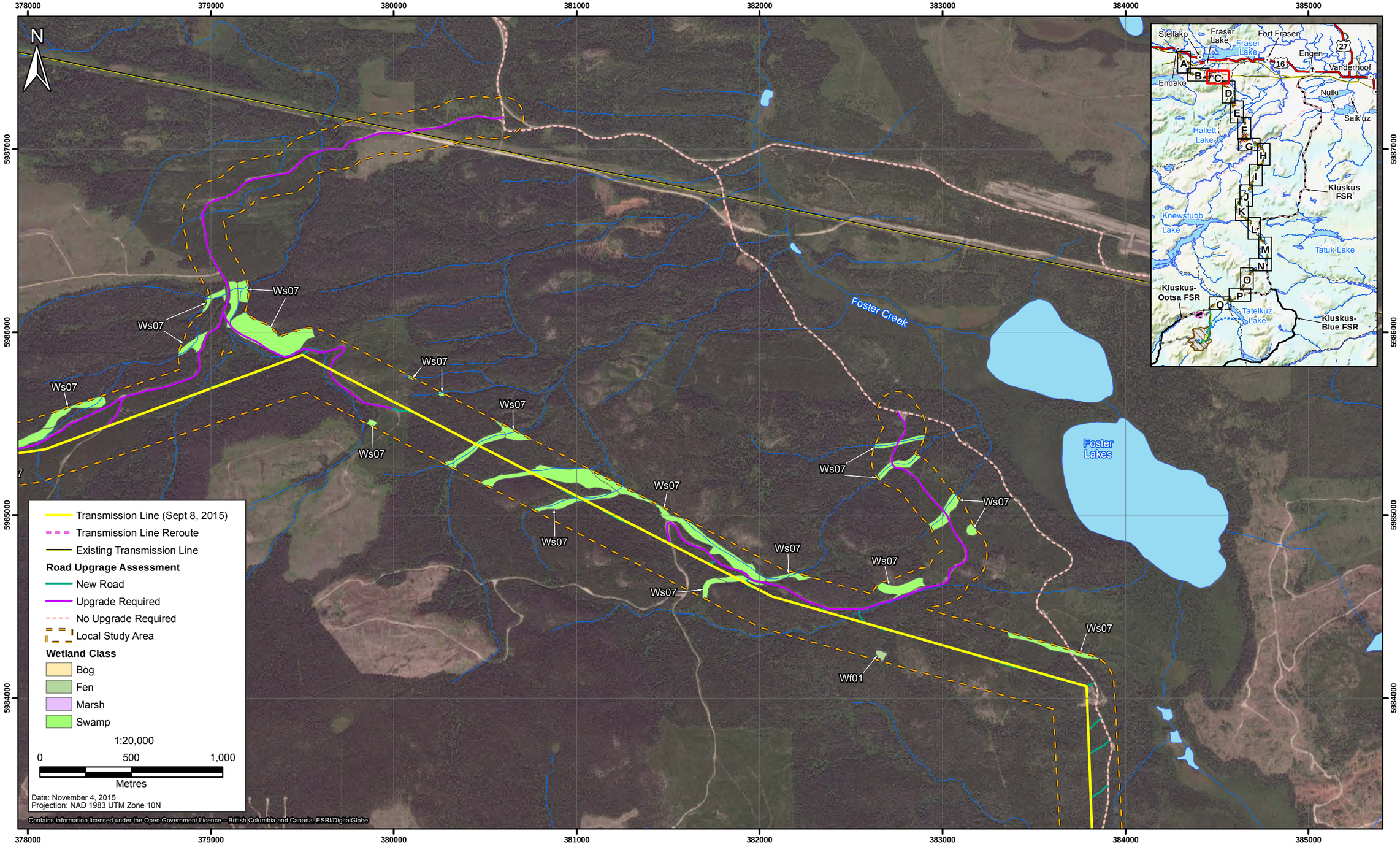


Figure 3.1-4

Blackwater Gold Project: Wetland Classification and Mapping in the Transmission Line Access Roads Expanded LSA Map 4

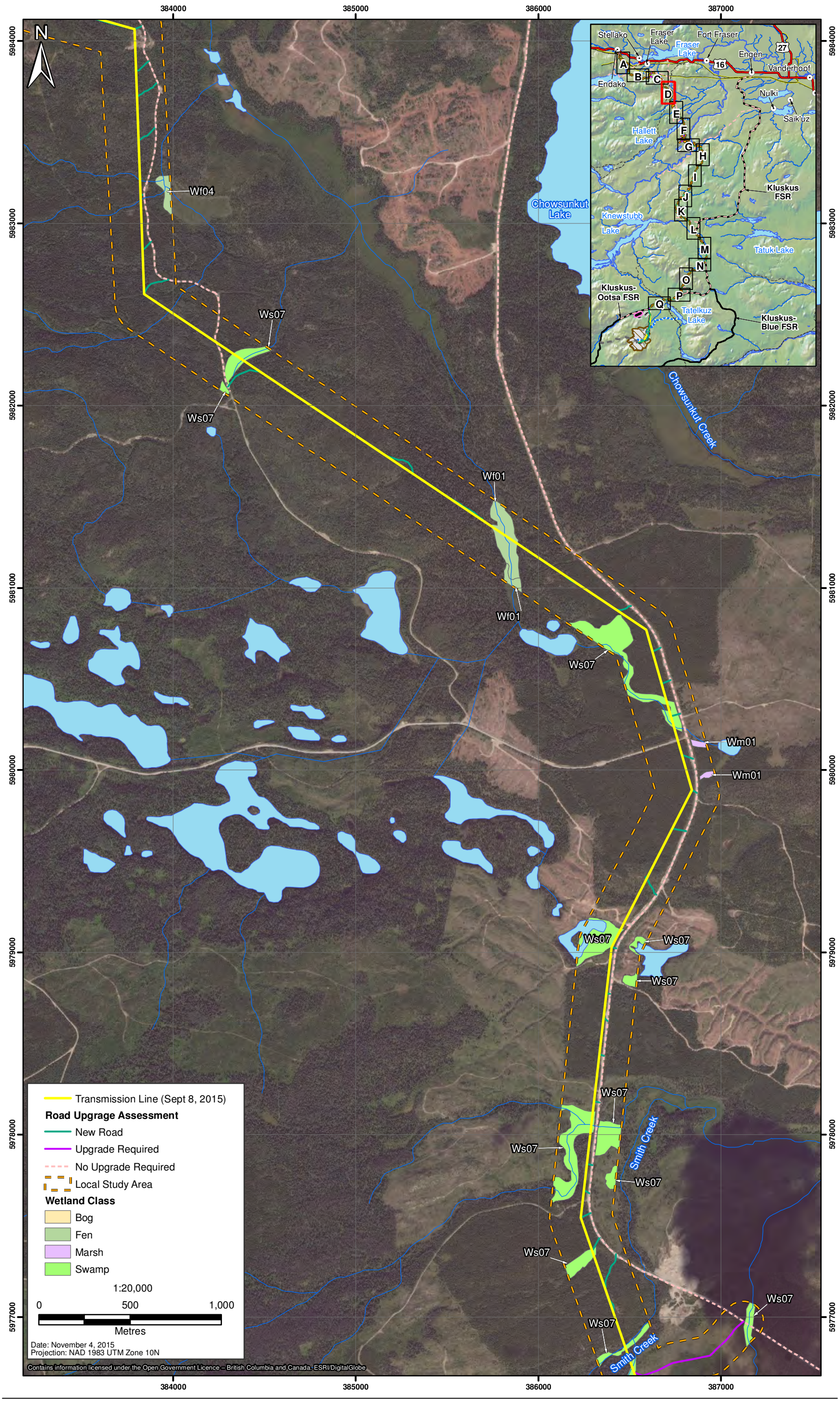


Figure 3.1-5

Blackwater Gold Project: Wetland Classification and Mapping in the Transmission Line Access Roads Expanded LSA Map 5

ERM

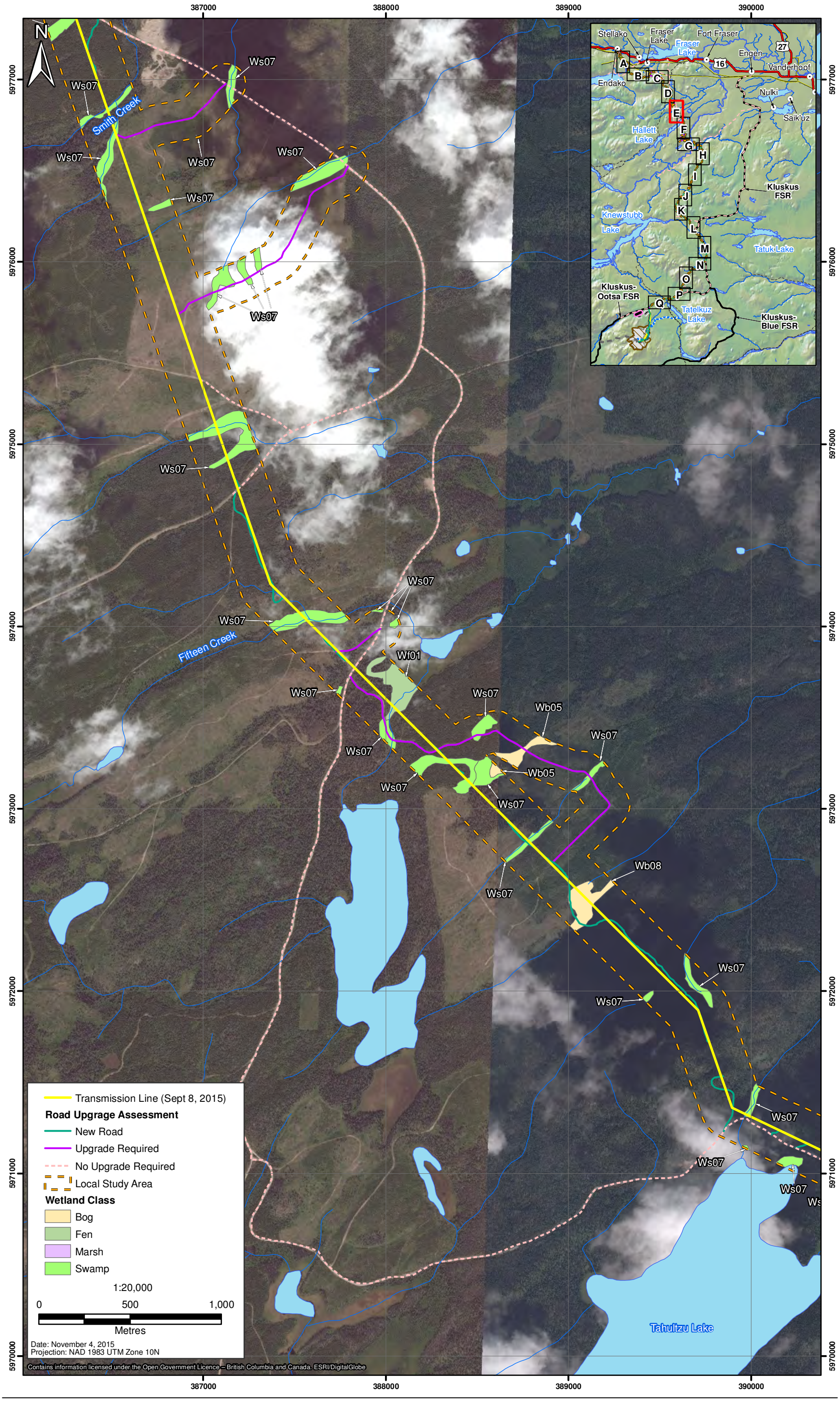


Figure 3.1-6

Blackwater Gold Project: Wetland Classification and Mapping in the Transmission Line Access Roads Expanded LSA Map 6

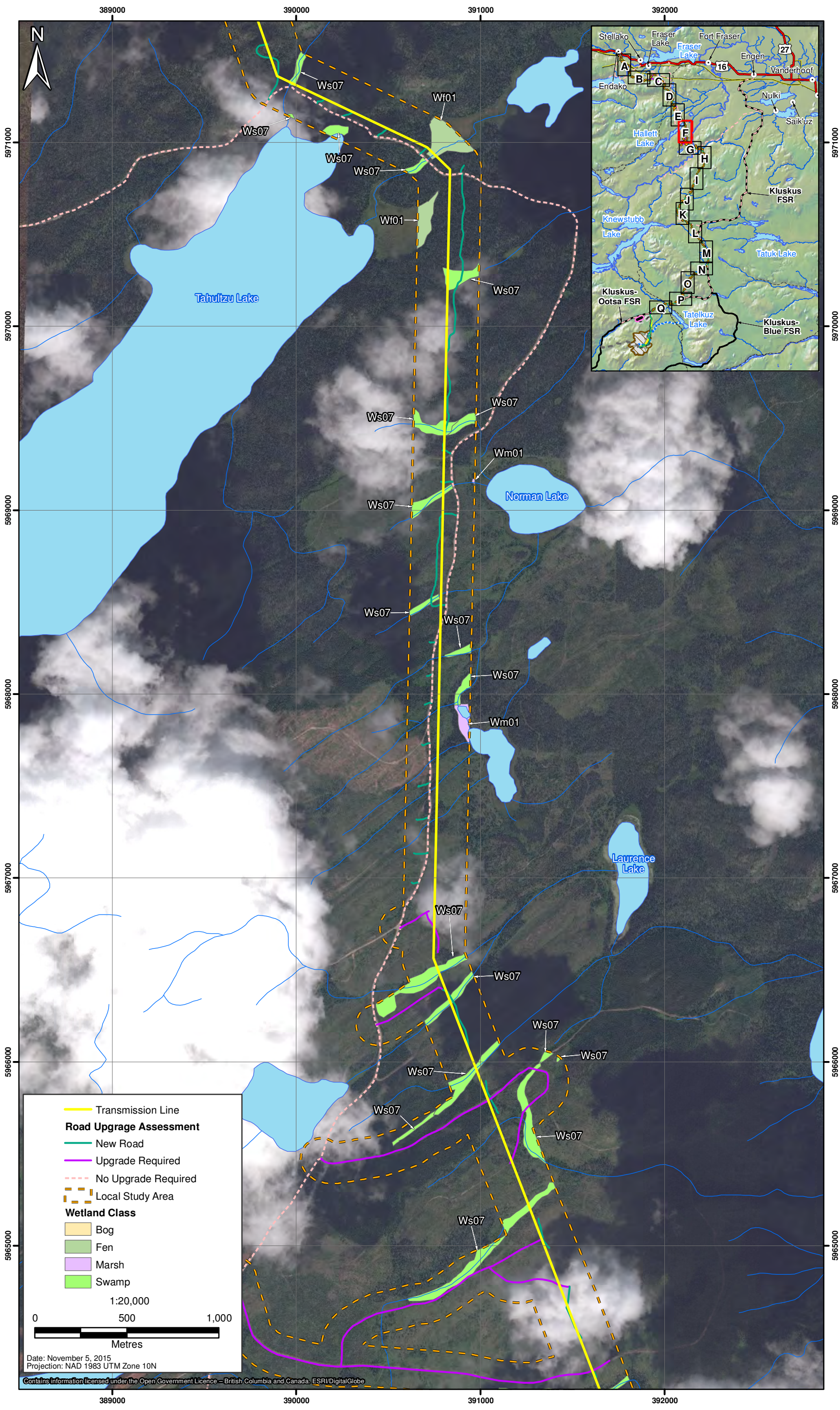


Figure 3.1-7
Blackwater Gold Project: Wetland Classification and Mapping in the Transmission Line Access Roads Expanded LSA Map 7

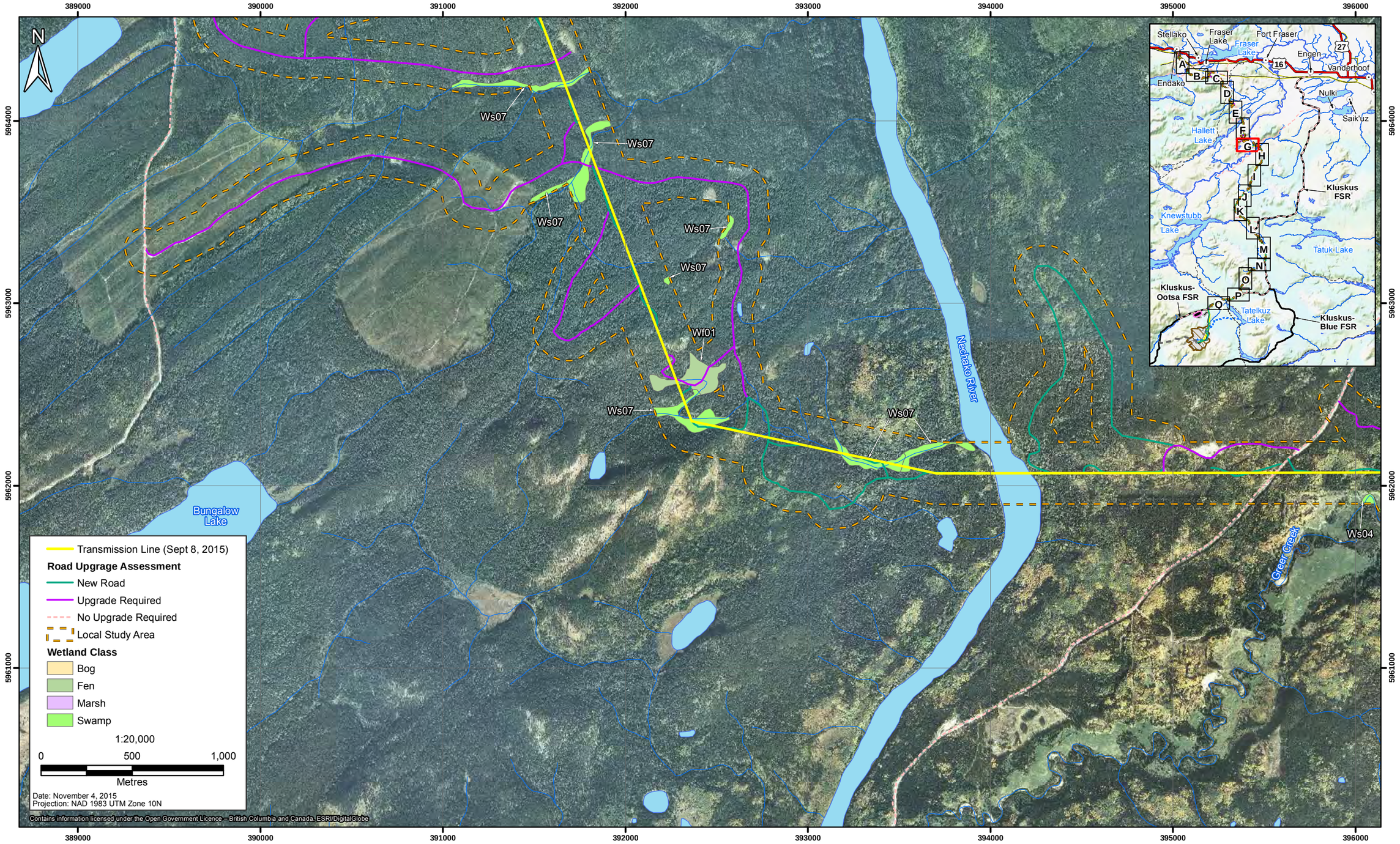


Figure 3.1-8

Blackwater Gold Project: Wetland Classification and Mapping in the Transmission Line Access Roads Expanded LSA Map 8

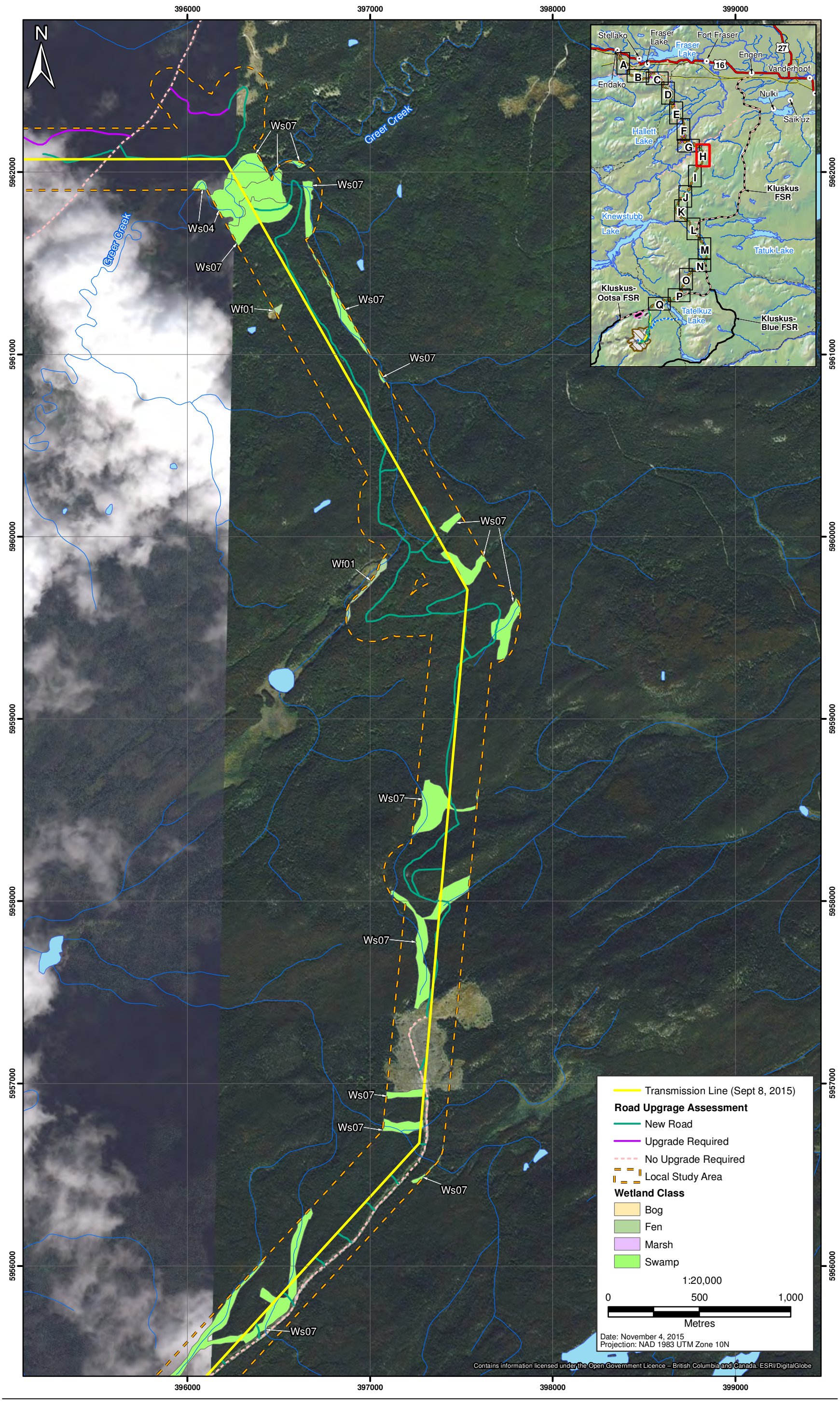


Figure 3.1-9

Blackwater Gold Project: Wetland Classification and Mapping in the Transmission Line Access Roads Expanded LSA Map 9

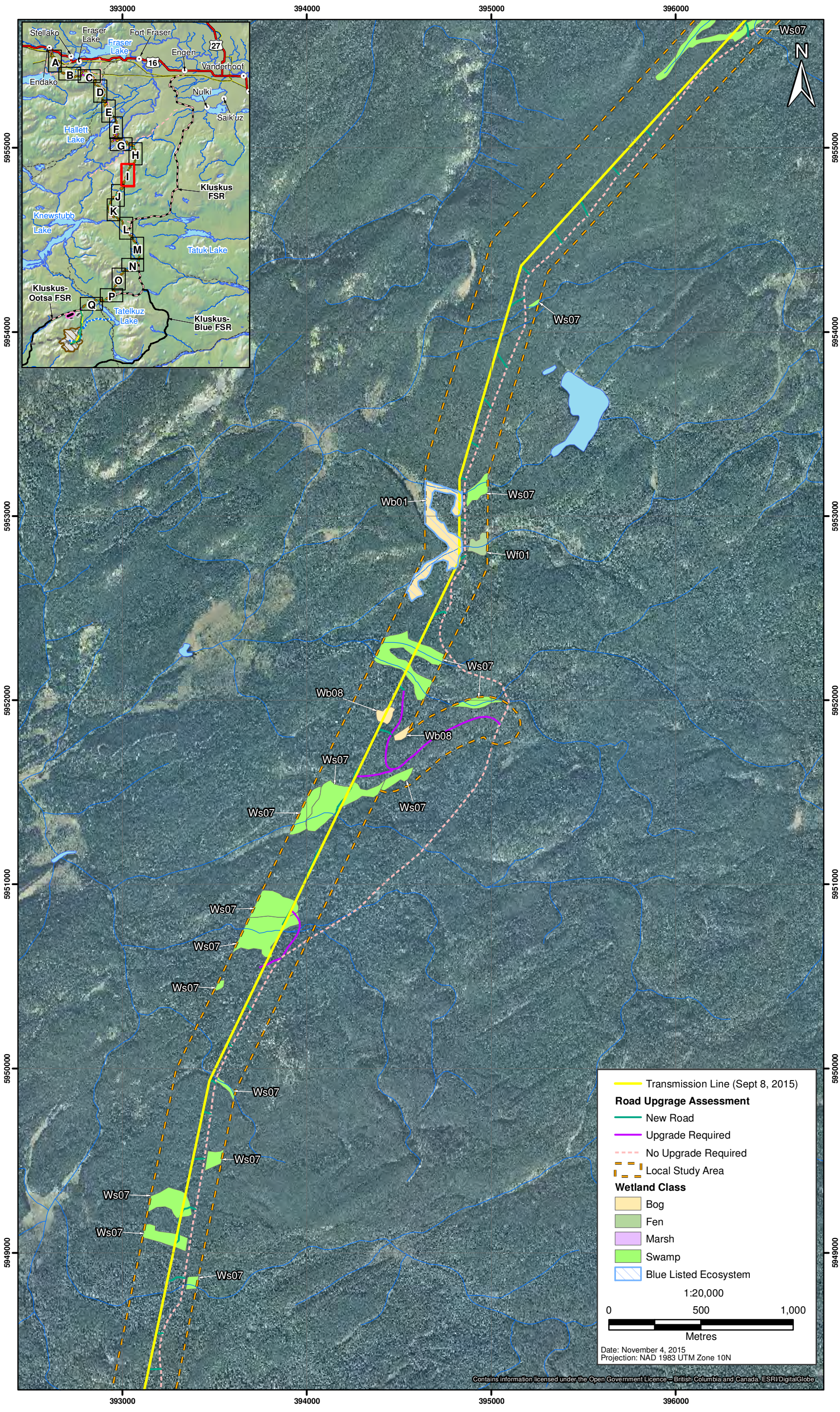


Figure 3.1-10

Blackwater Gold Project: Wetland Classification and Mapping in the Transmission Line Access Roads Expanded LSA Map 10

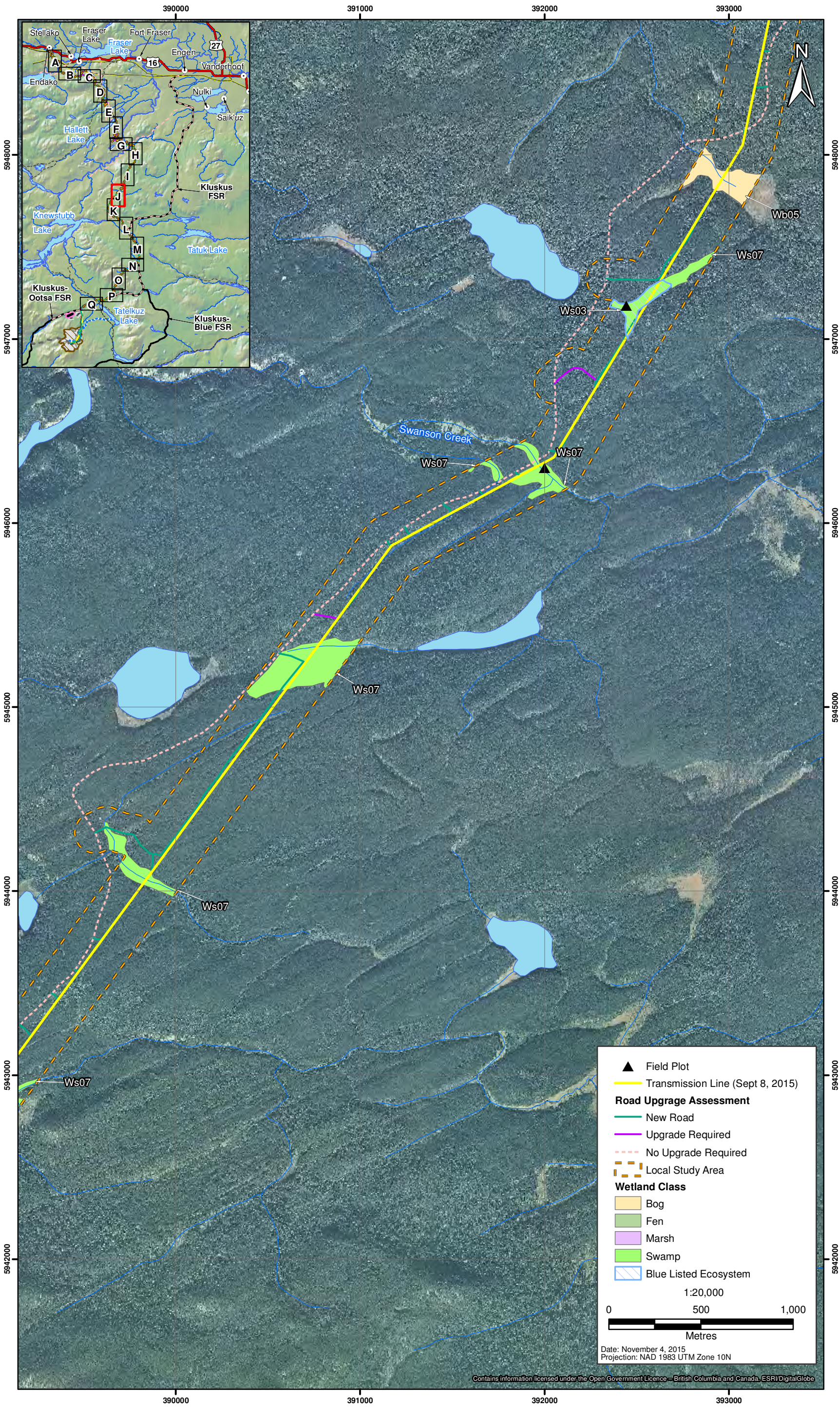


Figure 3.1-11

Blackwater Gold Project: Wetland Classification and Mapping in the Transmission Line Access Roads Expanded LSA Map 11

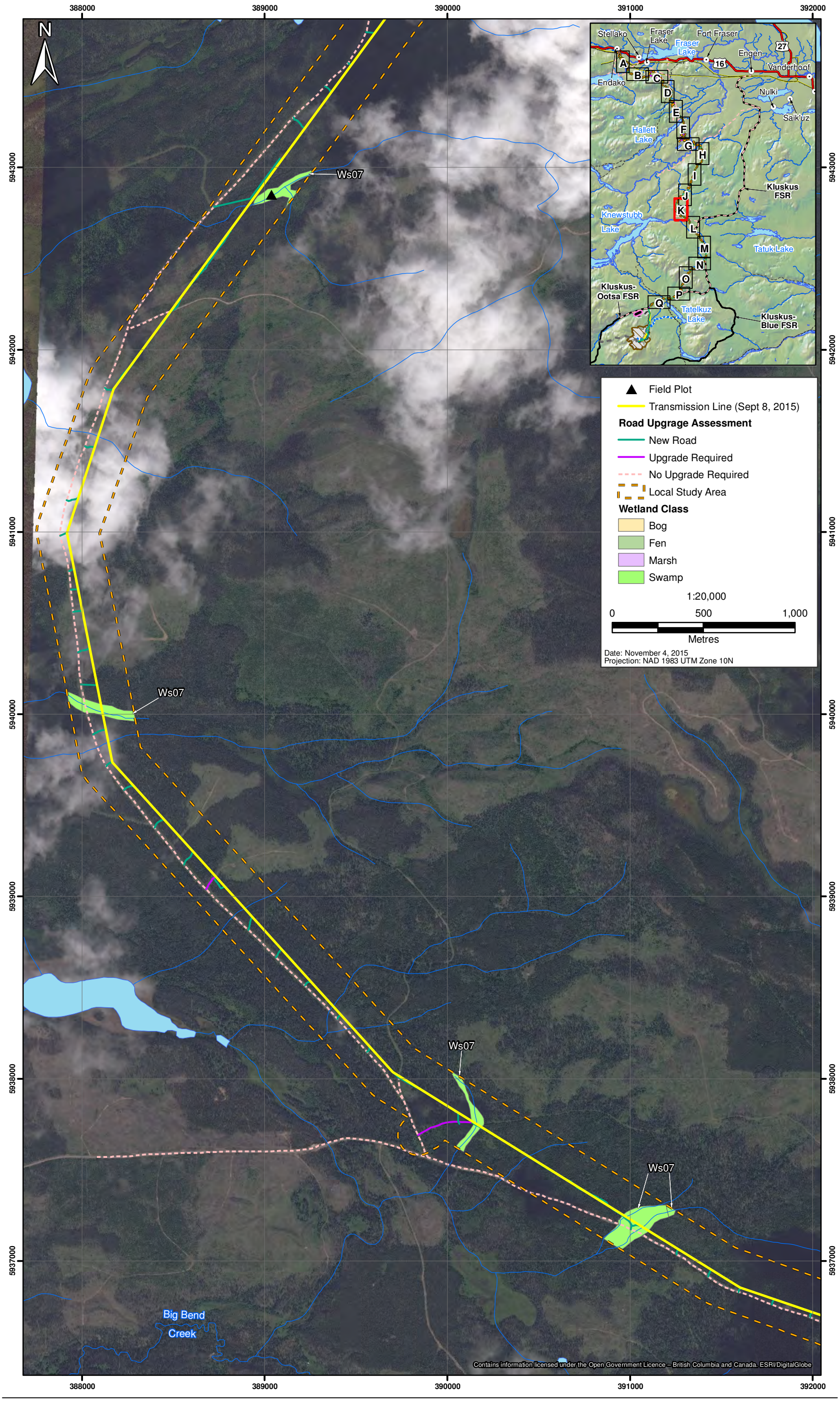


Figure 3.1-12

Blackwater Gold Project: Wetland Classification and Mapping in the Transmission Line Access Roads Expanded LSA Map 12

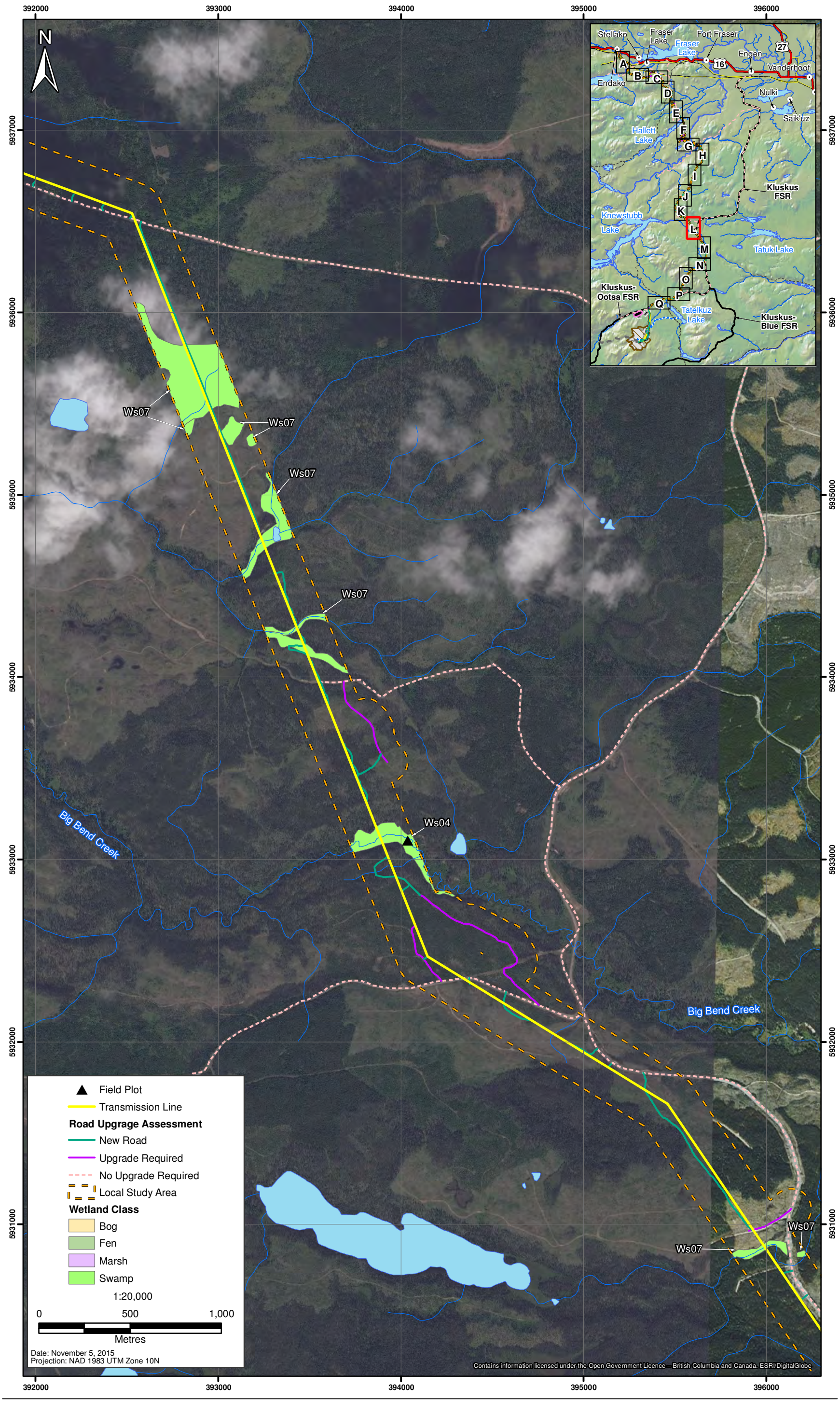


Figure 3.1-13

Blackwater Gold Project: Wetland Classification and Mapping in the Transmission Line Access Roads Expanded LSA Map 13

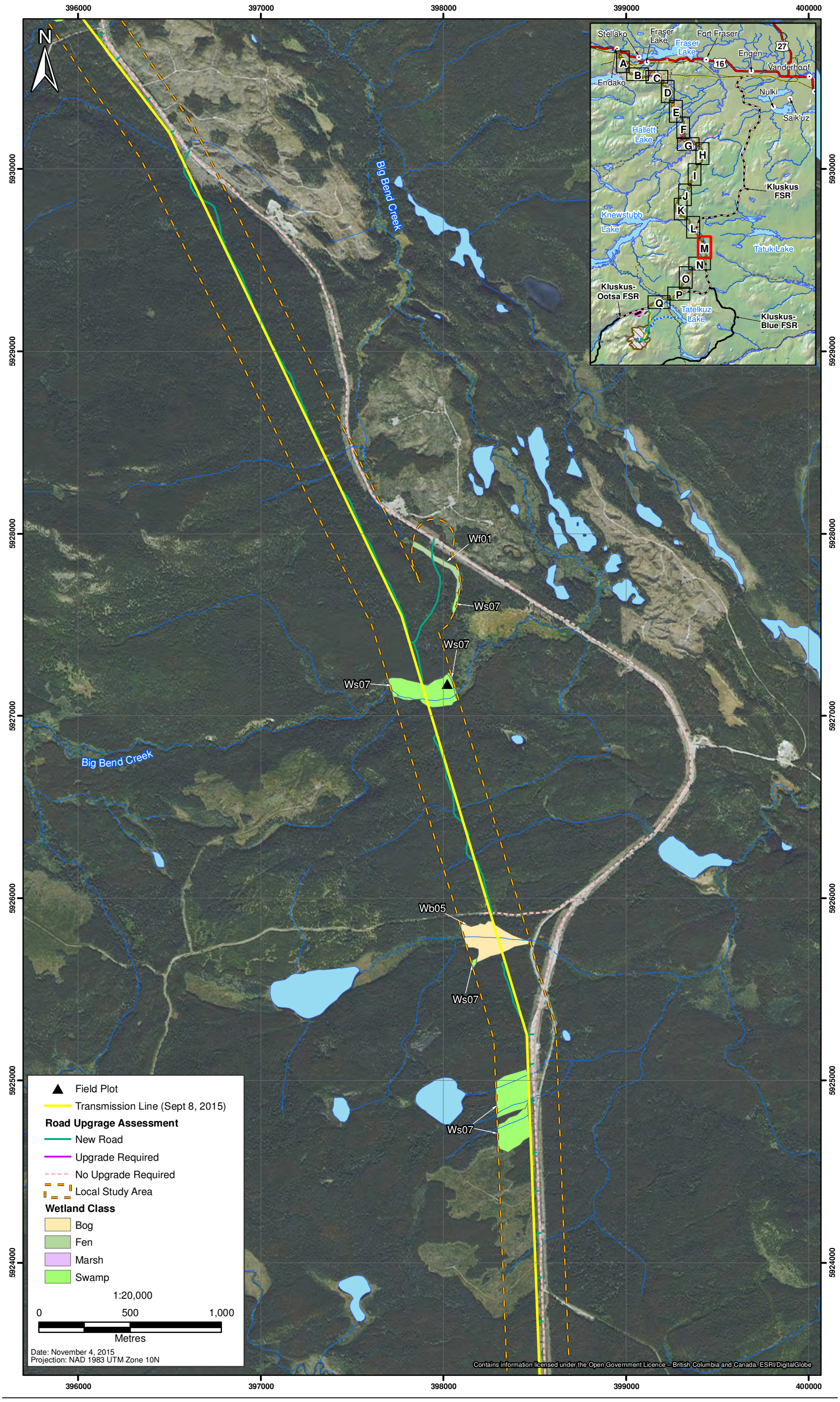


Figure 3.1-14

Blackwater Gold Project: Wetland Classification and Mapping in the Transmission Line Access Roads Expanded LSA Map 14

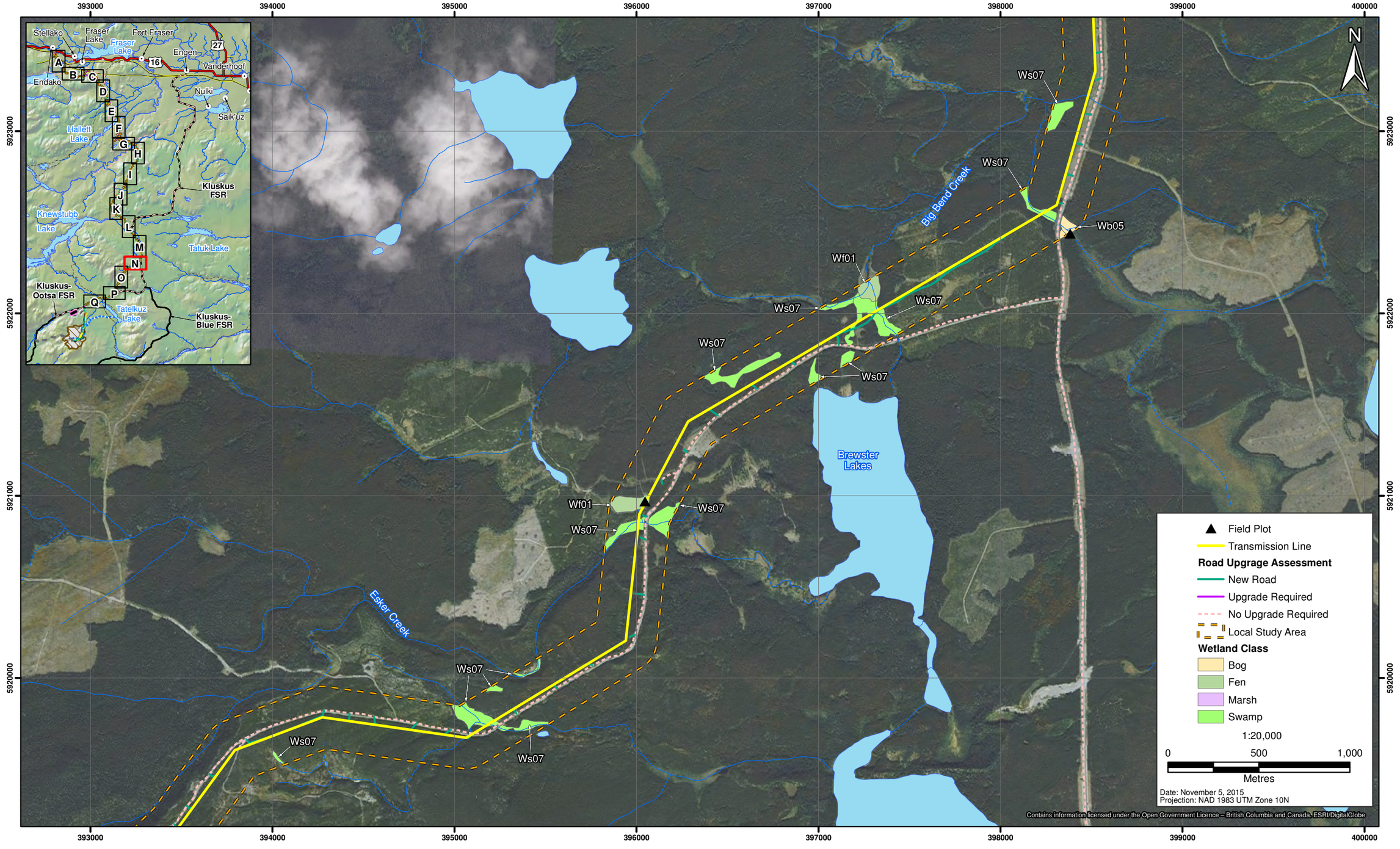


Figure 3.1-15

Blackwater Gold Project: Wetland Classification and Mapping in the Transmission Line Access Roads Expanded LSA Map 15

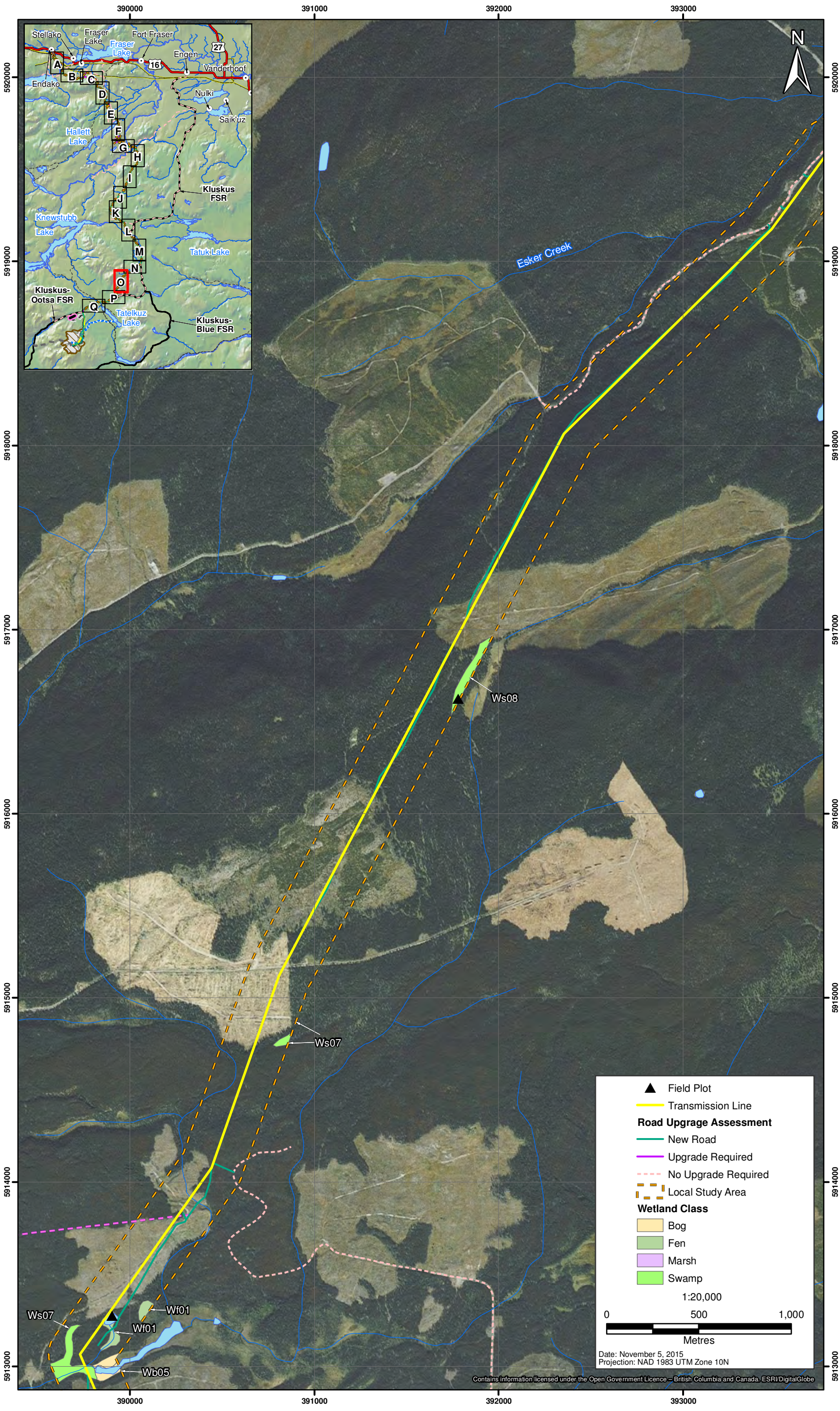


Figure 3.1-16
Blackwater Gold Project: Wetland Classification and Mapping in the Transmission Line Access Roads Expanded LSA Map 16

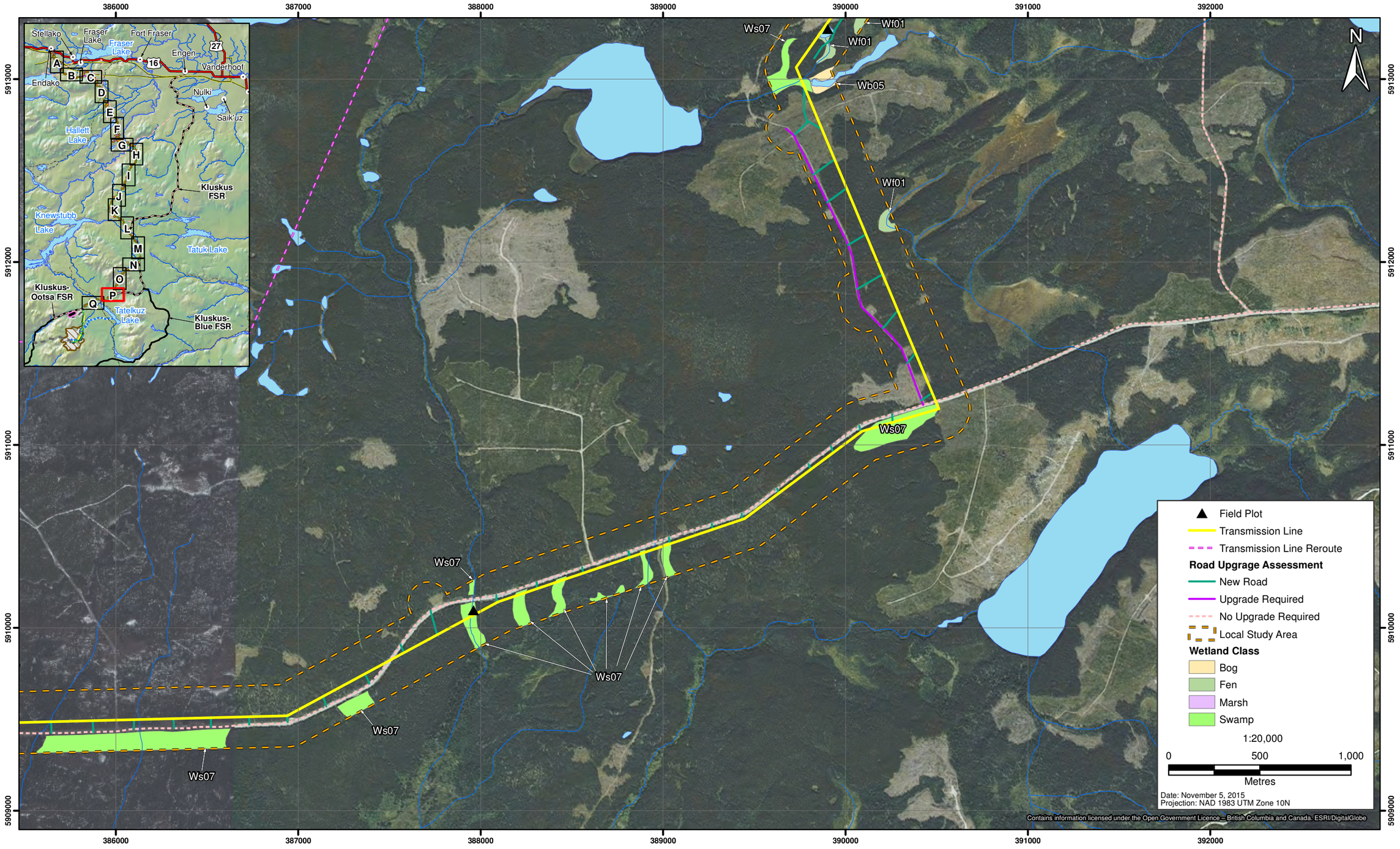
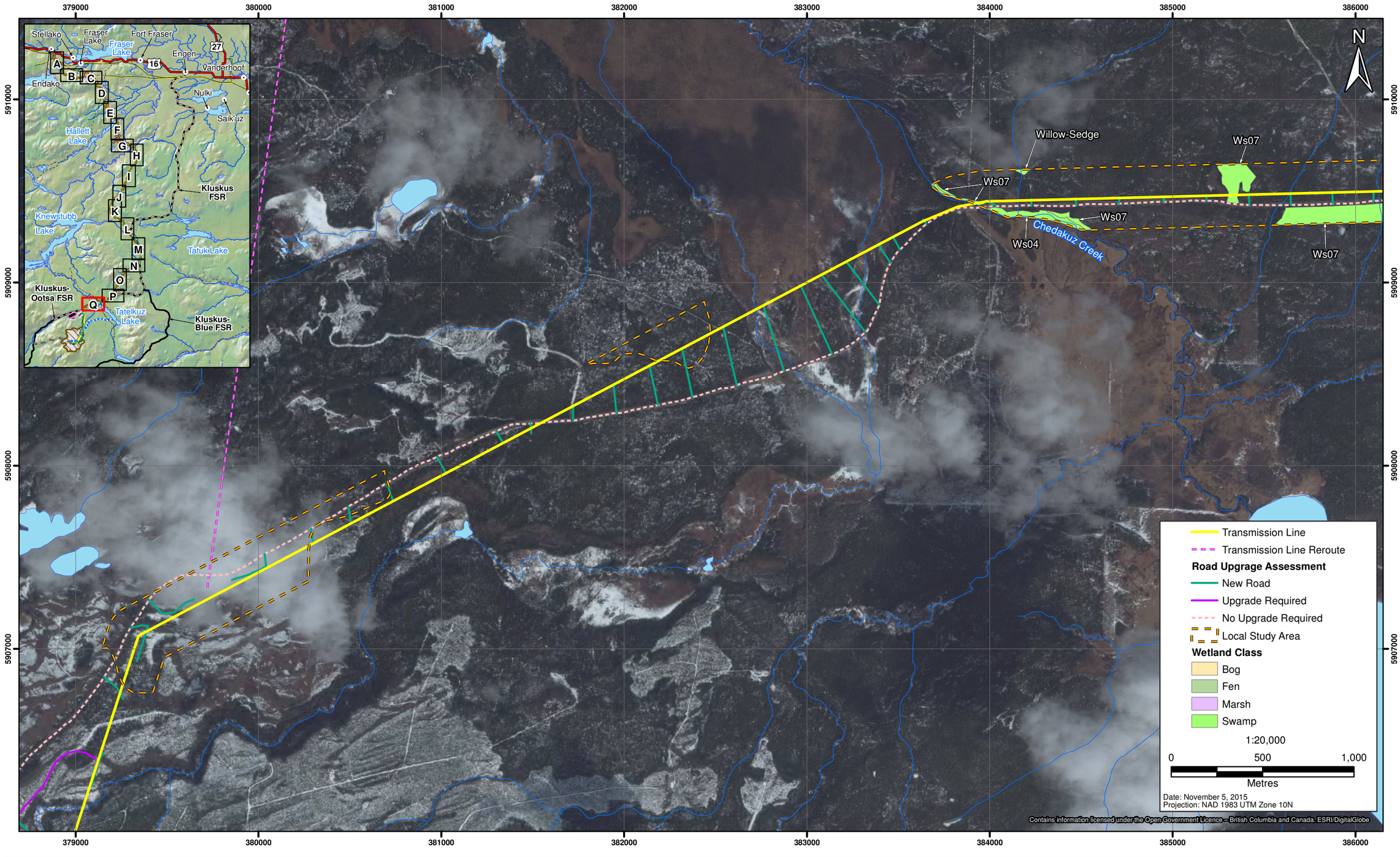


Figure 3.1-17

Blackwater Gold Project: Wetland Classification and Mapping in the Transmission Line Access Roads Expanded LSA Map 17



— Appendix 4 —

Wetland Plates

APPENDIX 4. WETLAND PLATES

Plate 4.1-1. Understory composition of Ws07 at BW002.

Plate 4.1-2. Woody peat orgain Soil in Ws07 at BW002.

Plate 4.1-3. Wf01 Fen at BW003.

Plate 4.1-4. Comarum palusture *at BW003 Wf01 fen.*

Plate 4.1-5. Eriophorum angustifolium *at BW004.*

Plate 4.4-6. Wf01 Wetland at BW005.

Plate 4.4-7. Wb05 Wetland at BW006.

Plate 4.4-8. Big Bend Meadow Riparian Area BW007.

Plate 4.4-9. Big Bend Creek Riparian Area and Flood Maintained Ecosystem BW008.

Plate 4.4-10. Ws07 Swamp edge at BW009.

Plate 4.4-11. Riparian Swamp at BW010.

Plate 4.4-12. Ws03 Swamp at BW011 – Salix *were difficult to identify but understory dominated by* Calamagrostis canadensis.