Peace Project Water Use Plan

Peace River Wildlife Stranding Survey

Year 1: Pre-spill survey results

Reference: GMSMON-12

Study Period: 2010

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BC Hydro Peace River Wildlife Standing Survey, GMSMON 12
2010 Pre-spill survey results

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BC Hydro WLR funded this project. Field studies were completed by CBA Ltd staff Karl Bachmann, Allan Carson and James Bradley. Ryan Gill provided GIS mapping and analysis. John Cooper acted as Project Manager. This report was prepared by Karl Bachmann and reviewed by John Cooper. The report benefited from constructive comments from Michael McArthur and Anré McIntosh (BC Hydro).

1 Introduction

In 1996 a controlled release of water from the WAC Bennett and Peace Canyon Dams raised concerns about downstream impacts to wildlife (BC Hydro 1997). As a result of the 1996 spill event, monitoring studies were recommended to assess impacts on a variety of resources for future spill events. BC Hydro is also required to conduct surveys at different spill volume thresholds to assess impacts on wildlife as part of its water licensing requirements (BC Hydro 2007). Controlled releases of water, or spill events, are known or suspected to impact four groups of wildlife downstream from the dam: ungulates, beaver (*Castor canadensis*), riparian birds, and western toad (*Bufo boreas*). These impacts include mortality of individuals and loss of habitat. A spill of greater than 70 000 cubic feet per second (cfs) is the threshold that will trigger wildlife impact surveys.

Since 1996, several wildlife surveys have been conducted that provide information on the vulnerability of floodplain-dwelling wildlife to spill events. In 1996 (Diversified Environmental Services 1996) Diversified Environmental Services conducted an assessment of ungulate use of islands with the Peace River. Two years later, Wiacek (1998) prepared a summary of the wildlife resources in the area and the potential impacts of fluctuating water levels on them. Robertson (1999) conducted aerial surveys for aquatic birds (focus on shorebirds and waterfowl) in 1996 and again in 1999. Fraker and Hawkes (2000) conducted wildlife surveys in 1999 on the floodplain of the Peace River from the Peace Canyon Dam to the Alberta border that focused on water-associated birds, amphibians and reptiles, and aquatic mammals. In 2005 and 2006, Keystone (Simpson et al. 2009; Keystone Wildlife Research Ltd. 2009) completed baseline wildlife surveys in the Peace River corridor to update previous baseline work that had been completed in the early 1990s (Simpson 1991; Simpson 1993). None of these studies, however, provide data recent enough to allow a pre-spill/post-spill assessment of impacts to affected wildlife species.

Similarly, although terrestrial ecosystem mapping had been completed for the study area (Keystone Wildlife Research Ltd. 2007), no information was available specific to riparian habitat types in the Peace River valley. Riparian habitat mapping, however, was recently completed for the entire study area as part of the GMSWORKS 7 project (MacInnis et al. 2011), which classified the entire study area into 24 riparian habitat classes. Information from this project will be used to report on the area and type of habitat inundated at maximum spill levels.

To address data requirements for assessing spill impacts, this project (GMSMON-12) consists of wildlife surveys and assessment of potential impacts of habitat loss and direct mortality on wildlife as the result of a spill. To address the impact of spill events on selected wildlife several management questions have been developed (BC Hydro 2007):

1) What are the impacts on ungulates and their habitat as a result of a spill event?
2) What are the impacts on beavers and their habitat as a result of a spill event?
3) What are the impacts on riparian birds and their habitat as a result of a spill event?
4) What are the impacts on the western toad and their habitat as a result of a spill event?

To address these management questions, the following hypotheses will be tested by the monitoring program:

H_1: Ungulate mortality/habitat loss resulting from a spill significantly impacts the ungulate population in the Peace River floodplain downstream of Peace Canyon Dam.

H_2: Beaver mortality/habitat loss resulting from a spill significantly impacts the beaver population in the Peace River floodplain downstream of Peace Canyon Dam.

H_3: Riparian bird mortality/habitat loss resulting from a spill significantly impacts the riparian bird population in the Peace River floodplain downstream of Peace Canyon Dam.

H_4: Western toad mortality/habitat loss resulting from a spill does not significantly impact the western toad population in the Peace River floodplain downstream of Peace Canyon Dam.

The main tasks of this project are to:

1. Select study or index sites based on TEM data and flow mapping to be surveyed both pre- and post-spill, and potentially, at peak spill levels
2. Complete pre-spill surveys for the following 4 species or species groups:
    a. Ungulates – survey entire study area
    b. Beaver – survey entire study area
    c. Riparian birds – survey selected index sites
    d. Western toad – survey selected index sites
3. Write a survey plan for the same species or species groups to be implemented in the event of a spill
4. Should a spill occur, complete post-spill surveys for the same species or species groups and if necessary, peak spill surveys for ungulates
5. Estimate direct mortality and/or habitat loss for the 4 species or species groups

This report provides a summary of the site selection process, pre-spill wildlife survey methods and results, and an outline of the post-spill monitoring procedures. A final report incorporating the habitat analysis and results from post-spill surveys will be completed if a spill occurs or by the end of the contract time period (2013).

2 Study Area

The study area consists of the floodplain of the Peace River from the Peace Canyon Dam to the confluence of the Peace and Pine Rivers (Figure 1). Approximately 40 islands of varying sizes occur within this stretch of river, the largest of which are in the 100 ha range. The linear distance of the mainstem Peace River in the study area is 102 km.

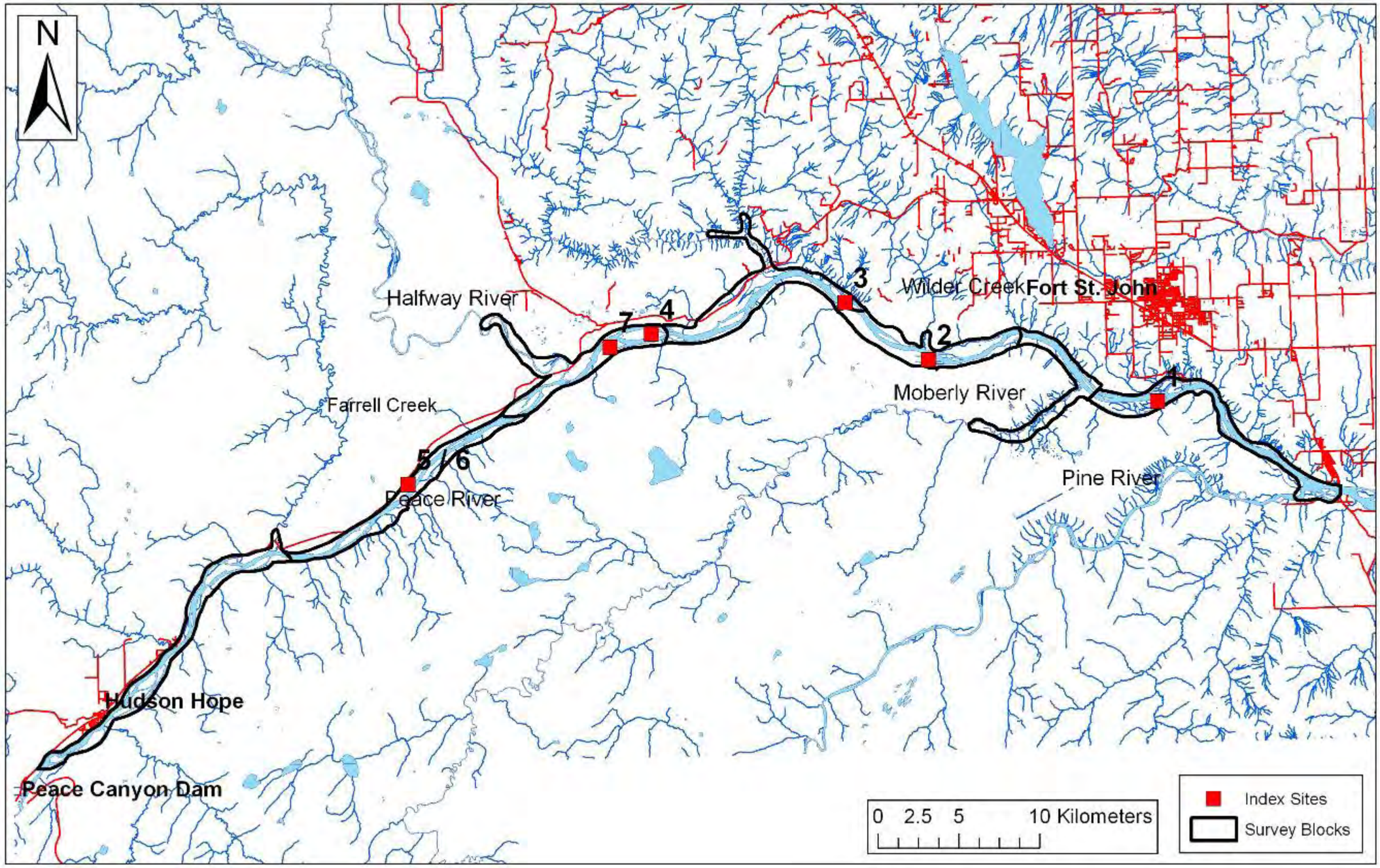

Figure 1. GMSMON 12 study area, index sites, and aerial survey blocks in the Peace River valley downstream from the Peace Canyon Dam, B.C.

Because this project will use riparian habitat information from the GMWORKS-7 project, we bounded our study area as the area of riparian habitat defined by the BC Hydro spill photo set taken at 10 000 cfs. Similarly, the habitat analysis will be completed using the 120 000 cfs line work used in GMSWORKS-7 project as the maximum spill level to allow a calculation of riparian habitat inundated post-spill.

3 Methods and Baseline Survey Results

The survey design uses a pre- and post-spill approach to address the study objectives. Pre-spill surveys established a baseline for species abundance and distribution. Post-spill surveys will be compared against this baseline to estimate mortality and/or habitat loss.

Reports and data from previous surveys conducted in the study area were consulted to provide guidance on index site locations based on recorded locations of target species. Kim Hawkins and Anre MacIntosh (BC Hydro) provided copies of relevant reports, some of which were downloaded from the BC Hydro 'Site C' website. Literature searches were also conducted in Ministry of Environment and Ministry of Forests databases. A digital elevation model (DEM) provided by BC Hydro with 0.5 m contour lines was overlaid on an orthophoto background to identify areas likely to flood during a spill event (characterized by low gradients and elevations close to operational levels of the river). With large areas of the riverbank characterized by steep cutbanks or rendered inaccessible by private land considerations, most candidate sites were associated with near-shore and mid-channel islands.

Prior to beginning wildlife surveys, two days of aerial reconnaissance were conducted to evaluate and select candidate sites for GMSMON 3, a fish stranding monitoring project being conducted concurrently with this project, GMSMON 12. An additional two days of ground reconnaissance was conducted to evaluate the feasibility of accessing some candidate shoreline sites by vehicle and on foot. The relative scarcity of access roads and amount of private land bordering the river channel, however, renders aerial or boat-based access the only feasible methods to the majority of sites. Only index site 5/6 (see Figure 1) is accessible by vehicle.

3.1 Ungulates

All methods detailed below conform to RISC protocols for Aerial Surveys (Resources Inventory Committee 2002). Encounter transects were used to conduct presence/not detected surveys for ungulates. Although sightability of ungulates was probably low due to leafed-out deciduous trees, aerial surveys will allow an assessment of ungulates swimming or stranded on islands during a peak spill. This would not be possible with ground-based ungulate surveys.

Survey block boundaries previously used by Keystone (Simpson 1993) were adapted for this project to allow comparison to data from previous years. The following main stem Peace River segments and associated shoreline areas were used as aerial survey blocks:

- Reach 1 – Peace Canyon Dam to Farrell Creek (23 km)
- Reach 2 – Farrell Creek to Halfway River (22 km)
- Reach 3 – Halfway River to Cache Creek (16 km)
- Reach 4 – Cache Creek to Moberly River (23 km)
- Reach 5 – Moberly River to Pine River (18 km)

Survey blocks were surveyed using a Bell 206 Jet Ranger with rear bubble windows and a Eurocopter A-Star. The survey crew consisted of 3 people, including the pilot. The navigator sat in the front seat to the left of the pilot and was responsible for navigating, tracking survey block boundaries, marking observation waypoints with a GPS, and spotting. The observer in the rear of the helicopter recorded observation details on data sheets and spotted and classified animals. All observers and the pilot communicated with each other using headsets. Upon spotting an animal, the observer called out the species and other details to be recorded on the data sheet. The navigator also recorded the waypoint location and provided a waypoint number.

A Garmin (Olathe, KS) GPS 76CSx was used to take waypoints for each animal observation. All location data were recorded in UTM coordinates (NAD 83). To ensure complete coverage of each survey block, we used a GPS – GIS interface to generate real-time flight tracks on a laptop computer linked to the GPS. DNR Garmin (Version 5.004; Minnesota Dept. of Natural Resources; http://www.dnr.state.mn.us/mis/gis/tools/arcview/extensions/DNRGarmin/DNRGarmin.html) was used to overlay the flight path and waypoint locations on an ArcMap coverage consisting of contours, streams, and survey block boundaries. These flight paths were automatically saved to a .shp file for each survey block.

Due to the linear nature of the survey blocks, survey coverage consisted of flying parallel flight lines at a constant height and speed. The pilot was guided by the navigator to maintain flight at 80 – 100 km/hr and a height of 50 – 80 m above the ground. Where the width of the area being surveyed exceeded 200 m on either side of the flight line down the centre (400 m wide transects), additional parallel transects were flown to ensure complete coverage of the survey block and its margins. The target for survey effort was 4.0 minutes/km^2.

We adapted RISC standard data sheets (Animal Observation Form - Ungulate (Aerial) Encounter/Fixed-width Transect, Appendix 1) to record location and classification data for all observations. A Level II age and sex classification scheme (adult male, adult female, juvenile) was used to classify ungulate observations (Resources Inventory Committee 2002). Although this survey was focused on ungulates (and beaver, see below), all mammal observations were recorded during the course of the surveys.

A total of seven survey blocks (Figure 1, Table 1) totalling 117.6 km^2 were surveyed on the 2nd and 3rd of June 2010 starting at 06:30 in the morning and finishing before noon to capture times of increased ungulate activity. Survey time for all blocks (excluding ferry and re-fueling time) totalled 7.28 hours.

Table 1. Ungulate survey blocks in the Peace River valley, B.C.

BLOCK	GEOGRAPHIC LOCATION	SURVEY DATE	SURVEY TIME (HRS.)	KM^2	SURVEY EFFORT (MIN/KM^2)
Peace Canyon	Peace Canyon dam to Farrell Creek	2-Jun-2010	1.52	19.9	4.6
Farrell Creek	Farrell Creek to Halfway River	2-Jun-2010	1.13	15.1	4.5
Halfway River	Either side of the Peace – Halfway River confluence and up the first section of the Halfway River	2-Jun-2010	1.35	18.4	4.4
Cache Creek[1]	Either side of the Peace – Cache Creek Confluence and up the first section of Cache Creek	3-Jun-2010	0.90	20.8	3.2
Wilder Creek	Centred on Wilder Creek	3-Jun-2010	0.85	15.4	3.3
Moberly River	From Tea Creek to the Peace – Moberly confluence	3-Jun-2010	0.73	10.7	4.1
Pine River[2]	From the Peace – Moberly confluence to the Peace – Pine confluence	3-Jun-2010	0.80	17.3	2.8

[1]The Bear Flats area was not surveyed due to private land considerations so 3.78 km^2 were subtracted from the survey block area for survey effort calculations.
[2]The Pine River survey block encompassed large recreational areas (e.g., parks) and private land areas. The lower survey effort reflects an increased helicopter speed to minimize disturbance over these areas.

A total of 42 detections comprising 81 individuals (Table 2, Appendix 2) were made of ungulates. Three of these detections were juveniles or included juveniles in the group (moose: 2, elk: 1, Figure 2). Detections are defined as sightings made during the survey (i.e., a single detection can include multiple individuals). Detections by survey block ranged from a low of 2 (Pine River) to a high of 9 (Peace Canyon, Cache Creek, Wilder Creek) with the remaining blocks all having 3 detections (Farrell Creek, Halfway River, Moberly River). The majority of individuals were detected on the banks of the main channel for all species with the exception of mule deer, which were observed equally on in-stream islands (Table 2).

Table 2. Numbers and locations of individuals made during aerial ungulate surveys in the Peace River valley, B.C.

BLOCK	ALAL[1]		CEEL[2]		ODHE[3]		ODVI[4]		ODSP[5]	
	BANK	ISLAND	BANK	ISLAND	BANK	ISLAND	BANK	ISLAND	BANK	ISLAND
Peace Canyon	-	-	-	1	1	1	5	2	2	-
Farrell Creek	2	-	3	-	-	1	-	-	-	-
Halfway River	1	1	-	-	-	-	-	-	1	-
Cache Creek	2	1	19	-	6	3	-	-	-	-
Wilder Creek	1	-	1	1	5	3	-	-	-	2
Moberly River	-	-	-	-	5	3	-	-	-	-
Pine River	-	-	-	-	-	6	-	-	-	-
TOTAL	**6**	**2**	**23**	**2**	**17**	**17**	**5**	**2**	**3**	**2**

[1]ALAL = Moose; [2]CEEL = Elk; [3]ODHE = Mule deer; [4]ODVI = White-tailed deer; [5]ODSP = Unidentified deer species

Figure 2. Moose cow with new (< 5 days old) calf on a mid-channel island, Peace River valley, B.C.

3.2 Riparian Birds

Breeding bird surveys were conducted by performing 5-minute point count surveys and recording all species heard or seen (Resource Inventory Committee 1999). Point count surveys were completed between sunrise and 4 hours after sunrise. Upon arriving at a point count station, the observer waited 1 minute to allow any disturbance effects on resident birds to dissipate. During point counts, each bird detection within 100 m was spatially mapped on a data sheet with concentric radii of 25, 50, 75, and 100 m from the point count station (Appendix 2). Birds beyond 100 m were noted but not spatially located, as distance estimation at further distances is problematic (Alldredge et al. 2007). Time was broken down into 0-3 minutes and 3-5 minutes intervals, and detections associated to whichever time interval they were initially detected in. Environmental variables (e.g., wind speed, Appendix 4) and time of day were also recorded. Birds detected flying over the point count station were recorded but were noted as "fly-overs" rather than detections associated with habitat sampled by the point count survey.

Nest searches for focal species were conducted opportunistically after morning point count surveys. Observations of breeding behaviour (e.g., carrying nest-building material) for focal species were noted during point counts as areas to conduct subsequent nest searches. Searches

were focused on species whose nesting ecology makes them most vulnerable to nest site inundation and mortality from a spill, mainly ground- and shrub-nesting species. Nest of species unlikely (e.g., raptor stick nests, cavity nests) to suffer direct nest mortality were recorded opportunistically. The UTM coordinates, type, height off the ground, and species using the nest were recorded for each nest.

Point count surveys and nest searching was conducted from the 13th to 16th and 18th of June, 2010 by a crew of two people to capture the peak of the breeding season for the majority of species. A total of 93 point count stations were established (minimum 200 m from centre to centre) and surveyed at index sites 1, 2, 3, 4, and 5/6 (Appendix 5, Appendix 6). Surveys recorded a total of 676 detections of 70 species (Appendix 7). Four threatened or endangered species were detected during the surveys: Black-throated green warbler, Canada warbler, LeConte's sparrow, and Rusty blackbird (Appendix 7).

Bird detections were transferred from hard copy data sheets to a .shp file layer using ArcMap 9.3.1 (Figure 3). All bird detections were also entered into an Access database.

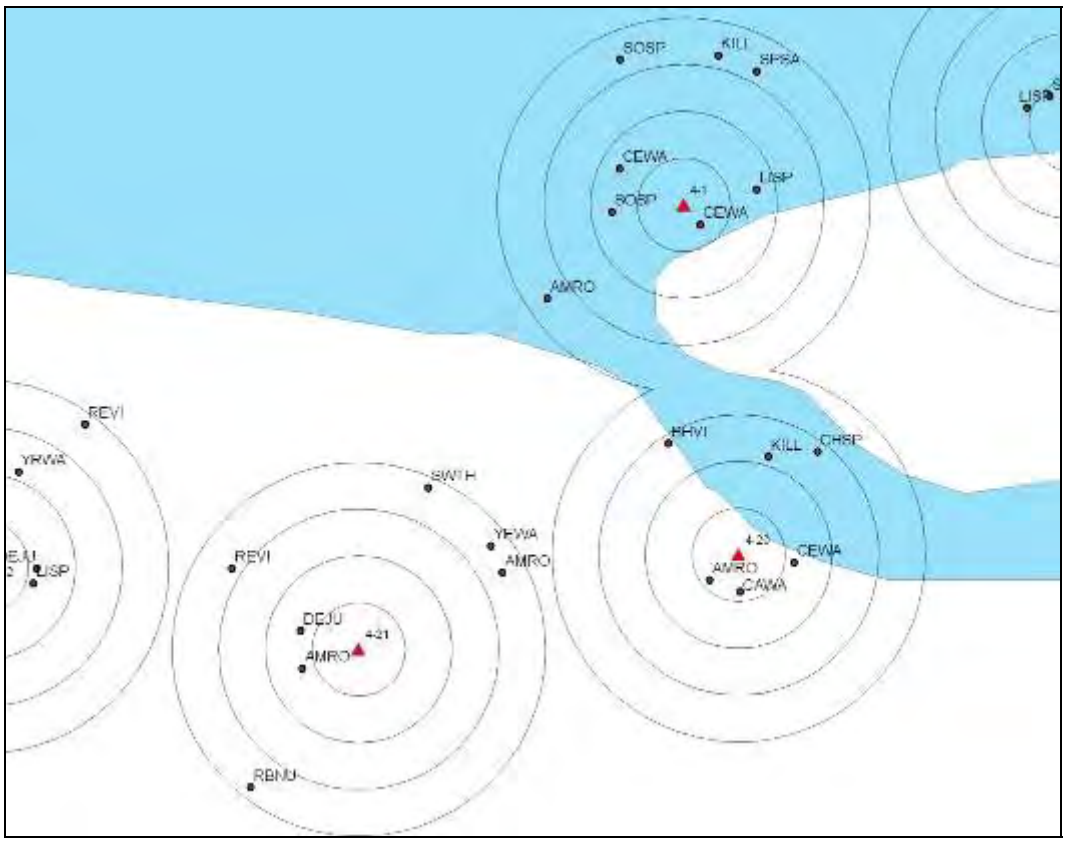

Figure 3. Bird detections mapped using ArcMap 9.3.1 from point count surveys in the Peace River Valley, B.C., June 13-18, 2010.

Seventy-seven nests were found during nest searching activities, including 31 unoccupied nests (Appendix 8). Some unoccupied nests had signs indicating they had obviously been constructed in a previous nesting season (e.g. nest cup full of dead leaves and spider webs), but others were

likely built during the survey year and became unoccupied (e.g., predation, Figure 5). Nest searching focused on areas likely to be inundated (less likely to be treed), so the majority of nests found were cup nest in shrubs and small trees (61.5%, n = 48) and ground nests (26.9%, n = 21). Other nest types found were bank (n = 3), cavity (n = 3), and stick (n = 3). Of the occupied cup nests found, the average height above the ground was 2.83 m (SE=±0.56).

Figure 4. American Robin nest with 4 eggs built in the crook of an alder shrub ~ 1 m off of the ground, Peace River valley, B.C., June 13, 2010.

Figure 5. Common garter snake predating a chipping sparrow nest in the Peace River valley, B.C., June 18, 2010.

3.3 Beaver

Aerial surveys for beaver structures were done concurrently with aerial surveys for ungulates (see section 3.1, above). These surveys were consistent with RISC standards (Resource Inventory Committee 1998a), although the timing is outside the optimum window (fall season after deciduous leaves have come off the trees and food caching activity is at its peak intensity). Given possible spill timing of June onwards, however, it was decided that surveys must be completed prior to a potential spill for 2010.

Observers recorded all beaver structures observed, including lodges, bank burrows, dams, food caches, and feeding activity. Sign of recent activity such as mud-piling, green vegetation on structures and/or in food caches were also noted. Any observations of individual animals were also recorded.

Fraker and Hawkes (2000) conducted surveys for beaver in the Peace floodplain and found them to be common downstream of Farrell Creek, but uncommon upstream. They recorded observations of lodges, dams, and food caches; most of the food caches were situated on the mainstem of the river. This is consistent with what was observed during this study (Appendix 10).

In total, 99 observations were made of beaver structures and individual animals (Table 3, Figure 6, Appendix 9). Three individual animals were observed, 2 on lodge structures and one swimming mid-stream. By using an assumption of 5 individuals per active lodge/bank lodge, the population estimate for the study area is 100 animals (Table 3).

Table 3. Summary of beaver structures and individuals observed during aerial surveys, June 2-3, 2010, Peace River Valley, B.C.

SURVEY BLOCK	ACTIVE?	BANK LODGE	DAM	FEEDING	FOOD CACHE	LODGE	GRAND TOTAL	BLOCK POP. ESTIMATE[1]
Cache Creek	N	3	2	-	-	2	7	35
	Y	6	-	-	-	1	7	
Farrell Creek	N	3	-	-	-	3	6	15
	Y	1	-	-	-	2	3	
Halfway River	N	7	2	-	-	3	12	5
	Y	-	-	1	-	1	2	
Moberley River	N	3	2	-	-	4	9	15
	Y	3	-	-	-	-	3	
Peace Canyon	N	2	2	1	-	5	10	5
	Y	-	-	2	-	1	3	
Pine River	N	11	6	-	-	1	18	-
Wilder Creek	N	7	2	-	1	1	11	25
	Y	3	1	-	-	2	6	
Total		**49**	**17**	**4**	**1**	**26**	**99**	**100**

[1]Population estimates for each block derived by assuming 5 individuals per active lodge.

Figure 6. Beaver food cache on main stem of the Peace River, B.C. Note fresh green material added to edge of cache.

3.4 Western Toad

Surveys for Western Toad were done concurrently with point count surveys for riparian birds (see section 3.2, above). Survey methods followed provincial standards for pond-breeding amphibians in Resource Inventory Committee (1998b).

Amphibian surveys consisted of systematic shoreline searches for juveniles and adults. Any individuals found were identified and photographed where possible. Shoreline searches were conducted around larger open water bodies. These surveys involved one searcher walking in a zigzag pattern parallel to the shoreline of pools, disturbing vegetation and overturning coarse woody debris and other physical features within 4-5 m of the water's edge. Duration of surveys was dependent on size of the water body involved. Fraker and Hawkes (2000) recommended conducting amphibian surveys during the breeding season (March – June) to increase the likelihood of detecting species occurring in the Peace River floodplain.

A crew of two people conducted 2 days of amphibian surveys at index sites 5/6 and 7 on the 12th and 17th of June. Amphibian observations were also opportunistically recorded during point count surveys and nest searching for birds (13th to 16th and 18th of June). Two species of amphibian (western toad [Figure 7] and wood frog) and one species of reptile (common garter snake) were detected. A total of 31 detections were made, 8 western toad, 19 wood frog, 2 common garter snake, and 2 groups of unidentified tadpoles (Appendix 11).

Figure 7. Western toad pair in pectoral amplexus in shallow side-channel pool on the shore of the Peace River, B.C. Note string of eggs.

4 Monitoring Plan

As per the terms of reference for this project, BC Hydro will inform CBA Ltd. when a spill is imminent. A spill is defined as water released in addition to turbine discharge. The Peace Spill Protocol contains monitoring plans detailing environmental information to be collected surrounding a spill event (BC Hydro 2007). Some of these surveys are required and some are conditional on discharge volume; wildlife surveys are triggered by total discharges (turbine discharge + additional discharge) of >2000 m^3/s (or 70 000 cfs) for 2 days at the Peace Canyon dam (BC Hydro 2007). Peak spill conditions will depend on the magnitude of the spill, and will likely be identified by BC Hydro and relayed to CBA Ltd. Post spill conditions are defined as after the discharge from the dam returns to a pre-spill state (i.e., turbine discharge alone).

Upon confirmation from BC Hydro that a spill from the Peace Canyon Dam is imminent or is occurring, the monitoring activities outlined below will be implemented. Initial plans included using boats to access some sites, but given the relatively compressed survey time frame and safety considerations during a flood event, all access will be by helicopter. Peak- and post-spill surveys will repeat the pre-spill surveys (with some adjustments, see below) that were completed to provide pre-spill baseline data (see section 3, above).

4.1 Phase 1 – Aerial Survey Component

The aerial component of peak- and post-spill surveys will address both the ungulate and beaver monitoring objectives. A peak-spill survey will only be conducted if the spill is large enough to completely submerge islands during the spill. Although it was not planned to conduct beaver surveys during a peak-spill survey, information on location and status of beaver structures can be collected concurrently without impacting the efficiency of ungulate surveys.

Each individual survey (peak- and post-spill) will be completed in one day of flying. Pre-spill surveys were completed over 2 days to capture times of higher ungulate movement during the early morning period. It is likely, however, that ungulates on mid-channel islands experiencing rapid inundation will be more active and thus more visible during the majority of the day. Completing surveys during one day will provide data collected under similar conditions (i.e., water levels) in the context of a rapidly rising river.

All helicopter surveys will be based out of Ft. St. John. Survey blocks will be completed in the same order as the pre-spill surveys (i.e., start at the Peace Canyon Dam and work downstream towards the Pine River). Methods used will follow those used in the pre-spill survey. All observations of ungulates (e.g., on islands, swimming) within the survey block will be recorded.

4.2 Phase 2 – Ground Survey Component

The ground survey component will focus on riparian birds and western toad at the same 6 index sites established and surveyed during the pre-spill surveys. If the spill occurs during the breeding season for both riparian birds and western toad, the same methods and survey schedule will be used as the pre-spill surveys. If the spill occurs outside of the breeding season (~April – June for amphibians and ~May-June for birds), point count surveys and amphibian surveys will not be conducted.

All nest locations and amphibian observations located during the pre-spill surveys will be uploaded to field crew GPSes and each site will be investigated on the ground. The disturbance status of each site will be noted.

If the spill is large, some or most of the index sites may be completely inundated. This will be noted during the aerial ungulate and beaver survey flights (above) that will immediately precede ground surveys. All access (with the exception of index site 5/6 which is vehicle/foot accessible) will be by helicopter due to time and safety considerations.

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Appendix 1. Resource Inventory Standards Committee Animal Observation Form - Ungulate (Aerial) Encounter / Fixed-width Transect.

Animal Observation Form - Ungulate (Aerial) Encounter / Fixed-width Transect **Page ___/___**

Project _____ **Survey** _____ **Study Area** _____

Transect Label _____ Stratum _____ Trans Comment _____

Trans: Lgth _____ Width _____ Bearing _____ UTM: Start ____/_____/_____End ____/_____/_____

Obs Date _____/_____/_____ User Stats: 1) _____ 2) _____ 3) _____ 4) _____

Obs Day	Time	CC	Wind	Temp	Precip	Snow Depth	Snow Cover
Start							
End						Days since 5 cm Snow ____	

Navigator _____ Surveyors _____

Wpt #	Species	Grp Tot	Ungulate Classification								BEU	User Stats			
			Distance	Direction	u	j	a	f	m			Snow Cover	Veg Cover		
	M-														
	M-														
	M-														
	M-														
	M-														
	M-														
	M-														
	M-														
	M-														
	M-														
	M-														

Wpt #	Comments

[Use the back side of this form if additional lines are needed for observations associated with the transect labelled at the top of this form]

Appendix 2. Species detections and UTM coordinates for ungulates detected during aerial surveys of the Peace River valley, B.C. (CEEL = elk, ALAL = moose, ODHE = mule deer, ODVI = white-tailed deer, ODSP = unidentified deer species).

WAYPOINT	SPECIES[1]	EASTING	NORTHING	DATE	SURVEY BLOCK	COUNT	BANK/ISLAND[2]	COMMENT
85	ODHE	567699	6208734	02/06/2010 7:37	Peace Canyon	1	I	mule deer
87	CEEL	567225	6208435	02/06/2010 7:40	Peace Canyon	1	I	female elk
88	ODVI	571529	6212736	02/06/2010 7:49	Peace Canyon	2	I	2 white-tailed deer
93	ODSP	575844	6218527	02/06/2010 8:16	Peace Canyon	1	B	deer spp.
94	ODSP	574099	6217210	02/06/2010 8:20	Peace Canyon	1	B	deer spp.
97	ODHE	574558	6218526	02/06/2010 8:32	Peace Canyon	1	I	mule deer
101	ODVI	578711	6221087	02/06/2010 8:46	Peace Canyon	2	B	2 white-tailed deer, 1 male, 1 female
108	ODVI	573072	6214686	02/06/2010 8:53	Peace Canyon	3	B	3 white-tailed deer
110	ODHE	565460	6207539	02/06/2010 8:59	Peace Canyon	1	B	1 mule deer
112	ALAL	582211	6219909	02/06/2010 9:43	Farrell Creek	2	B	female moose with calf
113	ODHE	583784	6221173	02/06/2010 9:52	Farrell Creek	1	I	mule deer
117	CEEL	590743	6227317	02/06/2010 10:31	Farrell Creek	3	B	3 female adult elk
128	ALAL	595575	6229645	02/06/2010 11:09	Halfway River	1	B	female moose
135	ODSP	599538	6232865	02/06/2010 11:35	Halfway River	1	B	deer spp.
136	ALAL	601139	6233413	02/06/2010 11:44	Halfway River	1	I	female adult moose, standing still, possible calf present
149	ODHE	610887	6237044	03/06/2010 6:45	Cache Creek	1	B	mule deer
151	ODHE	612636	6236084	03/06/2010 6:49	Cache Creek	2	B	2 mule deer
153	ODHE	613089	6236234	03/06/2010 6:53	Cache Creek	3	I	3 mule deer
155	ALAL	614029	6235411	03/06/2010 6:54	Cache Creek	2	I	female moose and very young calf
158	ALAL	612443	6237070	03/06/2010 7:00	Cache Creek	1	B	female moose
159	CEEL	609650	6236915	03/06/2010 7:02	Cache Creek	3	B	3 elk at mouth of Red Creek
161	CEEL	608762	6236437	03/06/2010 7:04	Cache Creek	5	B	4 adult elk and 1 calf
162	CEEL	608575	6236537	03/06/2010 7:04	Cache Creek	1	B	1 elk
163	CEEL	608974	6236855	03/06/2010 7:05	Cache Creek	8	B	8 elk
164	ODHE	608028	6236681	03/06/2010 7:06	Cache Creek	2	B	2 mule deer
165	CEEL	608654	6237041	03/06/2010 7:06	Cache Creek	2	B	2 female elk
167	ODHE	607104	6239605	03/06/2010 7:09	Cache Creek	1	B	mule deer
173	ALAL	608094	6236574	03/06/2010 7:22	Cache Creek	1	B	adult male moose
177	CEEL	615274	6233279	03/06/2010 7:33	Wilder Creek	1	B	female elk, calf possible present based on behaviour
186	ODHE	624457	6233144	03/06/2010 7:54	Wilder Creek	1	I	female mule deer

187	ODSP	624004	6232944	03/06/2010 7:54	Wilder Creek	2	I	2 deer and 1 black bear, confrontational stance, calf present?
189	ODHE	623959	6233610	03/06/2010 7:59	Wilder Creek	2	B	2 mule deer
192	ODHE	622539	6233148	03/06/2010 8:01	Wilder Creek	1	B	female mule deer
194	ODHE	623561	6233060	03/06/2010 8:06	Wilder Creek	2	I	2 female mule deer
195	CEEL	619994	6232254	03/06/2010 8:09	Wilder Creek	1	I	female elk
197	ALAL	618805	6232989	03/06/2010 8:17	Wilder Creek	1	B	adult moose
200	ODHE	615494	6234382	03/06/2010 8:21	Wilder Creek	2	B	2 mule deer
203	ODHE	628768	6230511	03/06/2010 9:11	Moberley River	3	I	3 mule deer
205	ODHE	627151	6232960	03/06/2010 9:16	Moberley River	4	B	2 male and 2 female mule deer
213	ODHE	626733	6228863	03/06/2010 9:34	Moberley River	1	B	mule deer with white radio collar
224	ODHE	632125	6229340	03/06/2010 10:11	Pine River	2	I	2 female mule deer
236	ODHE	634774	6230265	03/06/2010 10:37	Pine River	4	I	4 mule deer

[1]Mammal species codes follow Resource Inventory Committee (2008).

[2]Bank/Island refers to location of observation – on the main channel bank or an in-stream island

Appendix 3. Point count data sheet.

Date: **Observer:** **Time:** **Visit:** **Ceiling:** **Cloud:** **Wind:** **Temp:** **Precip.:**

BIRD
= heard singing

BIRD - V
= seen singing

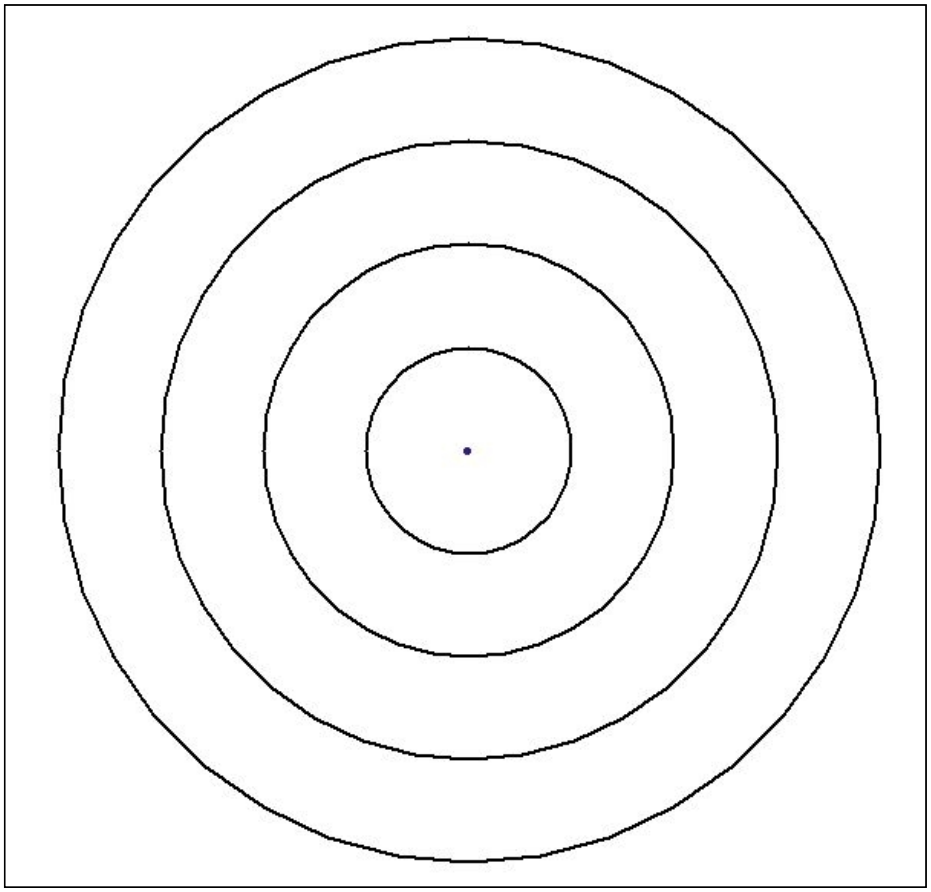
BIRD - V
= seen

BIRD
= detected (i.e. calling)

BIRD
= flyover (not landing within radius)

 # - BIRD
= more than one individual in association (e.g. flock)

BIRD^2
= bird detected in second time interval (min. 3-5)



25 m ring increments from 0 (plot centre) to 100 m.

Appendix 4. Environmental variable codes for point count surveys.

Ceiling:
The height of cloud cover. Record the average height of clouds during the survey.

ATT = Above Tree-tops
BTT = Below Tree-tops
AR = Above Ridge
BR = Below Ridge
H = High
VH = Very High

Cloud Cover (CC):
The extent of cloud cover during the survey period.

1 = clear, 0% cloud cover
2 = scattered clouds, <50% cloud cover
3 = scattered clouds, >50% cloud cover
4 = unbroken clouds, 100% cloud cover

Wind:
The strength of the dominant wind over the survey period using the Beaufort Scale. If wind strength split evenly between 1 or more classes, choose that which best characterized the conditions and detectability of birds. Acceptable conditions are Winds 0-3. >3 is considered unacceptable for conducting point counts (RISC 1999a).

0 = calm (<2 km/h)
1 = light air (2-5 km/h)
2 = light breeze, leaves rustle (6-12 km/h)
3 = gentle breeze, leaves and twigs constantly move (13-19 km/h)
4 = moderate breeze, small branches move, dust rises (20-29 km/h)
5 = fresh breeze, small trees sway (30-39 km/h)
6 = strong breeze, large branches moving, wind whistling (40-49 km/h)
7 = moderate gale+, whole trees in motion (≥50 km/h)

Precipitation:
The type of precipitation (if any) during the survey period. Acceptable conditions are no rain through very light drizzle.

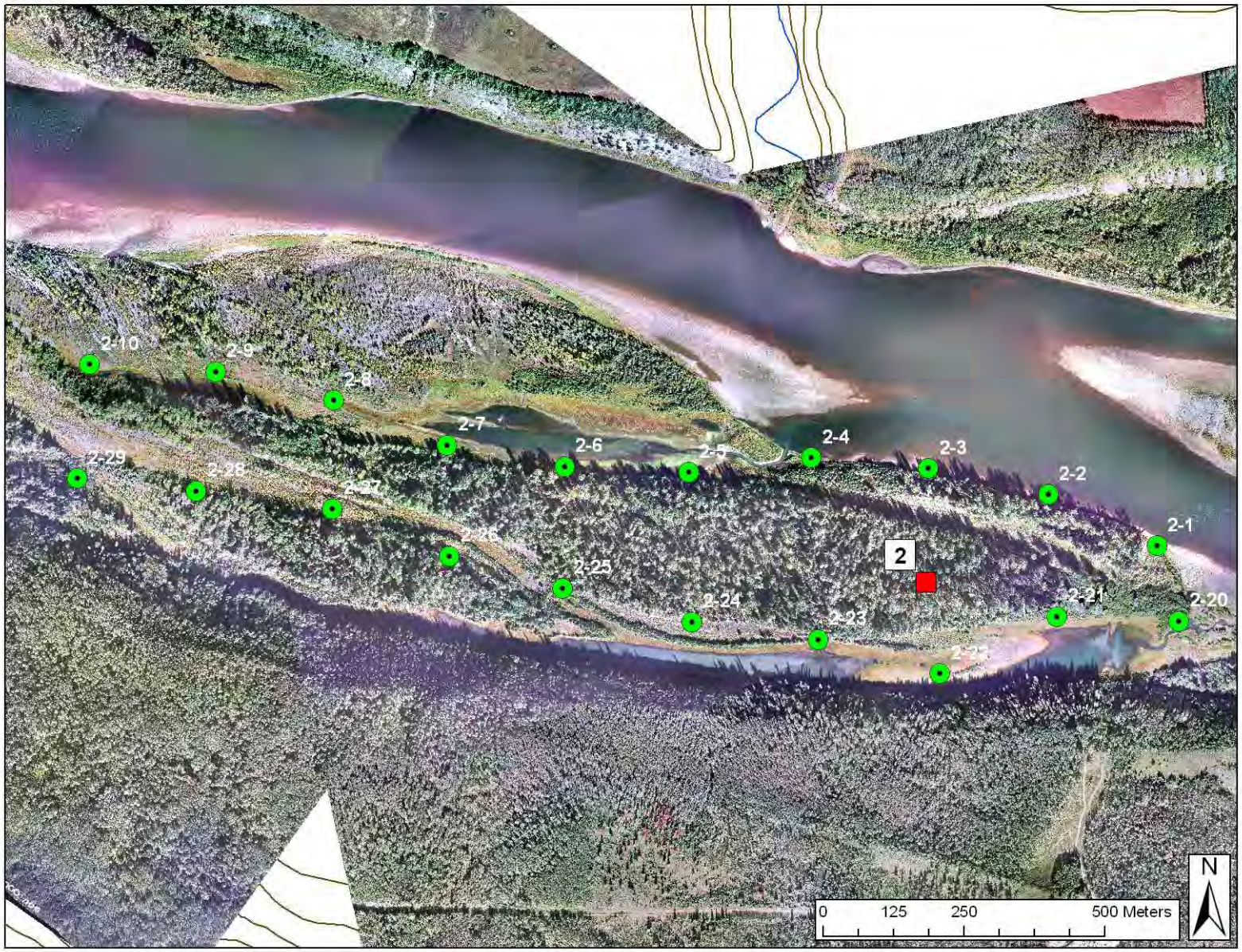
N = None
F = Fog
M = Misty Drizzle
D = Drizzle
LR = Light Rain
HR = Hard Rain
LS = Light Snow/Flurries
HS = Heavy Snow

Appendix 5. UTM coordinates of point count stations established at GMSMON 12 index sites in the Peace River Valley, B.C.

PCS[1]	X	Y
1-1	631953	6229313
1-2	632174	6229325
1-3	632206	6229107
1-4	632393	6229348
1-5	632615	6229372
1-6	632903	6229411
1-7	633114	6229487
1-8	633332	6229585
1-9	633461	6229425
1-10	633542	6229576
1-11	633755	6229613
1-20	632233	6228589
1-21	632459	6228590
1-22	632719	6228762
1-23	632954	6228832
1-24	633155	6229000
1-25	633327	6229137
1-26	633420	6229332
1-27	633622	6229314
1-28	633805	6229430
2-1	619550	6231976
2-2	619358	6232066
2-3	619146	6232113
2-4	618938	6232132
2-5	618721	6232106
2-6	618501	6232116
2-7	618292	6232154
2-8	618091	6232233
2-9	617882	6232284
2-10	617660	6232297
2-20	619589	6231842
2-21	619374	6231850
2-22	619166	6231749
2-23	618950	6231810
2-24	618727	6231841
2-25	618498	6231900
2-26	618297	6231957
2-27	618090	6232041
2-28	617848	6232072
2-29	617637	6232095
3-1	613875	6235781
3-2	614000	6235611
3-3	614190	6235496
3-4	614344	6235362
3-5	614551	6235316
3-6	614679	6235164
3-7	614392	6235172
3-8	614176	6235212
3-9	613970	6235286
3-10	613791	6235397
3-20	613736	6235865
3-21	613623	6236064
3-22	613461	6236216
3-23	613256	6236344
3-24	613058	6236430
3-25	613087	6236190
3-26	613234	6236030
3-27	613406	6235872
3-28	613551	6235696
3-29	613706	6235557
4-1	601753	6233830
4-2	601962	6233872
4-3	602165	6233905
4-4	602379	6233887
4-5	602589	6233817
4-6	602798	6233785
4-7	602951	6233659
4-8	602791	6233518
4-9	602607	6233420
4-10	602409	6233320
4-20	601782	6233643
4-21	601579	6233593
4-22	601377	6233637
4-23	601177	6233628
4-24	600964	6233661
4-25	600765	6233701
4-26	600558	6233675
4-27	600336	6233605
4-28	600123	6233551
4-29	600012	6233324
6-1	586874	6224197
6-2	587045	6224323
6-3	587118	6224524
6-4	587260	6224679
6-5	587416	6224818
6-6	587585	6224963
6-7	587291	6224473
6-20	586678	6224082
6-21	586518	6223926
6-22	586363	6223787
6-23	586247	6223599
6-24	586168	6223397
6-25	586249	6223428

[1]Point Count Station; the first number indicates the index site, the second the individual point count station.

Appendix 6. Maps of point count station locations at index sites in the Peace River valley, B.C. Green circles are point count stations; red squares are index site labels.


2-10
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2-21
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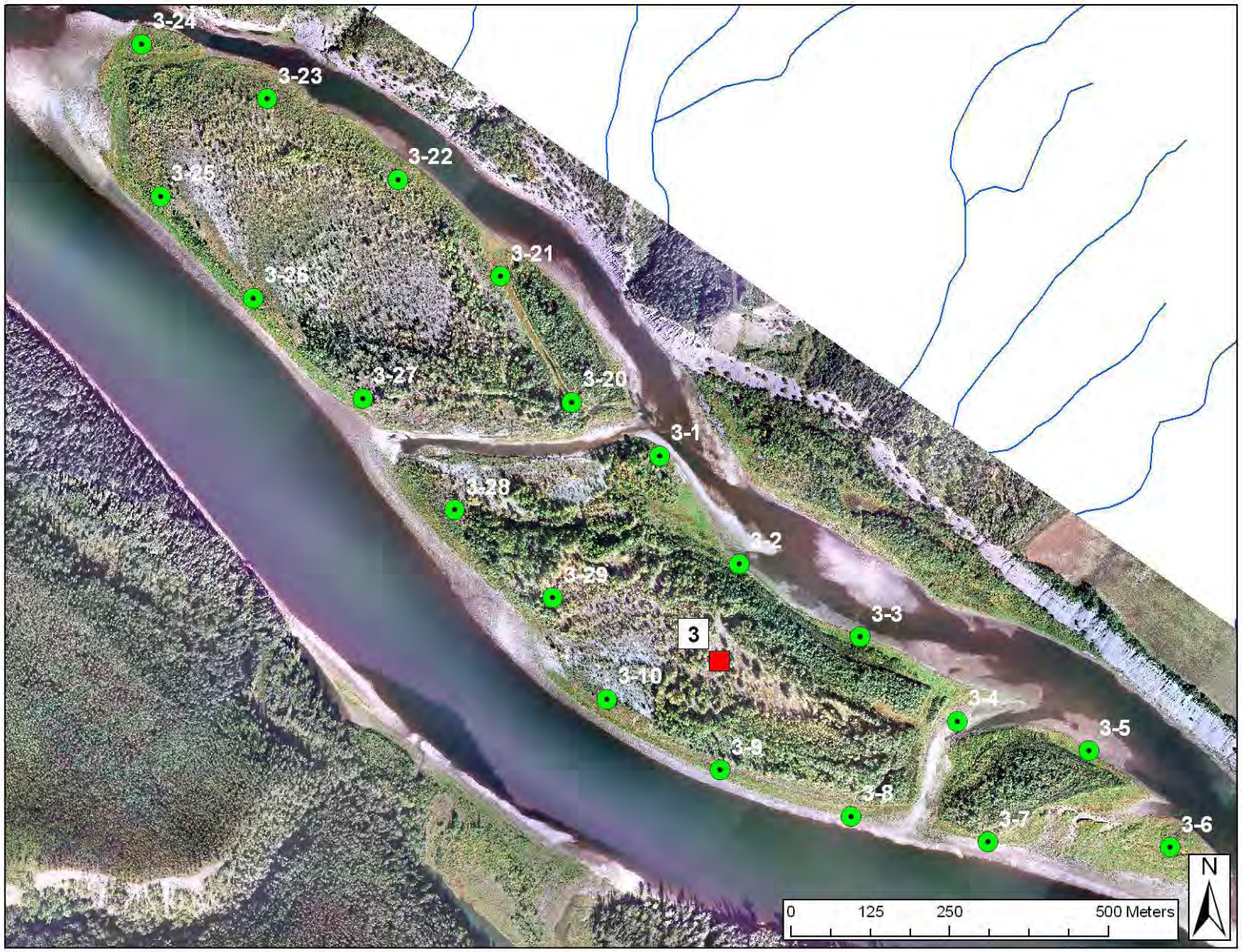
250
500 Meters
N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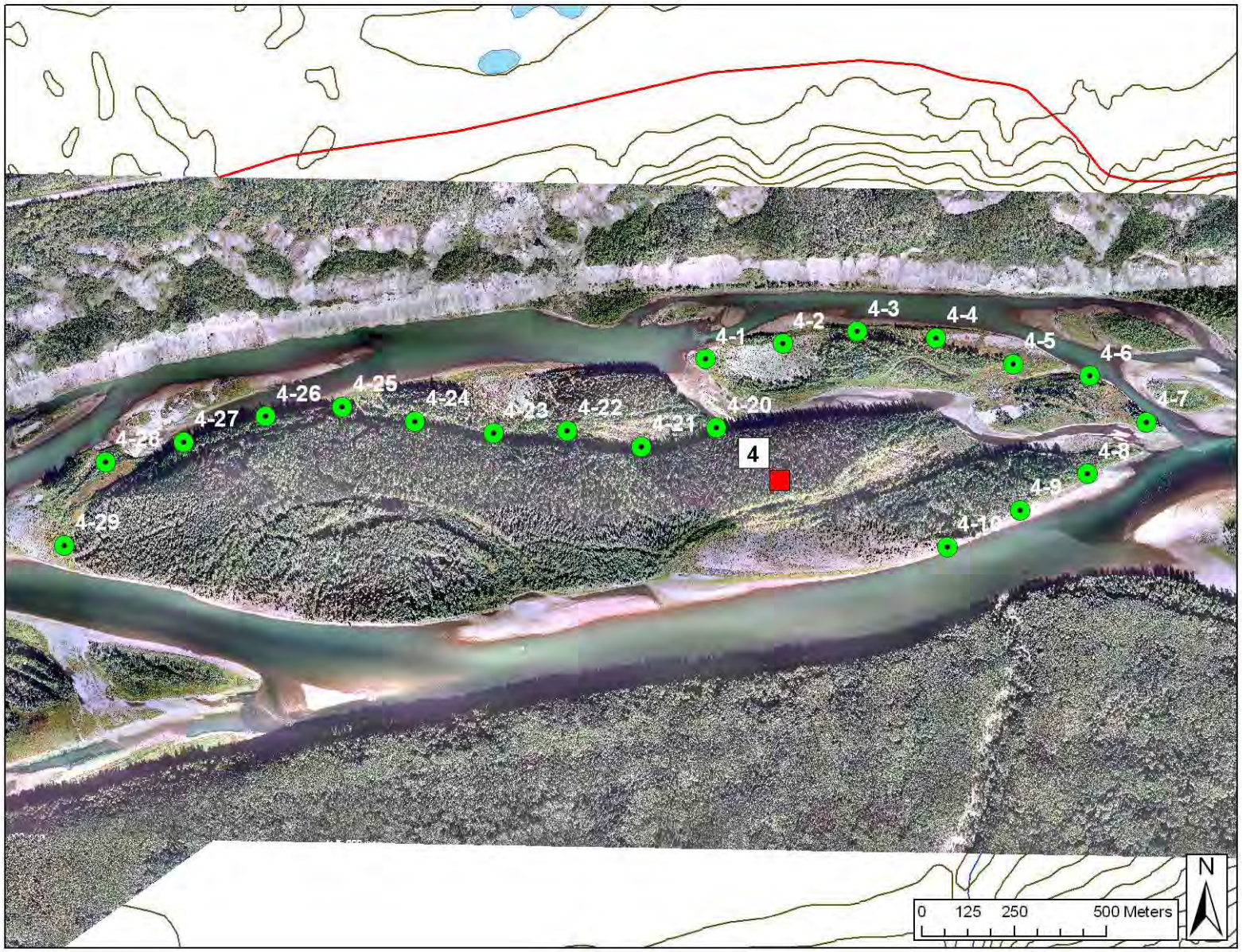
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N
0 125 250 500 Meters


6-6
6-5
6-4
6-3
6-7
6-2
5 / 6
6-1
6-20
6-21
6-22
6-23
6-25
N
0 125 250 500 Meters

Appendix 7. Bird species detected during point count surveys in the Peace River valley, B.C., June 13-18, 2010.

SPECIES[1]	STATUS	INDEX SITE 1	INDEX SITE 2	INDEX SITE 3	INDEX SITE 4	INDEX SITE 5/6	GRAND TOTAL
Alder Flycatcher	-	4	8	7	9		28
American Crow	-		4				4
American Kestrel	-		1				1
American Redstart	-	7	16	3	6	3	35
American Robin	-	17	9	7	8	3	44
American Wigeon	-		1			1	2
Barrow's Goldeneye	-				2		2
Black-and-white Warbler	-	9	1	2	1	2	15
Black-billed Magpie	-	2	4				6
Black-capped Chickadee	-	1		1	1		3
Belted Kingfisher	-	1					1
Black-throated Green Warbler	Blue		2				2
Brown-headed Cowbird	-	1		3	1	2	7
Blue-headed Vireo	-	5	3	3	4		15
Bank Swallow	-	1	6	3			10
Bonaparte's Gull	-		1				1
Brewer's Blackbird	-				1		1
Brown Creeper	-				1		1
Canada Goose	-		1				1
Canada Warbler	Blue, Threatened				1	1	2
Clay-coloured Sparrow	-	6	2	7			15
Cedar Waxwing	-	3	1	7	4	4	19
Chipping Sparrow	-	4	4	3	11	6	28
Common Goldeneye	-		1			2	3
Common Merganser	-					1	1
Common Raven	-	5			1		6
Common Yellowthroat	-	7	3	13	4	3	30
Dark-eyed Junco	-	2			2	1	5
European Starling	-				1		1
Fox Sparrow	-	2					2
Franklin's Gull	-	1	1				2
Gray Jay	-					1	1
Hammond's Flycatcher	-	1					1
Harry Woodpecker	-	1	1				2
Hermit Thrush	-	1	5		1		7
Killdeer	-			4	3	1	8
LeConte's Sparrow	Blue					1	1
Least Flycatcher	-	7	2	3	2	1	15

Lincoln's Sparrow	-	4	5	12	7	3	31
Mallard	-					1	1
Merlin	-		3	1			4
Magnolia Warbler	-	1	2		4	3	10
Northern Flicker	-		2	1	1	1	5
Northern Waterthrush	-		1				1
Northern Rough-winged Swallow	-		1				1
Orange-crowned Warbler	-	1		1		3	5
Ovenbird	-		2	2	1		5
Pine Siskin	-		1				1
Pacific-slope Flycatcher	-					4	4
Purple Finch	-				1		1
Rose-breasted Grosbeak	-	3	1			1	5
Red-breasted Nuthatch	-	1		1	6	3	11
Red-eyed Vireo	-	10	14	18	10	13	65
Rusty Blackbird	Blue, Special Concern			2			2
Red-winged Blackbird	-		6	2		3	10
Savannah Sparrow	-	3		2	1		6
Solitary Sandpiper	-			1			1
Song Sparrow	-	7	5	12	12	9	45
Spotted Sandpiper	-	5	1	6	4		16
Swamp Sparrow	-		1				1
Swainson's Thrust	-	2	1		2	1	6
Tennessee Warbler	-	5	6	1	2	5	19
Tundra Swan	-		2				2
Warbling Vireo	-	1	1				2
Western Tanager	-	1	1		3		5
White-throated Sparrow	-	2	4		3	2	11
Yellow-bellied Sapsucker	-		1			1	2
Yellow Warbler	-	12	9	11	6	10	48
Yellow-rumped Warbler	-	5	6		7	3	21
Grand Total		**151**	**153**	**139**	**134**	**99**	**676**

[1]Bird species codes follow Resource Inventory Committee (2008).

Appendix 8. UTM coordinates of nests found in the Peace River valley by species, May and June 2010.

SPECIES[1]	EASTING	NORTHING	DATE AND TIME	TYPE	COMMENTS
NEST	628708	6230677	28-MAY-10 13:14	CAVITY	stick nest and possible bufflehead cavity in Ac
Savannah Sparrow	616084	6233530	28-MAY-10 15:31:35	GROUND	SAVS nest with 4 eggs, pic # 001
Spotted Sandpiper	608274	6235500	29-MAY-10 10:04:30	GROUND	SPSA nest with 3 eggs, pic # 002
Killdeer	608195	6235549	29-MAY-10 10:16:49	GROUND	KILL chick and parents
Savannah Sparrow	599184	6232519	29-MAY-10 14:58:47	GROUND	SAVS nest, no eggs
Killdeer	593980	6228842	29-MAY-10 15:36:17	GROUND	KILL nest site, multiple scrapes
NEST	614530	6235286	15-JUN-10 3:03:16PM	STICK	unoccupied stick nest
NEST	602663	6233718	16-JUN-10 1:37:50PM	STICK	unoccupied stick nest
American Kestrel	619504	6232008	14-JUN-10 3:20:50PM	CAVITY	AMKE nest in Ac cavity, 15 m above ground
American Robin	613604	6235607	15-JUN-10 11:11:46AM	CUP	AMRO nest, 2 eggs, 1.5 m above ground
American Robin	600414	6232968	17-JUN-10 10:54:40AM	CUP	AMRO nest, 4 eggs, 3 m above ground
American Robin	600371	6232975	17-JUN-10 11:02:58AM	CUP	AMRO nest in construction, 4 m above ground
American Robin	599375	6232925	17-JUN-10 2:00:09PM	CUP	AMRO nest, 4 eggs, 3 m above ground
Clay-coloured Sparrow	614433	6235334	15-JUN-10 3:15:58PM	CUP	CCSP nest, 3 chicks, 0.25 m above ground
Chipping Sparrow	586994	6224265	18-JUN-10 1:10:19PM	CUP	CHSP nest, 4 chicks, 0.5 m above ground
Eastern Phoebe	619468	6232026	14-JUN-10 3:15:17PM	BANK	EAPH nest under over-hanging root mass on steep bank, 3 m above ground
Hermit Thrush	602327	6233339	16-JUN-10 10:52:00AM	GROUND	HETH nest on ground, 3 eggs
Belted Kingfisher	619450	6232037	14-JUN-10 8:19:25AM	BANK	KING nest in side of bank
Lincoln's Sparrow	618486	6232253	14-JUN-10 12:48:35PM	GROUND	LISP nest on ground, 5 eggs
Lincoln's Sparrow	602664	6233772	16-JUN-10 1:54:15PM	GROUND	LISP nest on ground, 3 chicks
Lincoln's Sparrow	600370	6232961	17-JUN-10 11:00:52AM	GROUND	LISP nest on ground
Lincoln's Sparrow	586982	6224168	18-JUN-10 2:30:34PM	GROUND	LISP nest on ground
Mallard	633191	6229499	13-JUN-10 12:59:48PM	GROUND	MALL nest on ground, 7 eggs, 3 m above waterline
NEST	602328	6233334	16-JUN-10 10:49:21AM	CUP	unoccupied cup nest
NEST	602610	6233440	16-JUN-10 11:48:04AM	CUP	unoccupied cup nest
NEST	600415	6232955	17-JUN-10 10:44:03AM	CUP	unoccupied cup nest
NEST	600395	6232959	17-JUN-10 10:50:25AM	CUP	unoccupied cup nest
NEST	600119	6232995	17-JUN-10 11:55:01AM	CUP	unoccupied cup nest
NEST	587559	6224962	18-JUN-10 10:51:27AM	CUP	unoccupied cup nest
NEST	587124	6224509	18-JUN-10 12:48:02PM	CUP	unoccupied cup nest
NEST	587102	6224481	18-JUN-10 12:55:19PM	CUP	unoccupied cup nest
NEST	587018	6224274	18-JUN-10 1:07:14PM	CUP	unoccupied cup nest
Song Sparrow	617714	6232468	14-JUN-10 11:33:16AM	GROUND	SOSP nest on ground, 3 chicks, 2 eggs
Song Sparrow	602968	6233658	16-JUN-10 1:09:01PM	GROUND	SOSP nest on ground, 1 egg

Swamp Sparrow	586850	6224183	18-JUN-10 2:54:10PM	GROUND	SWSP nest on ground, 4 chicks, pic #369
Tennessee Warbler	617572	6232479	14-JUN-10 11:21:43AM	GROUND	TEWA nest on ground, 3 chicks 1 egg
Cedar Waxwing	600392	6232959	17-JUN-10 11:04:41AM	CUP	CEWA nest, 1.5 m above ground
UNSP	599842	6232774	17-JUN-10 1:20:11PM	CUP	unknown sparrow nest, 4 chicks, 0.25 m above ground
White-throated Sparrow	586992	6224207	18-JUN-10 1:16:52PM	GROUND	WTSP nest on ground, in construction
Savannah Sparrow	587017	6224261	12/06/2010 9:35	GROUND	SAVS nest with 5 eggs, pic #316
American Robin	633757	6229389	13-JUN-10 8:54:54	CUP	AMRO nest, 4 eggs, 1.3 m above ground, picture #320
American Robin	633471	6229158	13-JUN-10 11:28:11	CUP	AMRO nest, 5 m above ground
American Redstart	633434	6229138	13-JUN-10 11:58:20	CUP	AMRE nest, 2.5 m above ground, pic #321
Rose-breasted Grosbeak	633433	6229135	13-JUN-10 12:06:51	CUP	RBGR nest, 6 m above ground
UNSP	633277	6229031	13-JUN-10 12:18:15	GROUND	unidentified sparrow nest on ground, 4 chicks, pic #322
American Redstart	618497	6231894	14-JUN-10 7:46:07	CUP	AMRE nest, 2.5 m above ground, pic #323
American Redstart	617643	6232083	14-JUN-10 9:25:41	CUP	AMRE nest, 2.5 m above ground, pic #333
Yellow-belied Sapsucker	617991	6231971	14-JUN-10 11:53:58	CAVITY	YBSA nest in Ep, 9 m above ground
Cedar Waxwing	613109	6236159	15-JUN-10 8:05:18	CUP	CEWA nest, 2 m above ground
Common Nighthawk	613606	6235707	15-JUN-10 9:39:20	GROUND	CONI nest site, flushed female from scrape in ground
Merlin	613426	6235938	15-JUN-10 10:54:22	STICK	MERL nest, 8 m above ground
NEST	613326	6235946	15-JUN-10 11:09:32	CUP	unoccupied cup nest with mud construction, 1 m above ground
NEST	613332	6235923	15-JUN-10 11:14:02	CUP	unoccupied small cup nest, 0.5 m above ground, possible COYE
NEST	613227	6236031	15-JUN-10 11:32:06	CUP	unoccupied grass cup nest, 0.75 m above ground
NEST	613146	6236113	15-JUN-10 11:48:32	CUP	unoccupied grass cup nest, 3 m above ground
NEST	613131	6236128	15-JUN-10 11:56:02	CUP	unoccupied grass cup nest, 0.25 m above ground
NEST	613093	6236255	15-JUN-10 12:34:31	CUP	unoccupied grass cup nest, 1 m above ground
NEST	613131	6236360	15-JUN-10 12:48:08	CUP	unoccupied grass cup nest, 1.5 m above ground
NEST	613664	6236057	15-JUN-10 13:28:44	CUP	unoccupied grass cup nest, 0.75 m above ground
Yellow Warbler	613661	6236043	15-JUN-10 13:33:54	CUP	YEWA nest, small grass and hair cup, 5 m off ground
NEST	613661	6236014	15-JUN-10 13:41:20	CUP	unoccupied cup nest, 0.5 above ground
Eastern Phoebe	601673	6233743	16-JUN-10 6:03:26	BANK	EAPH nest under lip of undercut bank, chicks present, 3 m above flood channel
Yellow-rumped Warbler	600479	6233638	16-JUN-10 11:37:19	CUP	YRWA nest in mature Sx, 10 m above ground
NEST	600830	6233685	16-JUN-10 12:03:55	CUP	unoccupied cup nest, 2.5 m above ground
NEST	600938	6233679	16-JUN-10 12:32:49	CUP	2 unoccupied cup nests, 2 m and 3 m above ground
NEST	601102	6233646	16-JUN-10 12:50:10	CUP	unoccupied cup nest, 2 m above ground

NEST	599080	6232493	17-JUN-10 7:49:34	STICK	unoccupied stick nest, 3 m above ground
Song Sparrow	598776	6232134	17-JUN-10 8:39:35	GROUND	SOSP nest on ground, 5 eggs, pic #337
NEST	598756	6232061	17-JUN-10 10:38:09	CUP	unoccupied nest, 2 m above ground
Spotted Sandpiper	598874	6232234	17-JUN-10 13:51:21	GROUND	adult SPSA and downy chick
Chipping Sparrow	586215	6223421	18-JUN-10 10:55:05	CUP	0.25 m above ground, 2 chicks being predated by common garter snake, pic #341-367
NEST	586198	6223429	18-JUN-10 11:29:06	CUP	unoccupied cup nest, 2 m above ground
NEST	586207	6223428	18-JUN-10 11:31:15	CUP	unoccupied cup nest, 2 m above ground
NEST	586227	6223448	18-JUN-10 11:33:55	CUP	unoccupied cup nest, 0.5 m above ground
NEST	586225	6223453	18-JUN-10 11:34:13	CUP	unoccupied cup nest, 1.5 m above ground
NEST	586244	6223465	18-JUN-10 11:37:27	CUP	unoccupied small twig nest, 1.5 m above ground
NEST	586251	6223485	18-JUN-10 11:45:32	CUP	unoccupied grass/twig nest, 2 m above ground
Red-winged Blackbird	586391	6223690	18-JUN-10 12:21:05	CUP	RWBB in cattail clump on side of pond, 0.25 m above ground

[1]The code ‘NEST’ denotes an unoccupied nest; the code ‘UNSP’ denotes an unidentified sparrow nest.

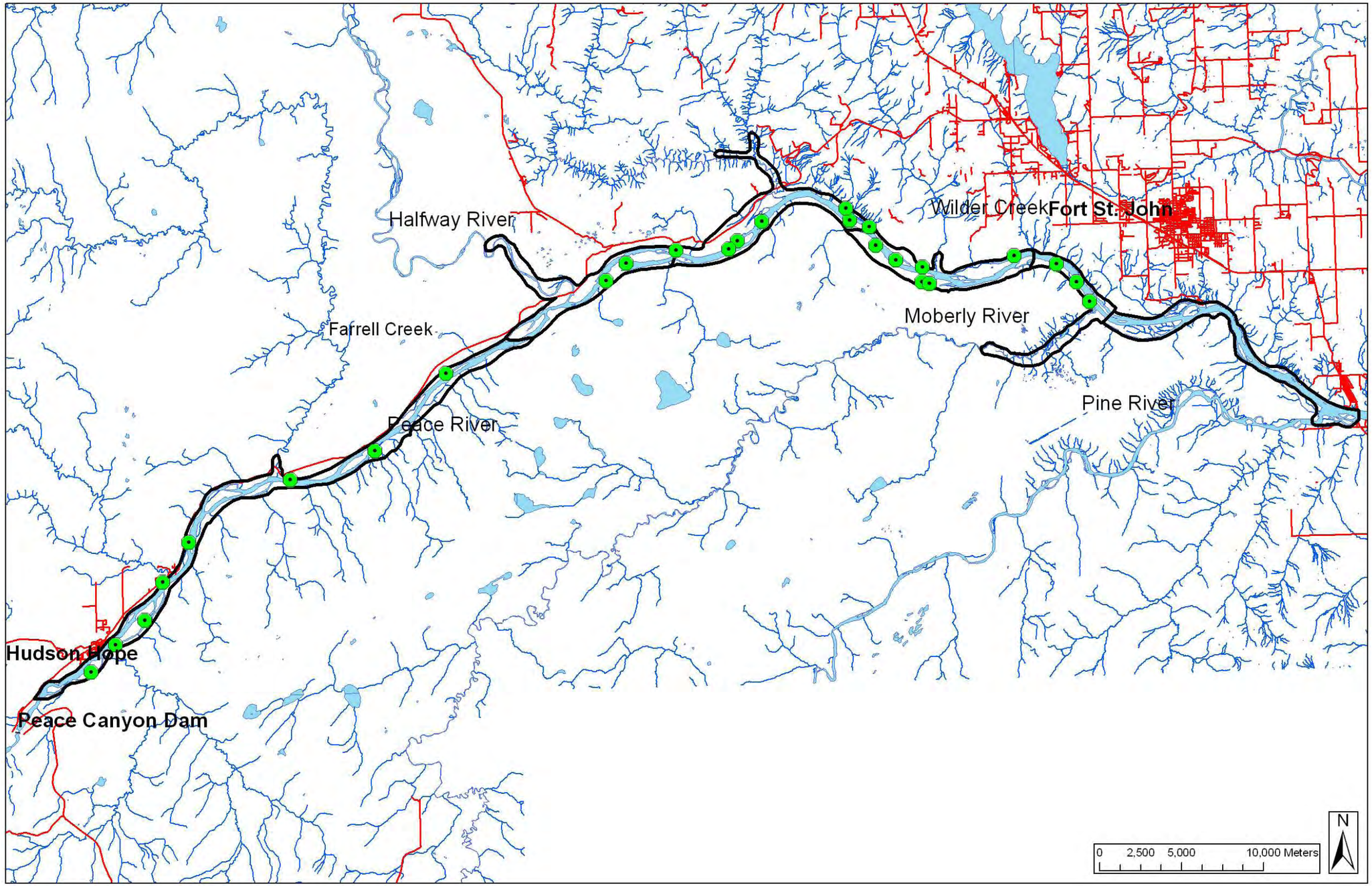
Appendix 9. Beaver (*Castor canadensis*) detections and UTM coordinates for detections made during aerial surveys of the Peace River valley, B.C.

SPECIES	EASTING	NORTHING	DATE AND TIME	SURVEY BLOCK	STRUCTURE	ACTIVE?	COUNT	COMMENTS
CACA	565550	6207094	02/06/2010 7:31	Peace Canyon	Dam	N	1	old beaver dam
CACA	567316	6208178	02/06/2010 7:38	Peace Canyon	Feeding	Y	1	beaver feeding activities
CACA	570583	6211310	02/06/2010 7:51	Peace Canyon	Feeding	Y	1	fresh beaver feeding
CACA	568811	6209820	02/06/2010 7:53	Peace Canyon	Feeding	Y	1	beaver in water towing freshly cut Ac branch
CACA	570884	6211416	02/06/2010 8:05	Peace Canyon	Feeding	N	1	old beaver feeding
CACA	573746	6216365	02/06/2010 8:21	Peace Canyon	Bank lodge	N	1	old beaver bank lodge
CACA	577236	6219065	02/06/2010 8:39	Peace Canyon	Lodge	N	1	old beaver lodge
CACA	577989	6219415	02/06/2010 8:39	Peace Canyon	Lodge	N	1	old beaver lodge
CACA	576307	6219355	02/06/2010 8:48	Peace Canyon	Lodge	N	1	old beaver lodge
CACA	574250	6218742	02/06/2010 8:50	Peace Canyon	Lodge	N	1	old beaver lodge
CACA	573692	6217508	02/06/2010 8:51	Peace Canyon	Lodge	N	1	old beaver lodge
CACA	573489	6217200	02/06/2010 8:51	Peace Canyon	Dam	N	1	old beaver dam
CACA	573267	6216069	02/06/2010 8:52	Peace Canyon		Y	1	beaver in river
CACA	573152	6215628	02/06/2010 8:52	Peace Canyon	Bank lodge	N	1	old beaver bank lodge
CACA	571683	6213635	02/06/2010 8:54	Peace Canyon	Lodge	Y	1	old beaver lodge, some signs of feeding acitivity
CACA	581336	6219662	02/06/2010 9:42	Farrell Creek	Bank lodge	N	1	bank lodge
CACA	584640	6221623	02/06/2010 10:00	Farrell Creek	Lodge	Y	1	beaver lodge, possible active
CACA	591096	6227494	02/06/2010 10:30	Farrell Creek	Lodge	N	1	very old beaver lodge
CACA	589587	6226760	02/06/2010 10:32	Farrell Creek	Lodge	N	1	old beaver lodge
CACA	588982	6226327	02/06/2010 10:33	Farrell Creek	Bank lodge	Y	1	beaver bank lodge and recent feeding
CACA	587963	6225439	02/06/2010 10:34	Farrell Creek	Bank lodge	N	1	beaver bank lodge
CACA	587714	6225170	02/06/2010 10:35	Farrell Creek	Lodge	N	1	beaver dam and lodge complex
CACA	585023	6222477	02/06/2010 10:43	Farrell Creek	Bank lodge	N	1	beaver bank lodge
CACA	579487	6219877	02/06/2010 10:49	Farrell Creek	Lodge	Y	1	beaver lodge, recent beaver feeding activity
CACA	595006	6230178	02/06/2010 11:06	Halfway River	Lodge	N	1	beaver lodge
CACA	595575	6229645	02/06/2010 11:09	Halfway River	Dam	N	1	old beaver dam
CACA	596165	6230276	02/06/2010 11:11	Halfway River	Lodge	N	1	beaver lodge
CACA	595686	6230321	02/06/2010 11:14	Halfway River	Bank lodge	N	1	old beaver bank lodge
CACA	600544	6232752	02/06/2010 11:28	Halfway River	Bank lodge	N	1	old beaver bank lodge
CACA	598753	6231953	02/06/2010 11:32	Halfway River	Lodge	Y	1	beaver lodge, fresh green visible
CACA	599569	6232585	02/06/2010 11:33	Halfway River	Lodge	N	1	old beaver lodge
CACA	599990	6233006	02/06/2010 11:34	Halfway River	Feeding	Y	1	fresh beaver feeding activity

CACA	601508	6233997	02/06/2010 11:51	Halfway River	Bank lodge	N	1	beaver bank lodge
CACA	599864	6233661	02/06/2010 11:53	Halfway River	Bank lodge	N	1	old beaver bank lodge
CACA	599705	6233634	02/06/2010 11:53	Halfway River	Dam	N	1	2 beaver dams on back channel
CACA	599429	6233504	02/06/2010 11:53	Halfway River	Bank lodge	N	1	old beaver bank lodge
CACA	597720	6231343	02/06/2010 11:55	Halfway River	Bank lodge	N	1	old beaver bank lodge
CACA	594992	6230275	02/06/2010 12:16	Halfway River	Bank lodge	N	1	old beaver bank lodge
CACA	606760	6234384	03/06/2010 6:40	Cache Creek	Bank lodge	Y	1	active beaver bank lodge
CACA	606257	6233867	03/06/2010 6:41	Cache Creek	Bank lodge	Y	1	active beaver lodge
CACA	608281	6235563	03/06/2010 6:42	Cache Creek	Bank lodge	Y	1	2 beaver bank lodges, possible active
CACA	614437	6235364	03/06/2010 6:51	Cache Creek	Bank lodge	N	1	2 inactive beaver bank lodges
CACA	613632	6235628	03/06/2010 6:53	Cache Creek	Bank lodge	Y	1	active beaver bank lodge
CACA	614817	6235226	03/06/2010 6:55	Cache Creek	Lodge	Y	1	beaver lodge and 1 beaver
CACA	613416	6236379	03/06/2010 6:57	Cache Creek	Bank lodge	Y	1	beaver bank lodge and 1 beaver
CACA	608606	6236189	03/06/2010 7:03	Cache Creek	Bank lodge	N	1	old beaver bank lodge
CACA	609059	6237263	03/06/2010 7:07	Cache Creek	Bank lodge	N	1	2 old beaver bank lodges
CACA	607407	6240898	03/06/2010 7:15	Cache Creek	Dam	N	1	old beaver dam
CACA	607079	6235200	03/06/2010 7:21	Cache Creek	Lodge	N	1	old beaver lodge
CACA	607463	6235524	03/06/2010 7:21	Cache Creek	Dam	N	1	old beaver dam
CACA	607736	6235812	03/06/2010 7:21	Cache Creek	Lodge	N	1	old beaver dam and lodge complex
CACA	603028	6233808	03/06/2010 7:27	Cache Creek	Bank lodge	Y	1	beaver bank lodge with food cache
CACA	614140	6234533	03/06/2010 7:32	Wilder Creek	Bank lodge	N	1	old beaver bank lodge
CACA	614519	6234095	03/06/2010 7:32	Wilder Creek	Dam	N	1	old beaver dam
CACA	618027	6231896	03/06/2010 7:35	Wilder Creek	Dam	Y	1	beaver dam with fresh beaver feeding
CACA	618505	6231787	03/06/2010 7:35	Wilder Creek	Lodge	Y	1	beaver lodge with fresh beaver feeding
CACA	618422	6232135	03/06/2010 7:37	Wilder Creek	Lodge	N	1	old beaver lodge
CACA	615237	6234102	03/06/2010 7:43	Wilder Creek	Bank lodge	Y	1	bank lodge with food cache
CACA	617207	6232959	03/06/2010 7:45	Wilder Creek	Bank lodge	N	1	old beaver bank lodge
CACA	616436	6233217	03/06/2010 7:45	Wilder Creek	Bank lodge	Y	1	beaver bank lodge with recent/green feeding
CACA	624831	6233253	03/06/2010 7:53	Wilder Creek	Food cache	N	1	old beaver food cache
CACA	623676	6233159	03/06/2010 7:58	Wilder Creek	Bank lodge	N	1	old beaver bank lodge
CACA	623662	6233490	03/06/2010 7:59	Wilder Creek	Lodge	Y	1	beaver and old beaver lodge
CACA	622845	6233181	03/06/2010 8:00	Wilder Creek	Bank lodge	N	1	beaver bank lodge
CACA	622539	6233148	03/06/2010 8:01	Wilder Creek	Bank lodge	N	1	beaver bank lodge
CACA	620995	6232858	03/06/2010 8:02	Wilder Creek	Dam	N	1	2 old beaver dams

CACA	622442	6232437	03/06/2010 8:12	Wilder Creek	Bank lodge	N	1	old beaver bank lodge
CACA	618078	6232805	03/06/2010 8:18	Wilder Creek	Bank lodge	Y	1	beaver bank lodge with fresh green
CACA	616238	6233722	03/06/2010 8:20	Wilder Creek	Bank lodge	N	1	beaver bank lodge
CACA	629725	6229827	03/06/2010 9:10	Moberley River	Bank lodge	N	1	old beaver bank lodge
CACA	628698	6230766	03/06/2010 9:11	Moberley River	Lodge	N	1	2 old beaver lodges
CACA	627885	6231901	03/06/2010 9:14	Moberley River	Lodge	N	1	old beaver lodge
CACA	625762	6233554	03/06/2010 9:17	Moberley River	Lodge	N	1	old beaver lodge
CACA	625368	6233583	03/06/2010 9:18	Moberley River	Bank lodge	N	1	old beaver bank lodge
CACA	628613	6230313	03/06/2010 9:25	Moberley River	Bank lodge	N	1	old beaver bank lodge
CACA	628293	6230694	03/06/2010 9:25	Moberley River	Bank lodge	Y	1	beaver bank lodge with fresh green
CACA	627493	6231910	03/06/2010 9:27	Moberley River	Bank lodge	Y	1	beaver bank lodge with fresh green
CACA	626260	6232972	03/06/2010 9:29	Moberley River	Bank lodge	Y	1	beaver bank lodge with fresh green
CACA	622576	6227800	03/06/2010 9:41	Moberley River	Dam	N	1	2 beaver dams in side channel of river
CACA	625944	6228069	03/06/2010 9:44	Moberley River	Dam	N	1	beaver dam
CACA	628856	6230019	03/06/2010 9:47	Moberley River	Lodge	N	1	beaver lodge
CACA	629661	6229197	03/06/2010 9:58	Pine River	Bank lodge	N	1	beaver dam and bank lodge
CACA	630382	6228800	03/06/2010 9:59	Pine River	Dam	N	1	beaver dam
CACA	630779	6228675	03/06/2010 9:59	Pine River	Dam	N	1	beaver dam
CACA	631188	6228557	03/06/2010 9:59	Pine River	Dam	N	1	beaver dam
CACA	631452	6228536	03/06/2010 10:00	Pine River	Dam	N	1	beaver dam
CACA	631725	6228545	03/06/2010 10:00	Pine River	Dam	N	1	beaver dam
CACA	633666	6229132	03/06/2010 10:13	Pine River	Bank lodge	N	1	beaver bank lodge
CACA	636372	6230050	03/06/2010 10:15	Pine River	Bank lodge	N	1	beaver bank lodge
CACA	636934	6229227	03/06/2010 10:16	Pine River	Lodge	N	1	2 old beaver lodges
CACA	637514	6227293	03/06/2010 10:19	Pine River	Dam	N	1	beaver dam
CACA	638003	6227055	03/06/2010 10:19	Pine River	Bank lodge	N	1	beaver bank lodge
CACA	641083	6225360	03/06/2010 10:21	Pine River	Bank lodge	N	1	beaver bank lodge
CACA	642505	6224734	03/06/2010 10:30	Pine River	Bank lodge	N	1	beaver bank lodge
CACA	642290	6224876	03/06/2010 10:30	Pine River	Bank lodge	N	1	beaver bank lodge
CACA	642009	6225062	03/06/2010 10:30	Pine River	Bank lodge	N	1	beaver bank lodge
CACA	637814	6228045	03/06/2010 10:34	Pine River	Bank lodge	N	1	2 beaver bank lodges
CACA	636390	6230393	03/06/2010 10:35	Pine River	Bank lodge	N	1	beaver bank lodge
CACA	633013	6229829	03/06/2010 10:41	Pine River	Bank lodge	N	1	old beaver bank lodge

Appendix 10. Map of active beaver lodges and food caches detected during aerial surveys, June 2-3, 2010 in the Peace River valley, B.C.



Appendix 11. Reptile and amphibian detections in the Peace River valley, spring and summer 2010 (BUBO = western toad, RASY = wood frog, THIS = common garter snake).

SPECIES[1]	X	Y	DATE AND TIME	COUNT	COMMENTS
RASY	632024	6229099	28/05/2010 11:20	1	wood frog
BUBO	599192	6232518	29/05/2010 14:56	1	juvenile Western Toad
UNID	567180	6208350	29/05/2010 18:41	1	wetland pond with tadpoles
RASY	586711	6224157	12/06/2010 9:18	1	wood frog in pool
RASY	587050	6224243	12/06/2010 11:24	1	wood frog
RASY	586996	6224179	12/06/2010 11:30	1	wood frog
RASY	586996	6224171	12/06/2010 11:33	1	wood frog
RASY	586959	6224136	12/06/2010 11:37	1	wood frog
RASY	586744	6224124	12/06/2010 12:29	2	wood frog
THIS	586568	6223956	12/06/2010 12:43	1	common garter snake
RASY	586538	6223930	12/06/2010 12:47	1	
THIS	586501	6223890	12/06/2010 12:51	1	
BUBO	586347	6223721	12/06/2010 13:08	1	juvenile western toad
BUBO	586250	6223562	12/06/2010 13:18	1	
RASY	586239	6223539	12/06/2010 13:20	1	
RASY	586329	6223700	12/06/2010 14:14	1	
BUBO	601755	6233645	16-JUN-10 13:25:05	2	juvenile western toad
RASY	601743	6233638	16-JUN-10 13:27:59	1	wood frog
RASY	601676	6233610	16-JUN-10 13:32:42	1	juvenile wood frog
RASY	599135	6232486	17-JUN-10 7:05:04	1	juvenile wood frog
RASY	599108	6232357	17-JUN-10 7:11:49	1	juvenile wood frog
RASY	599093	6232342	17-JUN-10 7:13:09	1	juvenile wood frog
RASY	599089	6232333	17-JUN-10 7:15:00	2	adult and juvenile wood frog
RASY	598585	6231789	17-JUN-10 11:43:56	2	wood frog
RASY	602536	6233374	16-JUN-10 10:17:49AM	1	wood frog
RASY	599203	6232521	17-JUN-10 3:52:31PM	1	wood frog
BUBO	600136	6232934	17-JUN-10 12:23:53PM	1	western toad
BUBO	599199	6232515	17-JUN-10 3:54:04PM	2	mating pair of western toad in pond, eggs coming out behind pair in string
BUBO	6258447	990841	09/09/2010 7:25	2	adult western toad and toadlet
BUBO	6258689	990350	09/09/2010 13:18	1	western toad toadlet

[1]Amphibian and reptile species codes follow Resource Inventory Committee (2008); UNID denotes unidentified species.