Appendix A. Breeding season pre-clearing nest survey methodology

Methodology to determine the presence of active bird nests

Site C Clean Energy Project

August 2015

1.0 Introduction

The British Columbia *Wildlife Act* (Section 34) (Province of BC 1996) and the federal *Migratory Birds Convention Act* (*MBCA*) (Section 5[9]) (Government of Canada 1994) provide legislation that prohibits the disturbance or destruction of a bird, its nest, or eggs. The federal *Species at Risk Act* (*SARA*) (Government of Canada 2002) provides similar protection for bird species at risk listed under *SARA*, regardless of whether they are also protected under the BC *Wildlife Act* or the *MBCA*.

Proposed development projects, such as BC Hydro Site C, require areas of native vegetation to be cleared for project infrastructure, and access and transmission corridors. Although most clearing on the proposed Site C Dam site will occur during the bird non-nesting season, some areas will require clearing during the bird breeding/nesting season. The Canadian Wildlife Service (CWS) Pacific Yukon region provides advice on compliance with the *MBCA* to minimize effects of vegetation clearing during the migratory bird breeding season (Environment Canada 2014a). Generally, pre-clearing bird nest surveys are required prior to any vegetation clearing during the nesting season to identify any active and nests and avoid any contraventions of the BC *Wildlife Act* and *MBCA*.

There currently are no provincial or federal standards for conducting bird nest surveys. As such, it is the responsibility of the proponent of a proposed development project to produce and adhere to their own bird nest survey methodology to demonstrate due diligence in not contravening any related legislation. The following document describes BC Hydro's bird nest survey methodology that will be implemented on the proposed Site C Dam construction project. The methods were developed using avoidance guidance from CWS (Environment Canada 2014a), provincial Best Management Practices (BC MFLNRO 2013 and 2014), and bird nest survey methodologies produced for similar development projects in British Columbia (BC EAO 2014). BC Hydro's bird nest survey methodology described below are intended to reduce the likelihood of any non-compliance with the *Wildlife Act*, *MBCA* and *SARA* in relation to vegetation clearing for the proposed Site C construction project.

2.0 Seasonal Timing of Surveys

Bird nest surveys should be conducted according to the following methodology (Table 1) if vegetation clearing is to occur, particularly between 1 March and 30 September, in areas associated with project activity, including ancillary areas outside the project footprint used for project related activities such as maintenance, storage, borrow pits, or any camp activities.

Table 1. Peace Region terrestrial wildlife least-risk windows (adapted from BC MFLNRO 2011).

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Songbirds				**1***	**1**	**-**	**31**	**15***				
Raptors and Owls			**1**	**1**	**-**	**-**	**31**	**-**	**30**			
Trumpeter Swans				**1**	**-**	**-**	**31**	**31**				

Exceptions	**Exceptions Nesting Period:** Any required clearing activities during this period should follow survey methodology for the Exceptions Nesting Period (see Section 3.2.7.3), to accommodate bird species that may breed outside of the typical nesting period.
Caution	**Caution Nesting Period:** Any required clearing activities during this period should follow survey methodology for the Caution Nesting Period (see Section 3.2.7.1).
Critical	**Critical Nesting Period:** Clearing activities should be avoided during this period. If clearing is required during this period, then survey methodology for the Critical Nesting Period (see Section 3.2.7.2) should be followed.

* Caution Nesting Period for songbirds was added by BC Hydro as none were suggested by BC MFLNRO (2011).

The Critical Nesting Period for songbirds for the project area is generally between 1 May and 30 July (BC MFLNRO 2011). The Critical Nesting Period for raptors, owls and Trumpeter Swans starts earlier (1 April to 30 July). The Caution Nesting Period for raptors and owls is 1-31 March and 1 August to 30 September, while for Trumpeter Swan it is 1-31 August. Although no Caution Nesting Period was suggested for songbirds by BC MFLNRO (2011), as a matter of due diligence BC Hydro has adopted 1-30 April and 1-15 August as the Caution Nesting Period for songbirds. The Exceptions Nesting Period occurs during all other times outside of the Critical and Caution Nesting Periods. Environment Canada suggests the regional nesting period for the project area (nesting zone B6) is from the end of April to early August (Environment Canada 2014a).

The timeframes in Table 1 should be used as a general guideline. Local weather conditions and timing of seasonal bird movements will vary across regions and among years due to seasonal weather, annual abundance of forage resources, and other variables such as overwintering conditions (i.e., for migratory species), which in turn influence seasonal arrival and nest construction times, and potentially local annual species abundance. **It will be at the discretion of the onsite Qualified Environmental Professional (QEP)[1] to determine or confirm which nesting period is currently underway during the survey period**.

[1] For the purposes of this document a Qualified Environmental Professional (QEP) is defined as a person who by way of education, training, skills, experience or a combination thereof, is able to accurately identify native bird species using field observations (e.g., physical characteristics, audible songs and calls, behavior, life history strategy, relevant habitat attributes, etc.).

3.0 METHODS

Surveys should be conducted by or under the direction of a QEP who has demonstrated bird survey experience. Field crew and coordinators conducting the nest surveys should have a background in birding, bird identification, or bird biology, and should be trained in the appropriate survey methods or have past experience with conducting such surveys. **At least one onsite QEP should be present during surveys**.

Project personnel involved in clearing should also be familiar with the bird nest survey methodology. **Strong and clear communication will be necessary between the bird survey and clearing crews to ensure that clearing crews are kept apprised of what areas are free-to-clear and for what period of time**.

Two main types of survey types will be used to identifying any active nests within the project footprint prior to any clearing: i) aerial surveys to identify large stick nests, and Trumpeter Swan and Sandhill Crane nests; and ii) ground surveys to identify nest sites of other species (e.g. songbirds, shorebirds, cavity-nesting owls and woodpeckers).

3.1 Aerial Large Stick Nest Survey Methods

Aerial surveys will be conducted to document the location of large stick nests as they are more readily detected from the air rather from the ground due to their size and position in the tree canopy. Ideally, surveys should be conducted in early spring prior to leaf-out to maximize the detection of large stick nests from the air. Wetlands that provide suitable habitat for nesting Trumpeter Swan and Sandhill Crane should also be inspected during aerial surveys. In most cases, a single aerial survey that covers the footprint area or specific locations that may not have existing survey data, may be sufficient. Follow-up ground or aerial surveys may be required later in the season to determine if identified inactive nest structures are being utilized by late nesters prior to any clearing.

Pre-flight planning should include: i) relevant literature review; ii) locations on maps or GPS waypoints of any previously recorded nest locations; and iii) a familiarization of relevant topographic maps and proposed project clearing areas. Aerial surveys can also be done opportunistically if other qualified crews require helicopter access to more remote locations.

Aerial grid patterns should be flown across large areas to be cleared, while linear flight lines should be flown along proposed transmission line and access corridors to be cleared. Survey flights will maintain a minimum height of 50 m above the tree tops with speeds ranging between 30-130 km/h (RISC 2001). Low flights over nesting sites should be avoided as they can cause disturbance and may result in birds abandoning a nest.

The flight survey path should be recorded by using the 'track' feature on a GPS. **The locations of all nests observed from the air will be recorded with a GPS waypoint**.

To determine whether a nest is active or inactive, the biologist will rely on clues that include nesting or territorial behavior by adults, the presence of new nest branches or greenery, and/or eggs, young or whitewash. Every attempt will be made to identify the bird species associated with each active nest without causing undue disturbance to the nesting birds.

Many raptor species reuse the same nest sites year after year. Because of this behavior, some raptor nests (e.g., eagle, Peregrine Falcon and Osprey[2] are legally protected year-round, even once the young have fledged and regardless of the presence or absence of breeding activity in a given year (Province of BC 1996).

3.2 Ground-based Nest Survey Methods

3.2.1 *Timing During the Day*

The intent of ground-based nest surveys is to identify the location of nests and nesting birds. Although there is generally an increase in bird activity (e.g., territorial singing and foraging) during early morning hours, nest surveys can be conducted throughout the day provided that light conditions permit the location of nests. Data gathered during the morning is useful for determining species composition and diversity; however, **the primary goal of the survey is to passively locate nests**.

Surveys should not be conducted during inclement weather such as heavy rain, snow, fog, high wind or cold temperature, as bird detectability may be limited during these conditions. Surveys should generally not be conducted when ambient temperature is ≤ 5°C or ≥ 30°C. Conducting surveys under these conditions may also add stress to the adults or cause the female to flush from the nest and endanger the survivability of eggs or nestlings.

3.2.2 *Survey Effort*

Finding nests can be difficult as most birds purposefully construct their nests in hidden locations to avoid detectability and depredation. Consequently, surveys should be conducted methodically and thoroughly to maximize efficacy of locating nests. As a general rule, **survey effort should not exceed 1 ha/hr during the Critical Nesting Period in high quality nesting habitat**. However, the actual duration of the survey may be significantly faster depending on factors such as terrain, time of year, forest type, understory vegetation (i.e., the amount of shrub and herbaceous ground cover), and experience of the nest searchers. **Surveys should be conducted both within the clearing limits and up to 30 m beyond the limits**.

Generally, survey personnel should walk transects through the area to be cleared, passively searching for nests and nesting activity. For crews of two or more, individuals should be spaced within visual distance and walk parallel to one another along the transect. In addition to visually searching for nest structures, surveyors should also employ additional survey techniques to increase the likelihood of finding nests, such as observing bird song or behaviour as cues to locate nests. These may include behaviors such as adults carrying fecal sacs away from the nest, adults bringing food to the nest, young begging for food, adults giving alarm calls or exhibiting agitated behavior. The survey transect should be recorded using the 'track' feature on a GPS device.

[2] While Peregrine Falcon and Osprey are not documented nesters in the Site C footprint area, they are possible breeders for this area and occurrence of their nests should be included in aerial surveys.

All nests that are encountered should be documented in the following manor:

- The nest location (UTMs) using a handheld GPS.
- The species attributable to the nest (if possible).
- The nest and general habitat characteristics (e.g., tree species, nest height, dbh and position; and dominant vegetation cover), nest contents if possible (e.g., presence of eggs, young, or empty, or under construction), and adult behaviour (e.g., nest building, incubating or brooding).
- The nest status (e.g., active or inactive).

If an adult bird flushes from an area that is suspected of being potential nesting habitat, the surveyor should briefly search the immediate area for a nest. Care and attention should be used during the nest search as to not cause any significant stress or duress to nesting birds, which may lead to nest abandonment. Surveyors should minimize time spent in the nest area, particularly during periods of inclement weather when eggs or nestlings may be exposed to the elements. If a nest is not located, the surveyor should back away from the encounter area and observe the detection site for any further bird activity through binoculars from a concealed location that does not cause unnecessary disturbance to the possible nesting pair. If adult birds exhibit excessive agitated behavior, surveyors should leave the area immediately. If the adult does not return or if a nest is not located, **the flushing location should be recorded as a GPS waypoint so that it may be revisited during the next survey round** to try and confirm the potential nest location. Similarly, any apparently active nest that is not attended by adult birds will be marked and revisited to confirm activity on the next survey round.

Under no circumstances should the surveyor physically touch a nest or attempt to climb a tree to look into a nest. Additionally, the surveyor should not intentionally cause birds to flush from the nest thereby risking exposure or depredation of the eggs or nestlings. Bird survey crews should communicate daily information regarding the number of active nests identified, their locations, and predicted nest completion date to the construction manager and clearing crew.

3.2.3 *Determining Nest Status*

Each nest observed will be given a designation of active or inactive. Nests that are determined not to be in current use due to derelict condition or other biological indicators (e.g., lack of adult birds nearby, spider webs across nest cavity entrances, moss growing on the nest cup, etc.) , will be given the designation of inactive. If the contents of the nest are easily observed from a distance, the presence of eggs or new nesting material can be used as indicators of current activity. Other means to determine nesting activity include observations of adult birds exhibiting nesting or territorial behavior in the vicinity of the nest.

Nests that appear in good condition and are suspected of being active, but bird presence or breeding activity was not confirmed, should be given a tentative active designation. It is only **after two observation periods of approximately 1 hour each, on two separate day visits that a potentially active nest can be designated as inactive**. Surveyors should avoid approaching a nest if nesting activity is observed or if a nest has the potential to be active. Instead, surveyors should observe the nest from a concealed distant location, viewing the nest through binoculars or a spotting scope.

3.2.4 *Nest Buffers*

A no-clearing nest buffer should be established around all confirmed active nests and suspected nest areas with significant evidence of breeding. Buffers will ensure as best as possible, that any clearing outside of the buffer will not render a nest ineffective or cause it to become inactive. An experienced QEP familiar with the habits and life histories of encountered bird species will be able to make a professional judgment on the likelihood of a nest being present when one is not directly found. Arboreal nests and nests in root wads or dense vegetative tangles are generally extremely difficult to locate. However, by using 'significant evidence indicators', suspected nest areas can be marked and appropriately buffered, thus better meeting the intent of the non-disturbance legislation and minimizing intrusion on an actual nest. Significant evidence indicators of breeding activity include:

a) Birds carrying food – for most songbirds (in particular), this activity indicates a nest or young in close proximity.
b) Birds carrying nesting material – indicates a nest is likely nearby.
c) Distraction displays – generally only performed within a few metres of an active nest site. Examples of distraction displays include, but are not limited to: a Killdeer, plover or sandpiper performing a broken-wing display, usually with an outstretched wing and flared tail; songbirds (wood-warblers and ground-nesters in particular) performing an injured display where both wings are tucked near to the body and fluttered rapidly; waterfowl performing an injured display with both wings loping or dragging alongside the body, and raptors, gulls or terns diving-bombing an intruder. Most distraction displayed are accompanied by emphatic vocalizations.
d) Persistent alarm calls and agitated behaviour. This is species-specific, but typically indicates a nest or young is close by. Examples include: birds giving scold notes, cries, or loud, abrupt, screeches, screams and other vocalizations; birds snapping their bills; birds flitting in and out of immediate view; or birds boisterously rushing towards an intruder.

If an experienced QEP observes at least one of the significant evidence indicators above, then the suspected nest area should be buffered. In most cases, an experienced observer will likely be able to narrow down the nest location to within a few meters.

The size and shape of the buffer will depend on various factors, including: site topography, proximity of the nest to naturally open areas, type and amount of surrounding vegetation cover, nesting period, a particular species' sensitivity to disturbance, rareness of the species in the local/regional area, and the type and extent of clearing activities that will be occurring next to the buffer. The onsite QEP will recommend the size of nest buffer to be established based on the above factors. For most bird nests, a minimum of a 30 m radius buffer should be established around active nests. In general, the precautionary principle should be implemented when establishing nest buffers: when in doubt, larger is better. See Table 2 for recommended minimum nest buffer sizes for various bird species and guilds. Also refer to Appendix A for an agency-based comparison of recommended nest buffer radii.

Table 2: Recommended minimum buffer sizes around active bird nests.

Bird Species or Guild	Recommended Buffer Size[3]
Songbirds[4]	30 m radius
Ground Nesters (e.g., grouse, Common Nighthawk)	30 m radius
Waterfowl and Shorebirds	30 m radius
Cavity Nesters (including cavity-nesting owls and raptors, and most woodpeckers/sapsuckers)	30 m radius
Pileated Woodpecker	50 m radius
Raptors and Owls (stick nesters/non-cavity nesters)	100 m radius
Bald Eagle, Golden Eagle, Osprey, Peregrine Falcon, Northern Goshawk, Trumpeter Swan, Sandhill Crane	200 m radius
Great Blue Heron	300 m radius

No clearing activities within the established buffer areas should occur until after the QEP has determined that nesting and fledging are complete, or if the status of the nest has been changed from active to inactive.

3.2.5 *Adaptive Buffer Size Methodology*

Under certain site specific circumstances and with written rationale and documentation approved by the QEP, proposed buffer sizes may be reduced in size or changed in shape from those described in Table 2. Such circumstances may include, but are not limited to:

1) Proposed activities adjacent to nest buffers are not considered highly disruptive or to cause significant disturbance to a nesting bird (e.g., no clearing or disruptive activities are required near the buffer area; work only involves moving crews, machinery or equipment past buffers with no stationary/proximal work intended; or no heavy machinery use is required adjacent to buffers).

2) A proposed mitigation plan or strategy is developed and implemented to minimize disturbance effects or impacts on a nesting bird (e.g., hand clearing is substituted for machine clearing; temporary physical barriers (i.e., landscape fabric curtains) are erected between proposed activities and the buffer zone thereby providing a visual and auditory shield; bird nesting behaviour is directly monitored by an onsite QEP during proposed activities and activities are immediately halted if a nesting bird is disturbed from the nest; or naturally occurring topographic features or vegetation structure provide sufficient buffering/shielding around the nest).

[3] Recommended buffer sizes were developed from a combination of sources including: buffer sizes recommended for similar proposed development projects (BC EAO 2014); recommended buffer sizes in *Guidelines for Raptor Conservation during Urban and Rural Land Development in British Columbia 2013* (BC MFLNRO 2013); Buffer Zone and Setback Distances Recommendations (Environment Canada 2014b); and *Develop With Care 2014: Environmental Guidelines for Urban and Rural Land Development in British Columbia* (BC MFLNRO 2014).
[4] For White-winged Crossbill nest area buffers, refer to sec. 3.2.7.3.

3) Timing and duration of the bird breeding season can vary across regions and among years (see discussion in sec. 2.0). Consequently, if the onsite QEP is able to confirm that a particular nesting period is off-set from the timing windows shown in Table 1, then the onsite biologist has the discretion to adjust the required nest survey methodology (i.e., survey cycles and effort, see sec. 3.2.7) and resultant least-risk timing and work windows. For example, if in a given year, peak songbird nesting is confirmed as ended by the middle of July (as opposed to 31 July in Table 1), then at that time the "critical" least-risk window can be shifted to "caution".

3.2.6 *Flagging Nest Buffers*

Active bird nest locations will be flagged using assigned coloured flagging tape. Fallers, foremen and inspectors will be made aware of what colour of flagging is used to delineate nest buffers. Flagging tape should be hung approximately 5 m from the nest to show generally where the nest is located. A waterproof, permanent marker should be used to indicate the direction, distance and height to the nest from the flagging, for any follow-up monitoring. The bird species standardized 4-letter code and a unique nest number (e.g., AMRO-21) should also be written directly on the flagging tape.

The appropriately sized nest buffer should also be clearly flagged with the assigned coloured flagging tape. In dense vegetation a solid barricade strip of flagging may be necessary to ensure its visibility. It is important that the buffer be visible from a distance so approaching clearing crews can plan their route.

After the birds are thought to have fledged the nest and buffer area will be re-searched using the same methods as described above prior to giving a 'free-to-clear' designation.

Inactive nests should also be inconspicuously flagged at dbh on the nest tree and labeled with date, nest number and status of nest. The flagging should not be visible for clearing crews, but only visible to bird surveyors for follow-up nest surveys.

3.2.7 Survey Cycle

During the Critical Nesting Period (see Table 1), **three complete nest surveys** (a full survey cycle) should be completed prior to clearing, during the Caution Nesting Period (see Table 1) **two complete nest surveys** (a full survey cycle), while for the Exceptions Nesting Period (see Table 1), one complete nest survey is sufficient for a full survey cycle. Refer to Table 3 for a summary of these methods.

Table 3: Summary of the bird nest survey methodology for the different nesting periods.

Nesting Period	Total # of Bird Surveys Required for a Full Cycle	Number of Days to Complete a Full Cycle	Number of Days that are 'Free to Clear' after a Full Cycle	Number of Days after the Last Survey Date where a Single Nest Survey will Commence a New 'Free to Clear' Period
Critical	3 Surveys	5 Days	3 Days	5 Days
Caution	2 Surveys	5 Days	3 Days	5 Days
Exceptions	1 Survey	1 Day	5 Days	6 Days

During the Critical and Caution Nesting Periods, a single survey is insufficient for identifying active nests, as nesting activity can easily be missed due to variables such as:

a) Timing of surveys related to the seasonal breeding cycle (e.g., incubating birds often sit tightly on the nest and will not readily be detectable, whereas birds feeding young will be much more noticeable); and
b) New breeding birds (i.e., individuals of the same or new species) are constantly showing up daily during the nesting season and as such, new nests could easily be missed with only a single survey.

However, during the Exceptions Nesting Period, a single survey is likely sufficient as there are very few bird species or individuals that typically nest during this period.

3.2.7.1 During the Critical Nesting Period

The full survey cycle (three nest surveys) should be performed within a maximum of 5 days. This will allow clearing to occur following the final survey for a 3-day period. If clearing does not occur within these 3 days, a single follow-up nest survey can be completed within 5 days from the last survey date, which would commence a new 3 day period where clearing is allowed. If no clearing has occurred within the 5 days of the last survey date of a full survey cycle, then a new full survey cycle (three nest surveys) should be initiated

Figure 1 provides a 14-day example overview of the survey and ‘free to clear’ cycles for this duration of time within the Critical Nesting Period.

Days	Day 1	Day 2	Day 3	Day 4	Day 5	Day 6	Day 7	Day 8	Day 9	Day 10	Day 11	Day 12	Day 13	Day 14
Bird Survey	Yes	No	Yes	No	Yes	No	No	No	No	Yes	No	No	No	No
	Bird Survey 1		Bird Survey 2		Bird Survey 3	Clearing Allowed	Clearing Allowed	Clearing Allowed	No Clearing Allowed	No Clearing Allowed and Last Day*	Clearing Allowed	Clearing Allowed	Clearing Allowed	No Clearing Allowed
	3 Surveys Completed within a 5 Day Full Cycle					Free to Clear for 3 Days					Free to Clear for 3 Days			

* Last day to complete a single bird survey to commence a new 3 day 'Free to Clear' period. If no survey occurs on this day, then a new '3 Surveys Completed within a 5 day Full Cycle' would be required prior to any clearing.

Figure 1: An example of how the bird nest survey methodology would work during the Critical Nesting Period.

3.2.7.2 During the Caution Nesting Period

The full survey cycle (two nest surveys) should be performed within a maximum of a 5 day period and will allow clearing to occur following the final survey for a 3 day period. If clearing does not occur within these 3 days, a follow-up nest survey can be completed within 5 days from the last survey date, which would commence a new 3 day period where clearing is allowed. If no clearing has occurred within the 5 days of the last survey date of a full survey cycle, then a new full survey cycle (two nest surveys) should be initiated. If the onsite QEP determines that breeding activity is advancing early, then they should implement the Critical Nesting Period survey methodology during the Caution Nesting Period.

3.2.7.3 During the Exceptions Nesting Period

The Exceptions Nesting Period survey methodology is typically employed at times of year when very few bird species are expected to be breeding. Due to the highly variable nature of bird nesting behavior at this time, overall and species specific methods have been designed to minimize risk of non-compliance with the *BC Wildlife Act*, *MBCA* and *SARA.*

Application of the Exceptions Nesting Period Methodology: No breeding activity expected

For time periods (generally September 1 to February 15) when the QEP determines that bird breeding activity is unlikely, then no formal surveys will be conducted and "free to clear" status can be implemented until breeding evidence is detected. These determinations should also be habitat specific (example: aspen forest is "free to clear", but proposed clearing in spruce stands and bogs require a survey). <u>Breeding assessments should be conducted semi-regularly in areas scheduled for clearing; the frequency of surveys during the Exceptions Period will be dependent on observations of local bird breeding activity and the type of habitat (e.g., spruce vs. aspen) slated for clearing</u>. Breeding assessments will consist of a walk-through of different habitat types, looking specifically for breeding activity of target species. If no breeding evidence is detected then a "free to clear" status can continue. If breeding evidence is found, then species-specific survey methods will be implemented as described below.

Application of the Exceptions Nesting Period Methodology: Late breeding activity expected or detected

During August and occasionally extending into September, several species of songbirds frequently exhibit breeding behavior, including nest building, egg laying and the successful fledgling of young. Nest sites are typically distributed widely over the landscape, but can usually be detected relatively easily. Therefore, once the Caution Nest Period is over as determined by the QEP, the following can be implemented for the Exceptions Period, <u>generally expected until August 31</u>.

Assessments will consist of a single nest survey that will allow clearing to occur following the survey for a 5 day period. If clearing does not occur within these 5 days, then a new nest survey should be completed which would commence a new 5 day period where clearing is allowed. This process should generally be followed until August 31 unless local breeding chronology and species observations suggest otherwise.

Application of the Exceptions Nesting Period Methodology: Early breeding activity expected

For several species such as Gray Jays, ravens and some owls (e.g., Great Horned Owl, Gray Gray Owl), nesting activity may commence in mid-late February. White-winged Crossbills begin nesting in response to the availability of ripening cone crops, and can potentially nest at any time of year. Species-specific survey methodology will be implemented as determined by the onsite QEP. If the QEP determines that breeding activity is advancing early, then in this circumstance the Caution Nesting Period survey methodology could be implemented sooner.

Species-specific Survey Methodology during the Exceptions Nesting Period

White-winged Crossbill

In years of heavy spruce cone crops (as in 2015), White-winged Crossbills are expected to be breeding as early as late August or September, continuing until spruce seed (their main food source) availability becomes limited. The species nests almost exclusively in mixed-wood or spruce dominant stands. When it is determined by the onsite QEP that crossbills are widespread and settling in spruce areas, then a general walk-through survey of areas scheduled to be cleared over the subsequent two months should be conducted. Surveyors will note the locations of mixed-wood and spruce stands where crossbills are occurring, documenting numbers of birds and breeding evidence (e.g., persistent singing, nest building, courtship). Locations that are being actively used for feeding should then be visited again within a week to re-assess the breeding status. If a spruce stand is occupied and breeding activity is continuing, then a polygonal buffer should be established that encompasses the majority of spruce trees within a 50 m radius of the suspected nest area. White-winged Crossbills are at times semi-colonial nesters with several pairs potentially utilizing even a small spruce stand, and are somewhat reliant on the cone crop immediately surrounding the nest tree for feeding their young. Such sites should then be monitored on a schedule determined by the QEP, considering breeding phenology and the timing of proposed clearing operations. Once sufficient evidence is found to declare active nesting, then monitoring should continue until evidence of breeding activity has ceased.

3.2.8 Active Nest Reassessments

Once a nest is designated active, **additional survey time should be spent near the nest to document the change in status from active to inactive**. Based on the species biology and the stage of the nesting cycle, the onsite QEP should determine the timing and amount of effort required. Generally, to ensure that sufficient time has passed to allow for completion of nesting activities, a minimum of 5 days should elapse prior to initiating a reassessment of the nest (day one begins on the day following the last survey). Typically, most songbirds require 25-35 days from when eggs are laid in the nest until the nestlings have subsequently fledged from the nest.

Upon approaching the nest site, if the nest is obviously active, the surveyor should document such activity and leave the site. Otherwise, two one-hour watches should be conducted on two separate days (e.g., one 1-hr watch per day for 2 days) for a nest to be properly reassessed. The timing of nest reassessments should be chosen based on the likelihood of observing birds at the nest. If a nest is well-concealed and/or high enough in a tree that an incubating/brooding adult might not be observed, a third one hour nest watch will be conducted; this can be completed later on during the same day as the second survey.

Care should be taken to ensure that the presence of the observer does not deter birds from returning to the nest. Surveys should be conducted from an unobtrusive position, as far away from the nest as possible. Observers should use topographic features and vegetation to conceal their position. If a bird is observed spending time nearby but does not approach the nest, is carrying food and does not approach the nest, or is showing signs of distress (e.g., alarm calls, distraction/decoy behaviors), the survey should be halted and started again the following day from a different location.

An active nest status may be changed to inactive if, upon completing the appropriate number of nest watches described above, no adult, nestling or fledgling activity is observed associated with the nest or buffer habitat. As a final verification of inactivity, the nest can be approached, inspected and documented for nest damage, signs of abandonment, or successful fledging. **Clearing of nest buffers may occur upon confirmation from the onsite QEP that the status of the nest has changed to inactive. This confirmation will be provided in writing prior to commencement of clearing**.

During reassessment surveys, if any bird behaviour is observed that indicates the nest is still active, then the nest will retain its active designation and further nest reassessments should be halted to minimize disturbance. The no-clearing nest buffer shall remain in place until the nest is determined to be inactive by the onsite QEP. A subsequent nest reassessment may be conducted 5 days after the last reassessment survey date.

All active nests for which the status has changed to inactive should be reassessed at least 3 days prior to clearing as a matter of due diligence. Many bird species have multiple broods during the nesting season and may reuse the same nest again during the same breeding season. As a result, an active nest that has been reassessed as inactive may be reused later on in the nesting season by the same adult pair for another nesting attempt.

Active nests that are expected to remain active beyond the Critical and Caution Nesting Periods are still subject to the prohibitions of the *Wildlife Act* and the *MBCA*. Therefore, if a nest is discovered that remains active beyond either nesting period, an onsite QEP will need to reassess the nest to verify its inactive status prior to any clearing work.

Prepared by:
Todd Manning (RPBio., RPF), Michael Shepard (RPBio.) and Paul Chytyk
Strategic Resource Solutions (SRS)
Victoria, B.C.

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Appendix B. Pre-clearing nest survey reports

Site C – Pre-clearing nest survey summary reports: Aug-October 2015

(South Bank)

- 28-31 August 2015 report (S. bank)
- 17 September 2015 report (S. bank)
- 21-22 October 2015 report (S. bank)

White-winged Crossbill Nesting Assessments for Proposed BC Hydro's Site C Construction Area (August 28-31, 2015)

Prepared by:

Todd Manning (RPBio., RPF) and Paul Chytyk
Strategic Resource Solutions (SRS)
Victoria, BC

Prepared for:

Bill Golding
Silvicon Services Inc.
Smithers, BC

4 September, 2015

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Report Body: Paul Chytyk

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Introduction

The BC Hydro Site C Dam is entering the initial clearing and construction phase of the project and will require areas of native vegetation to be cleared for project infrastructure, access and transmission corridors. Most clearing on the proposed Site C site will occur during the bird non-nesting season (fall and winter months) to avoid disturbance to active bird nests. However, White-winged Crossbills (*Loxia leucoptera*) (hereafter referred to as crossbills) have a peculiar breeding biology where they can nest at any time of the year if conditions are suitable.

Crossbills are widespread in the sub-boreal spruce region, which includes the Site C Dam and reservoir area. Crossbills typically arrive in areas containing white spruce (*Picea glauca*) stands in late May through July, as new cones are forming, and breed if the crop is strong (Benkman 2012). The main breeding season for crossbills is thought to occur from early July through late November. Crossbills remain in an area as long as the food source allows, switching to black spruce (*Picea mariana*) seeds after white spruce seeds have fallen in the late fall. However, nesting can continue throughout the winter and has been documented in the Yukon in mid-January (Sinclair et. al. 2003). There are only limited breeding records for British Columbia, occurring in March and May. Consequently, the nesting period and breeding distribution for the province is considered somewhat of an enigma (Campbell et al. 2001).

To determine if crossbills were breeding within proposed Site C areas to be cleared, nesting assessments for the species were conducted in stands containing mature spruce, their preferred nesting habitat. Assessments were conducted in order to identify areas used by crossbills and determine their breeding chronology. If active nesting was suspected, protective buffers would be established to ensure nest areas would not be disturbed by clearing activities. **The following report summarizes the findings of these assessments for the period August 28-31, 2015**.

Study Area

The study area covers two separate survey areas: one on the north bank and one on the south bank of the Peace River. The survey area along the north bank of the Peace River is north of the proposed Site C Dam site, and approximately 5 km southwest of Fort St. John. This survey area is centered around the proposed accommodation polygon where worker temporary housing for the project is to be constructed. The other survey area is on the south bank of the Peace River, south of the proposed Site C Dam site, and approximately 8 km southwest of Fort St. John. This survey area consists of several polygons scheduled to be cleared for accessing aggregate deposits used for dam construction.

In general, both survey areas are dominated by young and mature trembling aspen (*Populus tremuloides*) stands with a few mature mixedwood stands. The main areas of mixedwood occur in riparian areas alongshore of the Peace River and smaller tributaries, as well as in upland areas where suitable growing sites for spruce exist. Most mixedwood stands are aspen or black cottonwood *(P. balsamifera*) dominant; however, some areas along the Peace River are coniferous dominant where spruce can attain >90% canopy cover.

Methods

Qualified Environmental Professionals (Strategic Resource Solutions (SRS) bird biologists) conducted nesting assessments for crossbills in the study area 28-31 August 2015. To guide assessments, areas proposed to be cleared between September and November 2015 on both the north and south banks were identified. Then within these areas, a GIS-generated map created by Silvicon (Smithers, BC) identified forest polygons containing spruce. Forest polygons were categorized by spruce (either white or black) canopy cover using increments of 25%. Surveyors assessed these spruce polygons for suitable crossbill nesting habitat and any evidence of current nesting behaviour.

Suitable crossbill nesting habitat was assessed by identifying forested areas that were characterized by what is thought to be preferred crossbill nesting habitat, i.e., mature mixedwood stands with spruce as a leading canopy tree species and >50% canopy cover. Stands with emergent spruce that were significantly higher than the main aspen canopy were thought to be less suitable nesting habitat due to cone crops and potential nesting locations in the upper portions of the spruce trees being more exposed to unfavourable weather conditions and potential nest predation.

Additionally, abundance of spruce cones (the primary food source for crossbills), was assessed for each forest stand. Cone crops were classified using a 7-category rating scheme developed by BC Ministry of Forests (1992, see Appendix A, section outlined in red). This rating scheme classifies cone crops based on how many cones are present on a particular percentage of the mature spruce trees within the assessed stand. Cone crop ratings varied from Nil to Very Light to Very Heavy.

Each assessed forested area was then given an overall rating for crossbill nesting potential using a 4-category rating system (High, Moderate, Low and Nil). Ratings were determined by combining the cone crop rating with the nesting habitat quality observed in the stand. The higher this rating, the higher the potential of the forested stand to be used for nesting by crossbills.

Crossbill observations were also documented to provide an indication of the nesting chronology of the species for the study area. UTMs were collected for each crossbill observation and were categorized as: flyover, perched, calling, foraging, singing, courtship behaviour, adult returning/remaining at same location, adults carrying nest material, persistent alarm calls and agitated behaviour, young heard from nest, or fledglings observed.

Results

All polygons in the North and South Bank survey areas identified by GIS as having some spruce component in the main forest canopy were assessed by surveyors. Most polygons were assessed as having either Nil or Low potential for crossbill nesting since ground-truthing of these polygons found that spruce consisted of <10% canopy cover; as such these were not considered suitable crossbill nesting habitat.

Two areas were rated as High potential for crossbill nesting on the South Bank: an 8.8 ha area on a riparian island in the Peace River and a 9.5 ha area on the first bench up from the shore of the river

(Figure). A 5.5 ha area of Moderate potential for crossbill nesting was identified on the same riparian island as the High potential polygon. No High or Moderate potential crossbill nesting polygons were identified on the North Bank (Figure).

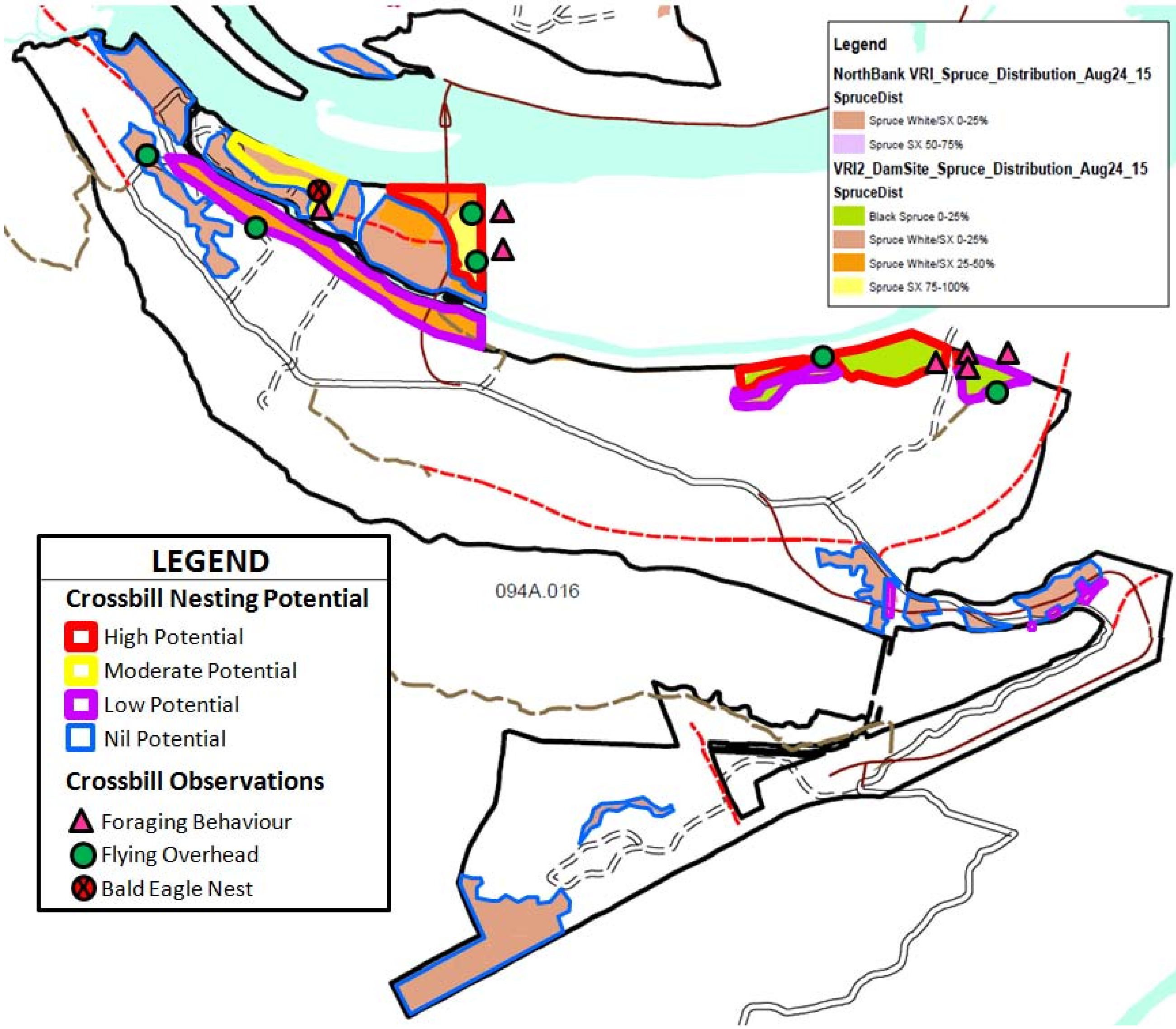

Figure 1: White-winged Crossbill nesting potential polygons for the South Bank at the BC Hydro Site C.

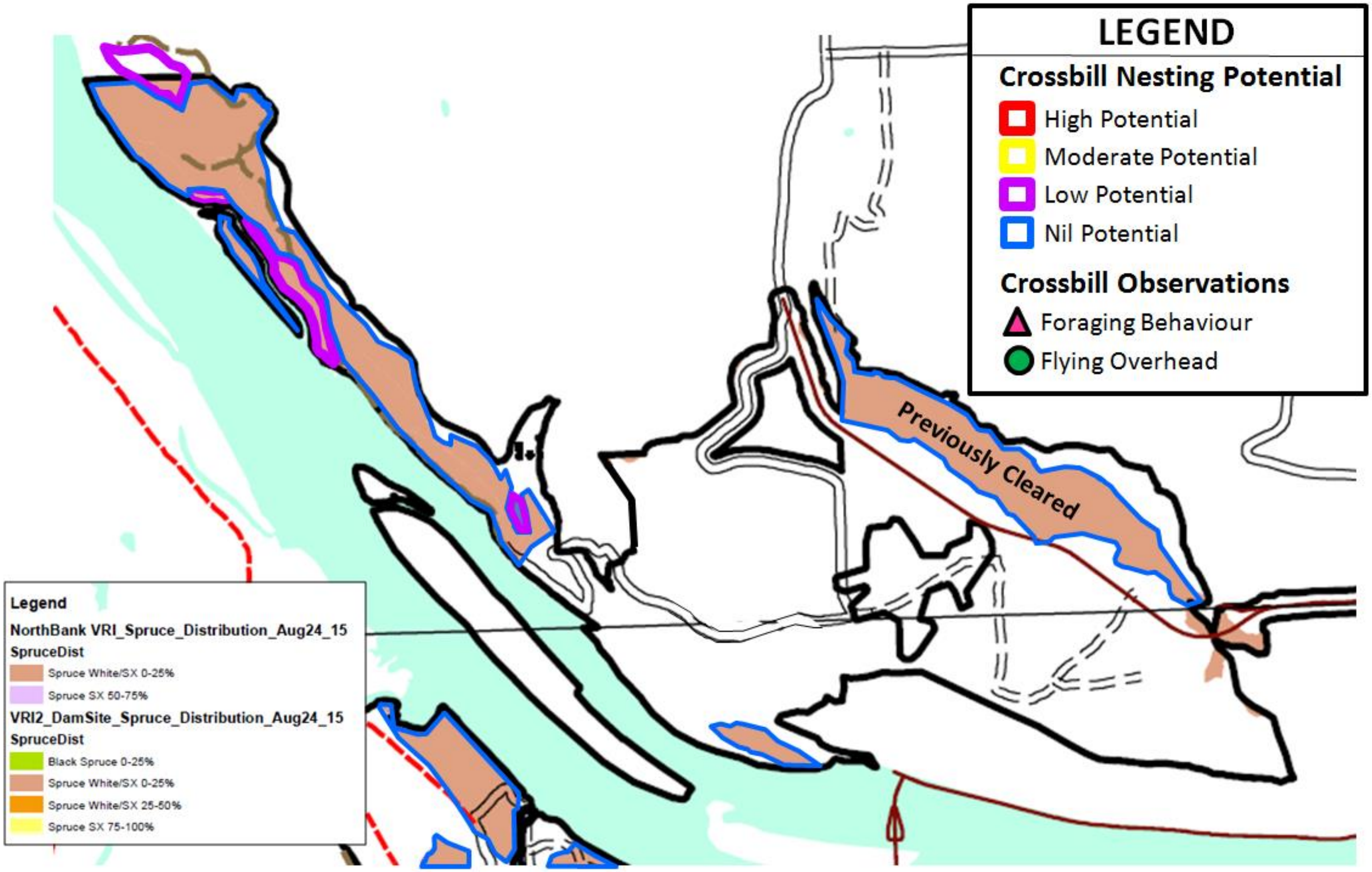

Figure 2: White-winged Crossbill nesting potential polygons for the North Bank at the BC Hydro Site C.

Fifteen observations of crossbills (Table) in 13 distinct observation locations (Figure and Figure) were documented in the study area; all observations occurred on the South Bank. Observations consisted of flyover, foraging, perched and calling behaviour. Spruce trees with heavy cone crops were preferred trees that crossbills selected for foraging (Figure). Up to 136-142 crossbills were observed in the study area, but it is difficult to know how many of these were double-counted due to the habit of crossbills flying back and forth while foraging. No nesting behaviour or evidence of nesting for crossbills was observed in the study area.

Table 1: Crossbill observations from 28-31 August 2015 at the BC Hydro Site C.

Date	# of Birds	Easting	Northing	Behaviour Observed
28 Aug	1	630597	6229138	Flyover, calling
28 Aug	2	630693	6229134	Perched, foraging, calling
28 Aug	4	630687	6228887	Perched, foraging, calling
28 Aug	35-40	630627	6228839	Flyover, calling
28 Aug	5	629866	6229225	Perched, calling
28 Aug	2	629553	6229345	Flyover, calling
29 Aug	5	633059	6228199	Perched, calling
29 Aug	24	632896	6228373	Perched, foraging, calling
29 Aug	5	633079	6228367	Perched, foraging, calling
29 Aug	3	632693	6228351	Flyover, calling
29 Aug	12	633186	6228424	Perched, foraging, calling
29 Aug	6	632997	6228455	Perched, calling
29 Aug	4	632310	6228429	Flyover, calling
30 Aug	24	628963	6229445	Flyover, calling
30 Aug	4	629516	6229101	Flyover, calling

One flock of 20 Red Crossbills (*L. curvirostra*) was also observed on the south bank; it is unclear whether this species breeds in the study area or if it is just a transient forager.

Figure 3: Crossbills appeared to favour white spruce with heavy cone crops for foraging. A flock of up to 20 Red Crossbills (white circles) were feeding at the top of this tree.

Most forest stands assessed had Medium to Heavy cone crops (see Appendix A for rating scheme). In general, these stands had fairly uniform numbers of cones in the individual trees (Figure); however, some stands were patchy, with some trees having heavy cone crops while others nearby had few or no cone crops (Figure). The abundant cone crop observed in 2015 in the Site C area appears to have attracted a fair number of crossbills to the study area. Crossbills began to arrive in the study area in late July (SRS 2015), a time when the cone crop was still green. The cone crop during the current assessment period of late August was mostly ripe, which is typically optimal for crossbill breeding.

Figure 4: Most stands of white spruce had fairly uniform number of heavy cones across individual trees.

Figure 5: White spruce on the South Bank: trees on the right had a heavy cone crop while trees on the left had few to no cones.

Other Observations

The federally listed (Threatened) and provincially blue-listed species (BC CDC 2015) Canada Warbler was also observed in the study area. A male was observed in a mixed flock of warblers at UTM 10U/632428E/6227406N. A Broad-winged Hawk, a provincially blue-listed species (BC CDC 2015) was observed perched at the edge of an aspen stand at UTM 10U/633059E/6228199N.

A Bald Eagle nest was located on the riparian island on the South Bank at UTM 10U/629866E/6229225N. This nest was active during the summer 2015 as evident from the abundant whitewash at the base of the nest tree. Another Bald Eagle nest was located on Eagle Nest Recreational Site Island, approximately 7 km further upstream along the Peace River at UTM 10U/624747E/6233480N. It is unknown if this nest was active in 2015.

Discussion and Recommendations

Assessments found no indication or evidence of current crossbill nesting in the study area. Crossbills were observed in the study area but only appeared to be foraging from stand to stand. No territorial or nesting behaviour was observed. As such, at this time, no buffers are required to protect any potential crossbill nest areas.

1) All areas delineated within the black outlined polygons of Figure and Figure have a free-to-clear status until approximately mid-February, except for the 3 polygons identified as Moderate or High crossbill nesting potential (indicated by the red-coloured polygons in Figure).

2) For the red-coloured polygons (Figure), another crossbill nesting assessment should be completed one week prior of any planned clearing of these areas in order to determine if any crossbill nesting activity is present within the polygons.

3) Bird survey crews should be provided with information regarding any new proposed areas to be cleared in upcoming months that are outside of the black outlined polygons of Figure and Figure and which contain spruce stands, so these new areas may be assessed for potential crossbill nesting activity.

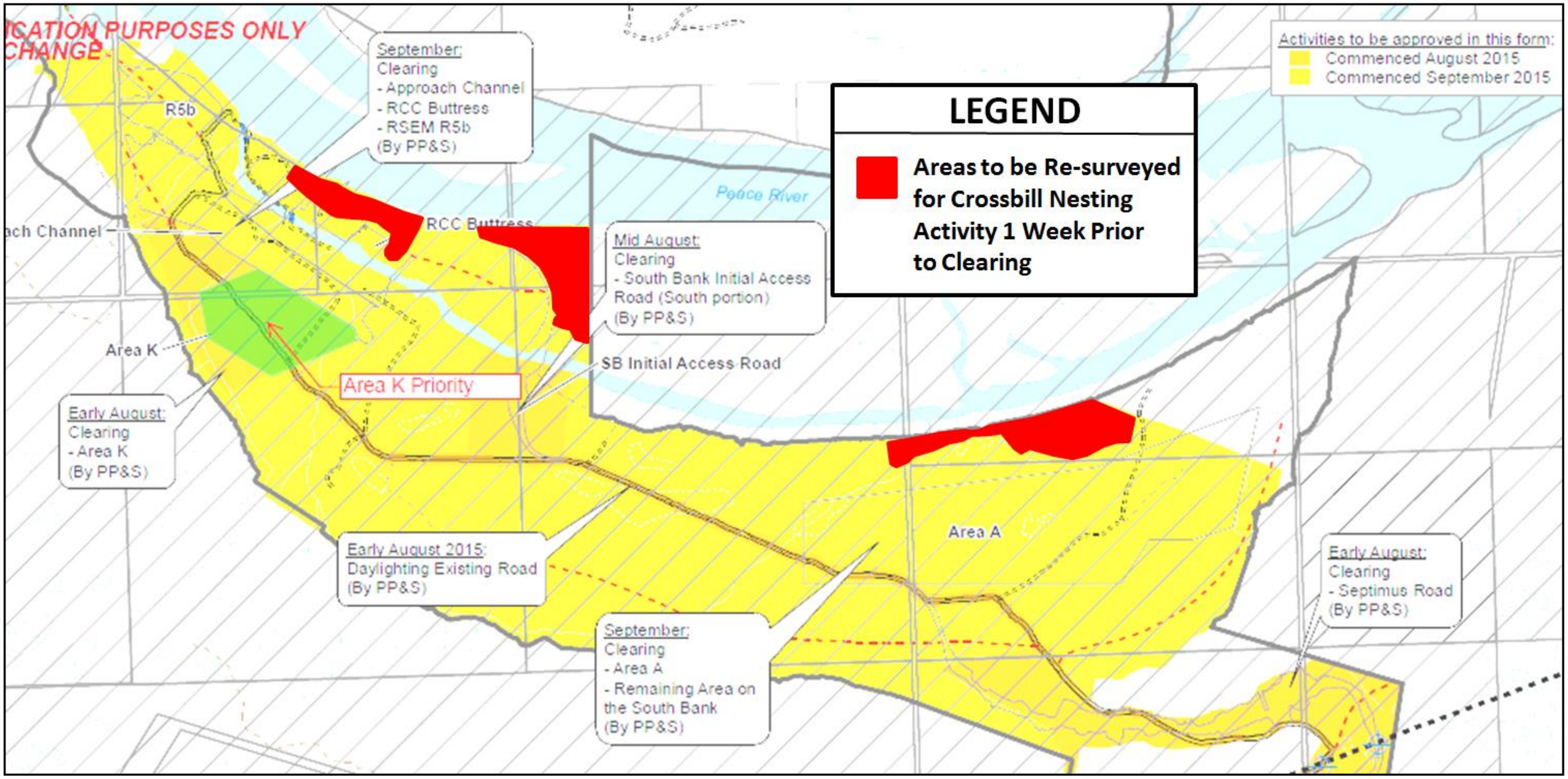

Figure 6: Areas on the South Bank at the BC Hydro Site C recommended to be re-surveyed for White-winged Crossbill nesting activity one week prior to clearing

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Appendix A: Cone crop rating scheme used for assessing cone crops at BC Hydro Site C.

Province of British Columbia | Ministry of Forests

CONE AND SEED CROP 19____

VCL (Lot)	REGION	DISTRICT	SPECIES (one)
TENURE	CP	BLOCK	SEED ZONE
LICENSEE		PSYU / TSA	ELEVATION (m)
PRIVATE (owner)		NAT. TOPO. / UTM GRID	STAND AGE
OTHER	LOCATION		ASSOCIATED SPECIES
BIOGEOCLIMATIC SUBZONE		FOREST ECOSYSTEM TYPE	

NUMERICAL CONE CROP RATING (one species)

(RATE ONLY DOMINANT AND CO-DOMINANT TREES OF CONE-BEARING AGE)

DESCRIPTION OF CONES OBSERVED	CROP IS	CIRCLE RATING
No cones on any trees	Nil	1
Few cones on < 25% of trees	Very light	2
Few cones on > 25% of trees	Light	3
Many cones on < 25% of trees	Light	4
Many cones on 25 - 50% of trees	Medium	5
Many cones on > 50% of trees	Heavy	6
Many cones on almost all trees	Very heavy	7

Average volume of cones / tree ______ (hl) x est. number of collectible trees / ha ________

x Area of stand ______ (ha) = a potential crop of _______ hectolitres.

DATE (Y M D)	RATED BY	POSITION

When numerical rating has been completed, detach this sheet only and forward it to the Regional Manager, attention: Silviculture, to arrive not later than July 30.

A REMINDER: Cone Crop Ratings provide information for:
1) making cone collecting plans (short-term);
2) history of cone crop periodicity (long-term).

Reports on "Nil" crops are, therefore, just as significant as reports on "Heavy" crops in any year.

FS 727 HSP 92/11 **DISTRIBUTION: WHITE & CANARY** - REGIONAL MANAGER, SILVICULTURE; **PINK** - ORIGINATOR

Strategic Resource Solutions (SRS)
5148 William Head Rd.
Victoria, BC. V9C4H5
Ph. (250) 478-7822

To: Paul Veltmeyer (RPF)
Vegetation Project Manager
BC Hydro, Site C Clean Energy Project

Sept. 22, 2015

RE: White-winged Crossbill Nesting Assessments (17 September 2015)

Dear Mr. Veltmeyer

White-winged Crossbill (*Loxia leucoptera*) (hereafter referred to as crossbill) nesting assessments were previously conducted between 28 and 31 August 2015 in identified forest polygons containing spruce on the north and south banks of the BC Hydro Site C Dam construction area (SRS 2015a). These assessments identified 3 forest polygons (Figure) on the south bank that contained moderate or high quality crossbill nesting habitat (Figure). Assessments recommended these polygons be re-assessed for any crossbill nesting activity one week prior to any clearing.

++++++++++++++++++++++++

Figure 1: Areas of white spruce and mixedwood stands were considered moderate or high quality crossbill nesting habitat.

Follow-up crossbill nesting assessments were subsequently conducted on 17 September 2015 by a Qualified Environmental Professional (Strategic Resource Solutions (SRS) bird biologist) and crew prior to planned clearing dates. All crossbill nest assessments followed survey methodologies specifically developed for BC Hydro for the Site C Dam project (SRS 2015b).

Assessments conducted on 17 September 2015 found little crossbill activity in the three identified forest polygons. A total of three crossbill observations were recorded within the vicinity of polygons 1 and 2 on the Peace River island; no crossbills were observed near polygon 3 on the Peace River uplands (Table and Figure). Observations consisted of foraging birds with limited vocalizations. No singing birds were detected, and there were no observations that would suggest current breeding or nesting behavior. All crossbill observations were associated with white spruce (*Picea glauca*) areas that had heavy cone crops (Figure).

Table 1: White-winged Crossbill observations on 17 September 2015 at the BC Hydro Site C.

Obs #	# of Birds	Easting*	Northing*	General Location	Behaviour Observed
1	12	629880	6229151	Polygon 1	Perched, foraging, calling
2	2	630786	6229144	East of Polygon 2	Perched, foraging, calling
3	20	630214	6228816	South of Polygon 2	Perched, foraging, calling

* UTM Zone 10.

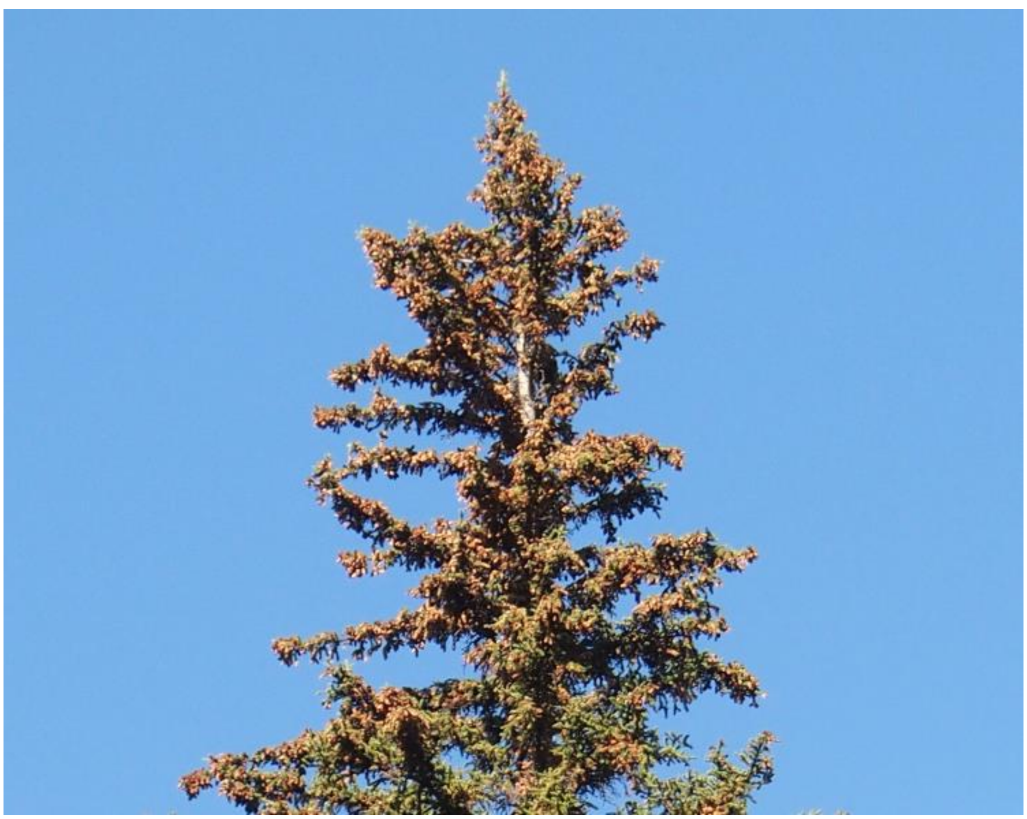

Figure 2: Cone crops on white spruce, crossbills' primary food source, were mostly heavy throughout the stands surveyed.

Conclusions

Assessments found no indication or evidence of current crossbill nesting in the areas surveyed. Crossbills were observed but only appeared to be foraging from stand to stand. No territorial or nesting behavior was observed. As such, at this time, no buffers are required to protect any potential crossbill nest areas within the 3 identified polygons shown in Figure 3.

Please don't hesitate to contact me directly if you have any questions about the above information.

Sincerely,

Todd Manning (RPBio., RPF)
Strategic Resource Solutions (SRS)

Literature Cited

Strategic Resource Solutions (SRS). 2015a. Protocol to determine the presence of active bird nests + exceptions period addendum. Unpubl. rep. prepared by Strategic Resource Solutions, Victoria, BC for BC Hydro, Burnaby, BC. Feb. 4, 2015. 12 pp.

Strategic Resource Solutions (SRS). 2015b. White-winged Crossbill nesting assessments for proposed BC Hydro's Site C construction area (August 28-31, 2015). Unpubl. rep. prepared by Strategic Resource Solutions, Victoria, BC for Silvicon Services Inc., Smithers, BC. September 4, 2015. 11 pp.

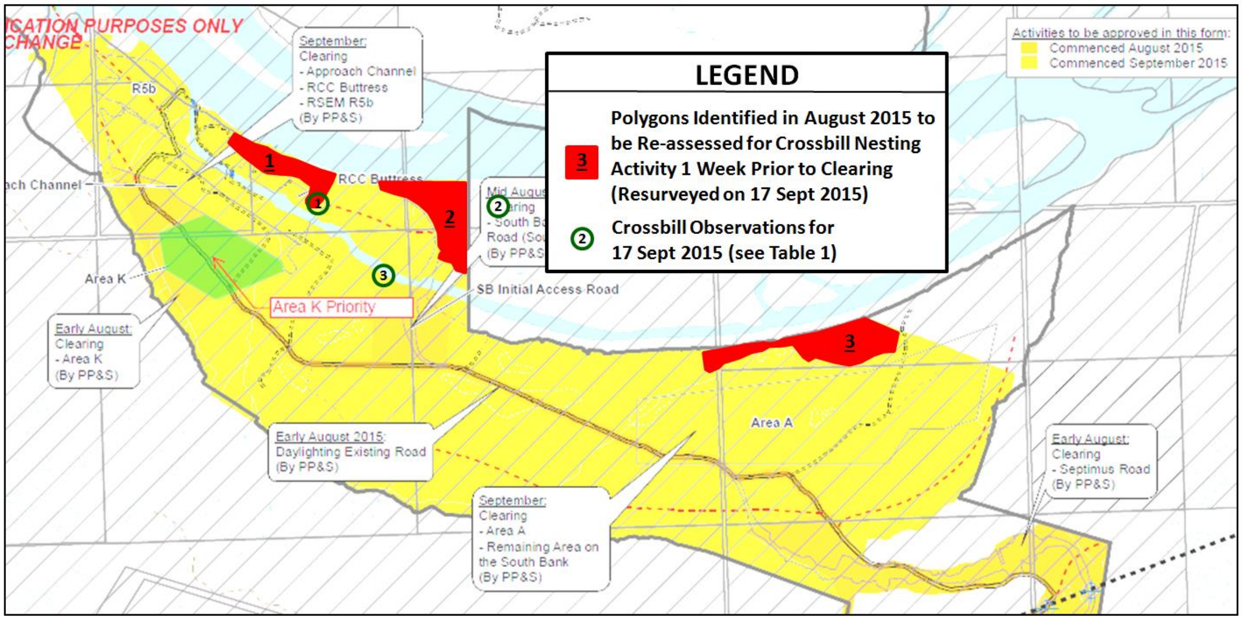

Figure 3: Surveyed areas on the South Bank at the BC Hydro Site C and White-winged Crossbill observations for 17 September 2015.

White-winged Crossbill Nesting Assessments for BC Hydro's Site C Reservoir Area (October 21-22, 2015)

Prepared by:

Michael G. Shepard (RPBio.) and Todd Manning (RPBio., RPF)
Strategic Resource Solutions (SRS)
Victoria, BC

Prepared for:

Bill Golding
Silvicon Services Inc.
Smithers, BC

26 October, 2015

Introduction

Assessments of White-winged Crossbill (*Loxia leucoptera*) habitat and breeding activity in the vicinity of the BC Hydro Site C Dam and lower reservoir area were conducted in late August 2015 (SRS 2015). These assessments were concentrated in spruce and mixed spruce stands, and in the vicinity of the dam construction site and upland areas that were being cleared for aggregate extraction. In late October 2015 further assessments were conducted on the South Bank between the Moberly River and Eagle Island in areas scheduled for clearing in the later fall and early winter 2015-2016.

This report summarizes the findings of these assessments for the period October 21-22, 2015.

Survey Area

The area surveyed was along the south bank of the Peace River, from near the confluence of the Moberly River, northwestward to approximately the west end of Eagle Island. Areas covered were primarily within the proposed reservoir footprint. These areas are scheduled for clearing from late October 2015 through the end of March 2016.

The area is composed of a mosaic of hardwood, mixwood and coniferous stands, with highly variable species and age class compositions. The dominant hardwood species are trembling aspen (*Populus tremuloides*), black cottonwood *(P. balsamifera*) and paper birch (*Betula papyifera*). In some areas, spruce (primarily white spruce *Picea glauca*) is dominant, attaining >80% canopy cover in some locations.

Methods

Qualified Environmental Professionals (Strategic Resource Solutions (SRS) bird biologists) conducted nesting assessments for crossbills in the study area on 21-22 October 2015. To guide assessments, areas proposed to be cleared between October 2015 and March 2016 were first identified. Within these areas, a forest cover map (VRI derived) produced by Silvicon Services Inc. (Smithers, BC) further identified forest polygons containing spruce, labelling them according to the proportion (%) of spruce composition (e.g., Sw20). SRS Surveyors assessed these spruce polygons for suitable crossbill nesting habitat and any evidence of current nesting/breeding behaviour. Spruce stands on Eagle Island were assessed for crossbill nesting habitat on 29 August 2015, and are mapped in the current report.

Suitable crossbill nesting habitat was assessed by identifying forested areas that were characterized by what is thought to be preferred crossbill nesting habitat, i.e., <u>mature mixedwood stands with spruce as a leading canopy tree species with >50% canopy cover</u>.

Additionally, abundance of spruce cones (the primary food source for crossbills), was assessed for each forest stand. Cone crops were classified using a 7-category rating scheme developed by BC Ministry of Forests (1992, Form FS 727HSP92/11).

Each assessed forested area was then given an overall rating for crossbill nesting potential using a 4-category rating system (High, Moderate, Low and Nil). Ratings were determined by combining the cone crop rating with the nesting habitat quality observed in the stand. **The higher this rating, the higher the potential of the forested stand to be used for nesting by crossbills**.

Crossbill observations were also documented to provide an indication of the nesting chronology of this species for the study area. UTMs were collected for each crossbill observation and were categorized as: flyover, perched, calling, foraging, singing, courtship behaviour, adult returning/remaining at same location, adults carrying nest material, persistent alarm calls and agitated behaviour, young heard from nest, or fledglings observed.

Results

Polygons in the survey area scheduled for clearing, identified by GIS as having some spruce component in the main forest canopy, were assessed by SRS surveyors on Oct. 21-22, 2015. Most polygons were assessed as having either Nil or Low potential for crossbill nesting since ground-truthing of these polygons found that spruce consisted of <10% canopy cover, or had poor or sparsely distributed cone crops. Consequently such stands were not considered suitable crossbill nesting habitat.

None of the areas surveyed were rated as high potential for crossbill nesting. Four areas were identified as having <u>moderate potential</u> (Figure 1).

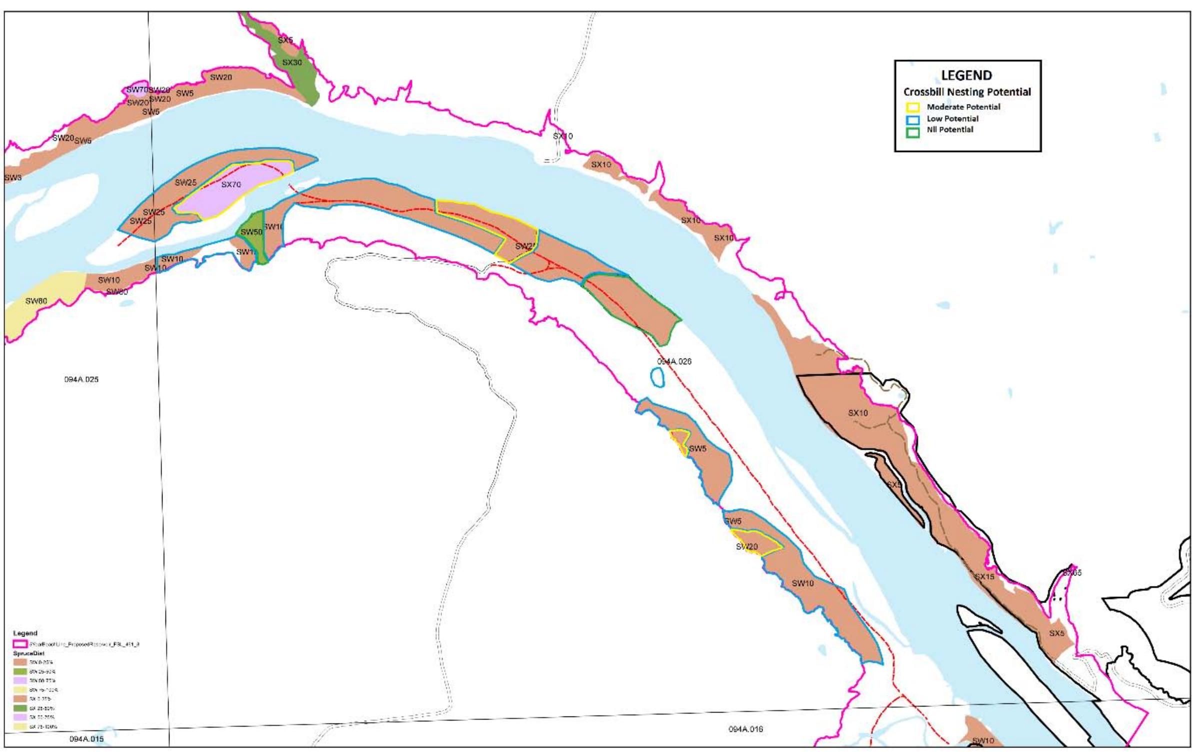

Figure 1: White-winged Crossbill nesting potential polygons for the South Bank between the Moberly River and Eagle Island at the BC Hydro Site C.

Seven observations of crossbills (Table) were documented in the study area on Oct. 21-22, 2015. Observations consisted of flyover, foraging, perched and calling behaviour. **No nesting behaviour or evidence of nesting for crossbills was observed in the study area**.

Table 1: Crossbill observations from 21-22 October 2015 at the BC Hydro Site C.

Date	# of Birds	Easting	Northing	Behaviour Observed
21 Oct	1	627353	6231057	Perched, calling
21 Oct	2	627333	6231299	Flyover, calling
21 Oct	2	627107	6231733	Flyover, calling
21 Oct	1	627014	6231768	Perched, foraging
21 Oct	4	626156	6232956	Perched, foraging, calling
21 Oct	1	625928	6232991	Flyover, calling
21 Oct	2	625435	6233124	Perched, foraging, calling

Most forest stands assessed had Light to Medium cone crops, generally in patchy/clumped distribution. The stage of cone ripeness was variable, but it appears that many trees had already shed their seeds. This suggests that optimal breeding conditions for crossbills has passed for the 2015-2016 fall and winter season.

Discussion and Recommendations

Field assessments found no indication or evidence of current crossbill nesting in the study area. Crossbills were observed in the study area but only appeared to be foraging or flying from stand to stand. No territorial or nesting behaviour was observed. As such, **at this time, no buffers are required to protect any potential crossbill nest areas**.

1) Related to crossbill activity, all areas surveyed (Figure 1) have a free-to-clear status until approximately mid-February 2016. NOTE: Areas not cleared by mid-February 2016 should be surveyed for early nesting bird species such as owls and jays.

2) Bird survey crews should be provided with information regarding any new proposed areas to be cleared in upcoming months that have not been previously assessed for crossbill habitat suitability and breeding behaviour (i.e., spruce dominant stands).

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Strategic Resource Solutions (SRS). 2015. White-winged Crossbill nesting assessments for proposed BC Hydro's Site C construction area (August 28-31, 2015). Unpubl. rep. prepared by Strategic Resource Solutions, Victoria, BC for Silvicon Services Inc., Smithers, BC. September 4, 2015. 11 pp.

Site C – Pre-clearing nest survey summary reports: June-Aug. 2015

(North Bank, South Bank)

- 17-19 June 2015 report (N. bank)
- 6-10 July 2015 report (N. bank)
- 21-24 July 2015 report (N. bank)
- 28 July-5 August 2015 report (N. bank, S. bank)
- 6-20 August 2015 report (N. bank, S. bank)

Preliminary
Pre-clearing Bird Nest Surveys for Proposed BC Hydro's Site C Construction Area
(June 17-19, 2015)

Prepared by:

Todd Manning (RPBio., RPF) and Paul Chytyk
Strategic Resource Solutions (SRS)
Victoria, BC

Prepared for:

Bill Golding
Silvicon Services Inc.
Smithers, BC

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Introduction

The proposed BC Hydro Site C Dam is entering the initial clearing and construction phase of the project and will require areas of native vegetation to be cleared for project infrastructure, access and transmission corridors. Although most clearing on the proposed Site C site will occur during the bird non-nesting season (fall and winter months), some areas may require clearing during the bird breeding/nesting season. Initial clearing may begin as early as the 2015 nesting season (July-August 2015). The British Columbia *Wildlife Act* (Section 34) (Province of BC 1996) and the federal *Migratory Birds Convention Act* (*MBCA*) (Section 6) (Government of Canada 1994) provide legislation that prohibits the disturbance or destruction of a nesting bird, its nest, or eggs.

The Canadian Wildlife Service (CWS) Pacific Yukon region provides advice on compliance with the *MBCA* in order to minimize effects of vegetation clearing during the migratory bird breeding season and thereby avoid incidental take[1] (Environment Canada 2014). Although clearing has not yet begun for the proposed Site C, BC Hydro requested preliminary pre-clearing bird nest surveys to be initiated to:

1) field test nest survey methodology (SRS 2015);
2) determine the locations, extent and approximate relative abundance of nesting birds in areas proposed to be cleared. This will be based on a combination of observations of actual active nests, probable nest sites, and habitat suitability (quality) for those species occurring at these areas; and
3) based on #2, determine the possible risk of any incidental take associated with different areas scheduled for future clearing and construction work.

Pre-clearing bird nest surveys that identify and establish retention buffers around active and probable nest sites are an accepted technique to minimize the risk of any incidental take when clearing vegetation during the nesting season and avoiding contraventions of the BC *Wildlife Act* and *MBCA*.

Study Area

Strategic Resource Solutions (SRS) bird biologists conducted preliminary pre-clearing bird nest surveys in an approximate area of 62.3 ha along the north bank of the Peace River, north of the proposed Site C Dam site approximately 5 km southwest of Fort St. John. The survey area was divided into four survey polygons representing a variety of different habitat types that would be encountered during initial proposed clearing and construction work.

The four survey polygons (**Error! Reference source not found.**) were as follows:

1) **Accommodations Polygon (38.0 ha).** An area proposed to be cleared where worker accommodations are to be built. This area consists of a mixture of open grasslands and shrublands that transition to maturing and mature trembling aspen (*Populus tremuloides*) stands

[1] Incidental take can be defined as inadvertent damage or destruction of active bird nests resulting from proximal human activities.

with the occasional small wetland. A large area of seeded pasture dominates the northern portion of this polygon.

2) **Office Polygon (2.6 ha).** An area proposed to be cleared where the main construction office will be built, and is characterized by a mature trembling aspen stand.
3) **Peace Riparian Polygon (2.2 ha).** A flat floodplain area along the north shore of the Peace River that is proposed to be cleared for construction and access purposes. It is predominantly mature black cottonwood (*P. trichocarpa*) with areas of heavy willow and alder understory.
4) **Road ROW (right-of-way) Polygon (19.5 ha).** An upland area on the south side of a small stream tributary that is proposed to be cleared to build an access road. The area is a mixture of mostly maturing and mature trembling aspen, with small areas of open grassland, shrublands and seeded pasture along the central portion of the ROW.

Methods

Preliminary pre-clearing bird nest surveys followed procedures developed for BC Hydro specific to their proposed Site C project. Please refer to the document, *Protocol to Determine the Presence of Active Bird Nests* (SRS 2015) for specific draft methodologies. As finding active nests can be very time-consuming due to their cryptic nature, the intent of the surveys was not to find all active nests, but to identify probable nesting areas based on observed bird behaviours and surrounding habitat quality. Field surveys were conducted between 17-19 June, 2015 using the SRS (2015) procedures, <u>with the following two exceptions</u>:

1) Only one survey was conducted instead of the recommended three surveys (SRS 2015) per polygon area. This was mainly due to meeting the objectives of field testing the survey methodologies and gauging relative nesting abundance. As well, no clearing was scheduled to immediately follow the surveys. Consequently, biologists only conducted one survey to gauge the time required to complete the surveys and estimate the relative abundance and approximate distribution of bird nests in a given habitat type/site location in order to assist planning purposes for future clearing work. Refer to Appendix B for locations of survey waypoints conducted from June 17-19, 2015.
2) No flagged buffers (30 m radii) were established around active and probable nest sites which were observed. Since no clearing was planned immediately after the surveys, it was unnecessary to mark any retention buffers.

Results

Surveys conducted between June 17-19 indicated that the breeding chronology of the 2015 nesting season was likely near the peak of the critical nesting period. A total of 11 active nests and 44 probable nest sites were located across all habitat types visited during the survey period (Figure 7). Active and probable nest sites were found for 25 different bird species (see Appendix A), including one provincially Blue-listed species, the Connecticut Warbler (BC CDC 2015).

Some habitat types/areas had greater abundance and densities of active and probable nest sites than others, and thus were classified as "High" to "Very Low Risk" habitat categories based on the likelihood of encountering nesting birds as well as observations of overall habitat quality and structural attributes for that area, and are defined below. Note that area risk ratings as described below are only useful for planning purposes – this type of area zoning/demarcation (as in Figure 8) is NOT necessary once a full survey cycle (2 or 3 passes) has been completed for corresponding areas and nesting periods.

High Risk Habitats:

High quality/suitability nesting habitat that typically supports a high diversity and relative abundance of bird species. For these habitats there is a high probability of encountering a nest and a high probability of incidental take after nest surveys are conducted and active and probable nest sites are identified, flagged and buffered in the field.

Examples of High Risk Habitats in the surveyed area include:

1) Mature trembling aspen stands with abundant standing dead trees (particularly recently dead, wildlife tree class 3 trees) and varied, dense understories of shrubs and herbaceous cover (Figure 1).
2) Mature riparian black cottonwood stands with dense understories of shrubs and herbs (Figure 1).
3) Wetlands bordered by a mix of mature trees and dense understories of shrubs and undergrowth (Figure 2).


Figure 1: Mature trembling aspen with dense understories and abundant cavity trees (left) and a mature riparian black cottonwood stand with dense understories (right).

Figure 2: Wetland bordered by abundant shrubs and mature trembling aspen.

Moderate Risk Habitats:

Moderate quality/suitability nesting habitat that typically supports a moderate diversity and relative abundance of bird species. For these habitats there is a moderate probability of encountering a nest and a moderate probability of incidental take after surveys are conducted and active and probable nest sites are identified, flagged and buffered in the field.

Examples of Moderate Risk Habitats in the surveyed area include:

1) Maturing and mature trembling aspen stands with few standing dead trees and open understories with few shrubs and undergrowth (Figure 3).
2) Open mature and maturing riparian black cottonwood stands with open understories and few shrubs and undergrowth (Figure 3).
3) Shrubland transition zones between grassland areas and forested stands (Figure 4).

Figure 3: Mature trembling aspen with open understories and few cavity trees (left) and open mature riparian black cottonwood with open understories (right).

Figure 4: Shrubland transition zone between grasslands and trembling aspen stand.

Low Risk Habitats:

Low quality/suitability nesting habitat that typically supports a lower diversity and relative abundance of bird species. For these habitats there is a lower probability of encountering a nest and a low probability of incidental take after surveys are conducted and active and probable nest sites are identified, flagged and buffered in the field.

Examples of Low Risk Habitats in the surveyed area include:

1) Natural grassland areas mixed with the occasional shrubby or “clumpy” treed areas (Figure 5).

Figure 5: Natural grasslands with the occasional shrubby area.

Very Low Risk Habitats:

Very low quality/suitability nesting habitat that typically supports a very low diversity and relative abundance of bird species. For these habitats there is a very low probability of encountering a nest and a very low probability of incidental take after surveys are conducted and active and probable nest sites are identified, flagged and buffered in the field.

Examples of Very Low Risk Habitats in the surveyed area include:

1) Seeded pasturelands and heavily disturbed open areas (Figure 6).

Figure 6: Seeded pastureland.

Results for the Accommodations Survey Polygon

This polygon was characterized by all four categories of risk habitats (Figure 8). Six areas of High Risk habitat were identified during surveys, including:

- An area of open canopied mature trembling aspen with abundant cavity trees and dense shrub thickets located on the western edge of the polygon and immediately south of the Office Survey Polygon;
- An area of mature trembling aspen with numerous cavity trees and dense shrubbery in the north-central part of the polygon;
- An area of mature, closed-canopied trembling aspen with a moderately-open tall shrub understory with some cavity trees on the eastern edge of the polygon; and
- Three small wetland areas in the south-central portion of the polygon, with the largest wetland located along the southern polygon boundary.

Moderate Risk habitat covered the majority of the polygon and consisted of all other forested areas not described in the High or Low Risk habitat categories. A large area of Low Risk open grasslands with the occasional shrubby or “clumpy” treed area was located in the southwest section of the polygon. A single large area of Very Low Risk habitat comprising of seeded pastureland was located in the northwest section of the polygon. The only species of bird found to be nesting in this pasture was Savannah Sparrow. Two probable Savannah Sparrow nest sites were located within 40 m of one another, so nest densities may be potentially high for this individual bird species within suitable micro-habitats of this polygon.

In total, 21 active and probable nest sites were located during surveys in the Accommodations polygon (Figure 7). Due to overlapping nest sites of more than one bird species, approximately 17 flagged retention buffers (4.8 ha) would be required to protect these nest sites, or approximately 12.5% of the 38.0 ha polygon.

Results for the Office Survey Polygon

This polygon had a small area of High Risk habitat characterized by open canopied mature trembling aspen with abundant cavity trees and dense shrub thickets on the very south edge of the polygon (Figure 8). The rest of the polygon was Moderate Risk habitat characterized by mature trembling aspen with few cavity trees and some areas of dense shrubbery.

In total, 4 active and probable nest sites were located during surveys in the polygon (Figure 7). Due to overlapping nest sites of more than one bird species, approximately 3 retention buffers (0.8 ha) would be required to protect these nest sites, or approximately 32.3% of the 2.6 ha polygon.

Results for the Peace Riparian Survey Polygon

The eastern half of this polygon was rated as High Risk habitat characterized by mature riparian black cottonwood stands with dense understories of shrubs and herbaceous undergrowth (Figure 8). High relative abundance and densities of breeding birds were observed in this area with surveys locating 12 active or probable nest sites within a 200 m long section of habitat (Figure 7). Within this area, two probable nest sites of Song Sparrow were located within 30 m of one another, indicting relatively high abundance for this species alone. However, the western half of this polygon was rated Moderate Risk habitat characterized by mature, open overstory riparian black cottonwood with an open understory and few shrubs and herbaceous plants.

In total, 14 active and probable nest sites and 2 inactive large stick nests were located during surveys in the polygon (Figure 7). Due to overlapping nest sites of more than one bird species, approximately 6 retention buffers (1.7 ha) would be required to protect these nest sites, or approximately 77.3% of the 2.2 ha polygon.

Results for the Road ROW Survey Polygon

This polygon was also characterized by all categories of risk habitats (Figure 8). Four areas of High Risk habitat were identified during surveys, including:

- Two areas of open canopied mature trembling aspen with abundant cavity trees and dense shrub thickets in the mid-west and mid-east portions of the polygon;
- An area of mature riparian trembling aspen with numerous cavity trees and dense tall shrubbery in the central part of the polygon; and

- A steep, mature riparian area of trembling aspen with a mixed-wood understory with dense shrubbery at the eastern border of the polygon prior to dropping down to the adjacent creek gully.

Moderate Risk habitat covered the majority of the polygon and consisted of all other forested areas, mostly of maturing and mature trembling aspen stands not described in the High Risk habitat category, as well as shrubby transitional areas between grasslands and forested stands. Small fingers of Low Risk habitat of transitional open grasslands and shrublands were located in the west-central part of the polygon. A section of Very Low Risk habitat comprised of seeded pastureland was located in the central part of the polygon.

In total, 16 active and probable nest sites were located during surveys in the polygon (Figure 7). Due to overlapping nest sites of more than one bird species, approximately 11 retention buffers (3.1 ha) would be required to protect these nest sites, or approximately 15.8% of the 19.5 ha polygon.

The steep riparian area to the north of the Road ROW polygon was not surveyed or assessed (Figure 8). However, visual inspections of this habitat indicated that it would likely be rated as High Risk given the mature trembling aspen stands, riparian habitat and dense undergrowth. The understory in this area included areas of Highbush-Cranberry (*Viburnum edule*) and Red-osier Dogwood (*Cornus stolonifera*), both of which are indicative of high nesting habitat suitability for Canada Warbler, a Schedule 1 species of the *Species At Risk Act* (SARA) (BC CDC 2015).

Discussion

The purpose of the preliminary mid-June surveys was to field test the draft survey methodology (SRS 2015), identify the potential number and of bird nests, and determine the amount of time required to complete future surveys.

Relative Abundance of Bird Nests

In an approximate survey area of 62.3 ha, 11 active and 44 probable nest sites were identified during the single pass survey. Due to overlapping nest sites of more than one species, a total of 37 retention buffers (10.4 ha) would be required to protect these nest sites, or approximately 16.7% of the 62.3 ha survey area. It is important to note that only ONE survey pass was completed during the field testing of the survey methodology, versus the recommended 3-pass survey. A 3-pass survey would most certainly result in more active and probable nest sites being discovered, with a resultant increase in the number of retention buffers being established. But this also means that some habitat types/construction areas will have no active or probable nest sites discovered during the 3-pass survey cycle [i.e., 3 consecutive days up to a maximum of 5 days, see sec. 3.2.7.1 (SRS 2015)] – such areas can therefore be scheduled "free to clear" for 3 days immediately after survey completion while within the critical nesting period window.

Estimated Amount of Time to Complete Surveys

For the purpose of managing clearing crew schedules it is estimated during the critical nesting period for areas of Moderate Risk habitat with relatively gentle topography, that a crew of 2 bird biologists could likely complete one survey pass and flag-out appropriate 30 m radius buffers around active and probable nest sites in an area the size of the Road ROW polygon (100 m wide x 2.0 km long = 20 ha) during a single field working day. However, 2-3 survey passes would be required to properly survey the size of the Road ROW polygon since field crews of 2 bird biologists are unable to adequately cover in a single pass a 100 m width of habitat containing moderate-to-heavy understory. Thus a second or perhaps third survey would be required to adequately cover the areas missed during the first pass, regardless of the nesting season period (i.e., critical versus caution nesting period).

Using the above example of a polygon 100 m wide in gentle topography, during the critical nesting period a survey crew of 2 bird biologists could likely survey the following distances in a single survey pass including flagging-out appropriate buffers:

- High Risk Habitat: 0.75 to 1.5 km length (100 m wide)
- Moderate Risk Habitat: 2.0 km length (100 m wide)
- Low Risk Habitat: 3.0 to 3.5 km length (100 m wide)
- Very Low Risk Habitat: 4.0 to 5.0 km length (100 m wide)

Recommended Survey Modifications

1) June surveys indicated that Low and Very Low Risk habitats may require <u>less than the recommended 3 separate survey passes</u> to adequately identify active and probable nest sites, even during the critical nesting period. Habitat areas that fall within these two risk categories would need to be individually assessed in the field prior to determining the adequate minimum number of surveys. However, initial surveys indicated that these open habitat areas are readily assessed and the open nature of this habitat makes detecting nesting birds easier than in forested stands or areas of dense shrubs.

2) If active or probable nest sites are found during the first survey pass whose buffers would inhibit planned clearing options, then further survey passes of the area would <u>not be required</u> since the first survey pass had already established that the area could not be cleared due to the presence of nesting birds.

3) A more precautionary approach should be adopted for protecting probable nesting areas for Blue- or Red-listed songbird species. Nest buffers should be <u>established for any federal SARA-listed or provincial Blue- or Red-listed songbird species if they are exhibiting nesting behaviour</u>, including male birds persistently singing from the same location. This approach will minimize any risk of incidental take for species that are of provincial conservation concern. Blue-listed species of songbirds that may occur in the Site C study area include: Barn Swallow, Baltimore Oriole, Black-throated Green Warbler, Canada Warbler (also SARA threatened), Cape May Warbler, Connecticut Warbler, Olive-sided Flycatcher (threatened) and Rusty Blackbird (special

concern). Bay-breasted Warbler is the only Red-listed species of songbird that may occur in the study area (BC CDC 2015).Common Nighthawk is SARA threatened, but is Yellow-listed (not at risk) in BC.

4) June surveys suggested that the 2015 breeding season may be quite advanced given the time of year, even though only two families of recently fledged birds were observed, Downy Woodpecker and Dark-eyed Junco, both of which tend to nest relatively early compared to other species. Another round of pre-clearing bird nest surveys will likely commence during the second week of July, which is still considered to be the critical nesting season (BC MFLNRO 2011) when 3 surveys are suggested by current survey methodologies. However, due to the observed advanced chronology of this year's nesting season by as much as 2 weeks, and perhaps due to a warm and early spring, biologists will need to assess the breeding behaviour carefully to determine if subsequent surveys should follow the critical or caution nesting season survey protocols.

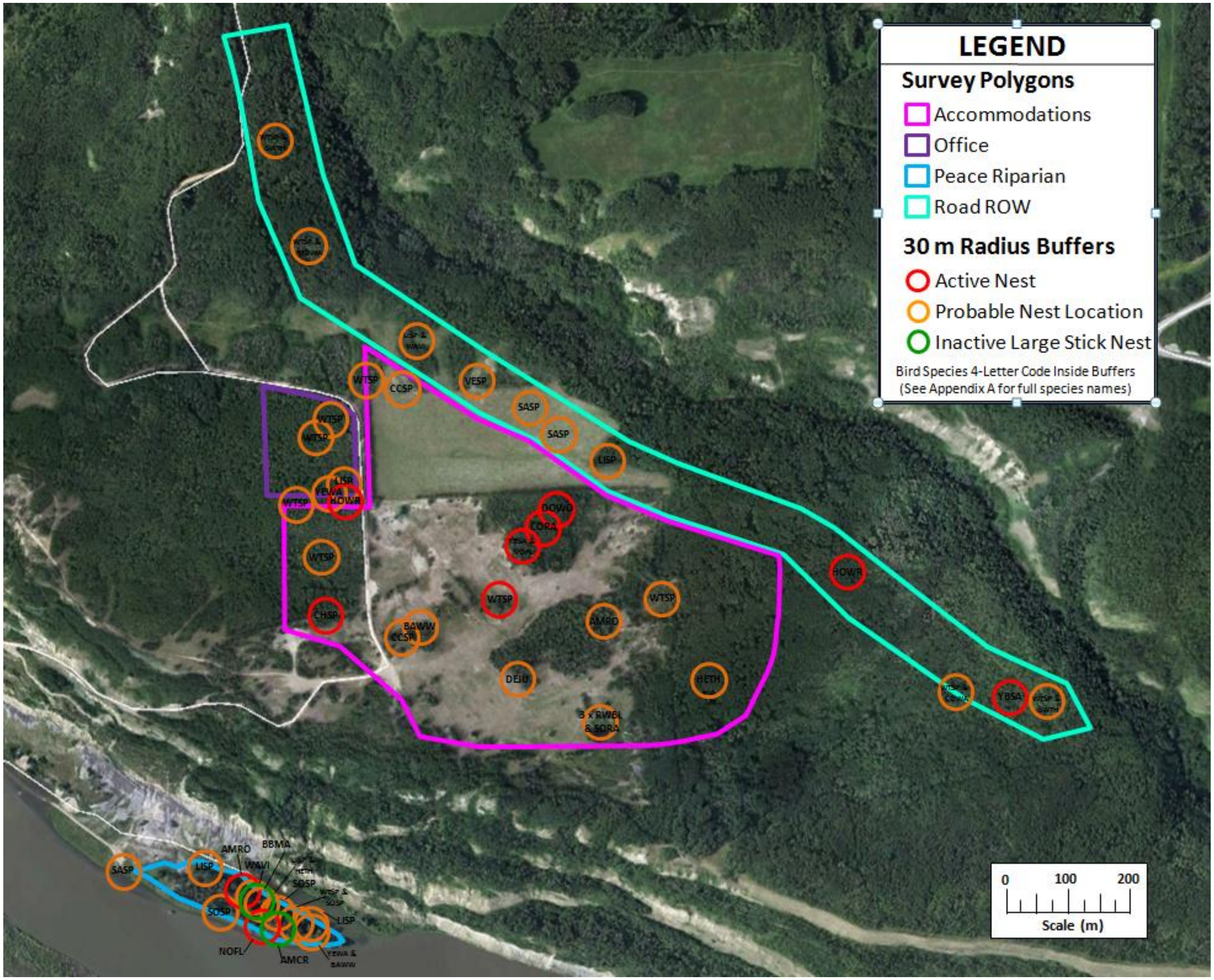

Figure 7: Active and probable nest sites and large stick nests located during 17-19 June 2015 surveys at proposed BC Hydro Site C clearing area (Google imagery).

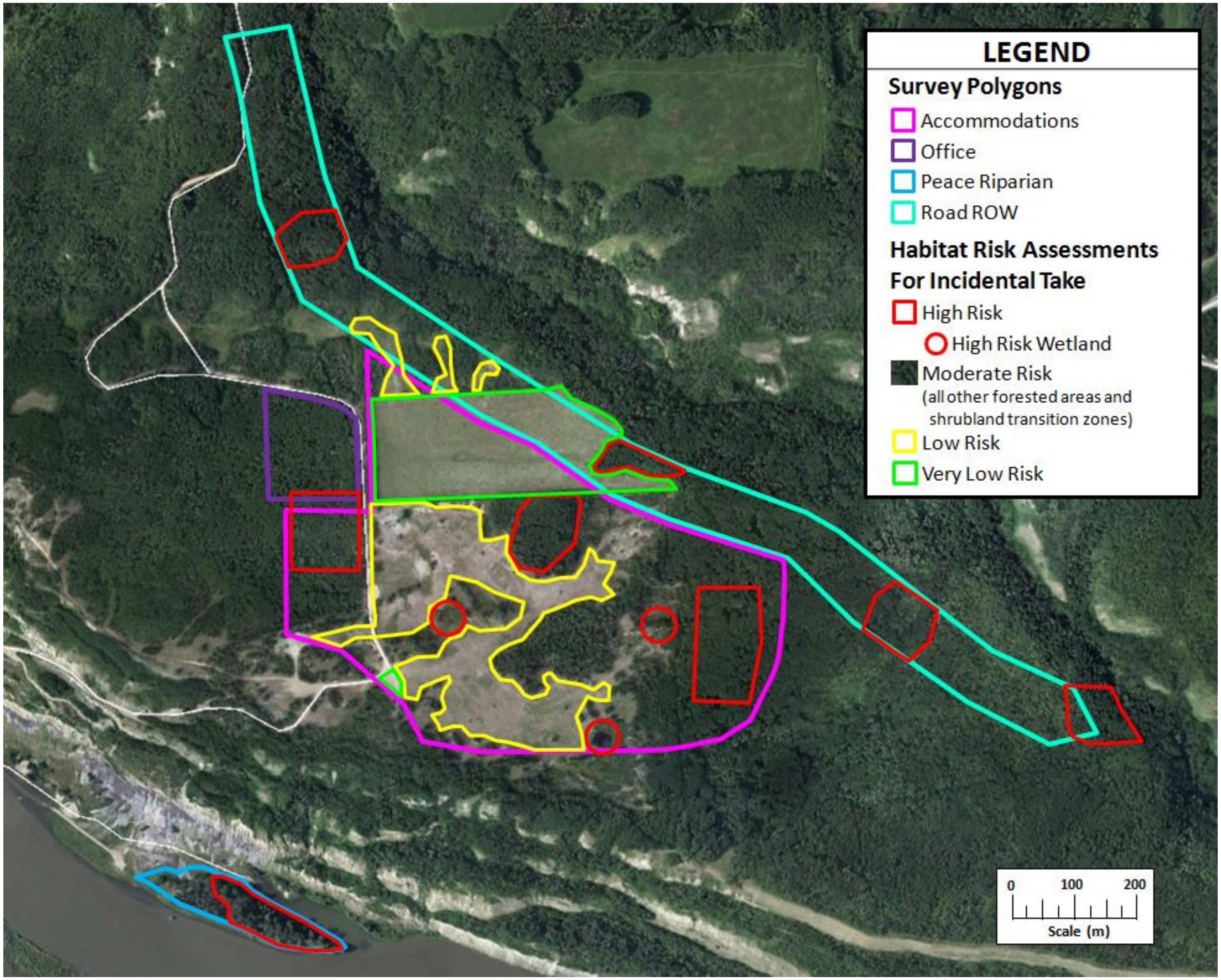

Figure 8: Risk habitat areas for incidental take at proposed BC Hydro Site C clearing area (Google imagery).

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Appendix A: Four-letter codes for bird species observed at active or probable nest sites in June 2015 for proposed BC Hydro Site C clearing area.

4-Letter Code	Bird Species
AMCR	American Crow
AMRO	American Robin
BAWW	Black-and-white Warbler
BBMA	Black-billed Magpie
CCSP	Clay-colored Sparrow
CHSP	Chipping Sparrow
CORA	Common Raven
COWA	Connecticut Warbler*
DEJU	Dark-eyed Junco
DOWO	Downy Woodpecker
HETH	Hermit Thrush
HOWR	House Wren
LISP	Lincoln's Sparrow
MOWA	Mourning Warbler
NOFL	Northern Flicker
RWBL	Red-winged Blackbird
SASP	Savannah Sparrow
SORA	Sora
SOSP	Song Sparrow
SWTH	Swainson's Thrush
VESP	Vesper Sparrow
WAVI	Warbling Vireo
WTSP	White-throated Sparrow
YBSA	Yellow-bellied Sapsucker
YEWA	Yellow Warbler

* Provincially Blue-listed Species (BC CDC 2015).

Appendix B: Survey route waypoints taken during 17-19 June 2015, for proposed BC Hydro Site C clearing area.

Preliminary
Pre-clearing Bird Nest Surveys for Proposed BC Hydro's Site C Construction Area
(July 6-10, 2015)

Prepared by:

Todd Manning (RPBio., RPF) and Paul Chytyk
Strategic Resource Solutions (SRS)
Victoria, BC

Prepared for:

Bill Golding
Silvicon Services Inc.
Smithers, BC

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Introduction

The proposed BC Hydro Site C Dam is entering the initial clearing and construction phase of the project and will require areas of native vegetation to be cleared for project infrastructure, access and transmission corridors. Although most clearing on the proposed Site C site will occur during the bird non-nesting season (fall and winter months), some areas may require clearing during the bird breeding/nesting season. To gauge the amount and density of nesting birds that may be encountered during the nesting season, BC Hydro requested preliminary pre-clearing bird nest surveys be initiated in an area proposed for cleared during the initial phases of Site C construction. The following report summarizes the findings of these preliminary surveys for the period July 6-10, 2015.

Study Area

The study area covered an area of approximately 70.0 ha along the north bank of the Peace River, north of the proposed Site C Dam site, and approximately 5 km southwest of Fort St. John. The survey area was divided into one linear transect and six survey polygons (Figure 7 and Figure 8) that are planned to be cleared during the initial phases of the proposed construction work.

The linear **Fenceline Transect** occurred along an existing fenceline that required fence maintenance and a short section of new fence alignment. No clearing was required along the fenceline, but crews would be inadvertently disturbing vegetation adjacent to the fenceline during the work. The fenceline traversed through mostly mature aspen (*Populus tremuloides*) stands, a riparian creek ravine and sections of open shrublands.

The six survey polygons were as follows:

5) **Accommodations Polygon (38.0 ha).** An area proposed to be cleared where worker accommodations are to be built. This area consists of a mixture of open grasslands and shrublands that transition to maturing and mature trembling aspen stands with the occasional small wetland. A large area of seeded pasture dominates the northern portion of this polygon.
6) **East Parking Area Polygon (1.4 ha).** An area proposed to be cleared for public parking and turn-around access for visitors to the site. It is characterized by disturbed shrubby and trembling aspen areas in the east, and a mature trembling aspen stand with a minor component of white spruce (*Picea glauca*), in the west.
7) **East Road ROW (right-of-way) Polygon (9.8 ha).** An area proposed to be cleared in order to build a new access road. The area is a mixture of mostly maturing and mature trembling aspen in the west, and mature mixed forest and trembling aspen stands in the east.
8) **Main Road ROW Polygon (14.9 ha).** An area proposed to be cleared and widened on either side of an existing built road in order to facilitate improved access. This polygon is a mix of mostly maturing and mature trembling aspen stands with the occasional small wetland, grassland opening, and shrubby transitional area.

9) **Peace Riparian Polygon (2.2 ha).** A flat floodplain area along the north shore of the Peace River that is proposed to be cleared for construction and access purposes. It is predominantly mature black cottonwood (*P. trichocarpa*) with areas of heavy willow and alder understory.
10) **West Parking Area Polygon (3.7 ha).** An area proposed to be cleared for public parking and turn around access for visitors to the site, and is characterized by maturing and mature trembling aspen stands.

Methods

Strategic Resource Solutions (SRS) bird biologists conducted preliminary pre-clearing bird nest surveys following procedures developed for BC Hydro, specific to their proposed Site C project. Please refer to the document, *Protocol to Determine the Presence of Active Bird Nests* (SRS 2015b) for specific survey methodologies. Because finding active nests can be very time-consuming due to their cryptic nature, the intent of the surveys was not to find all active nests, but to identify probable nesting areas based on observed bird behaviours and surrounding habitat quality. Field surveys were conducted between 6-10 July, 2015 using the SRS (2015b) procedures, with the following two exceptions:

3) Except for the West Parking Area Polygon and Fenceline Transect, only one survey was conducted instead of the recommended three surveys per polygon area (SRS 2015b) during the critical nesting period (BC MFLRO 2011). Since no clearing was scheduled to immediately follow these surveys, it was unnecessary to conduct all three surveys per area. Consequently, biologists conducted one survey mainly to estimate the relative abundance and approximate distribution of bird nests in a given habitat type/site location which will assist planning purposes for future clearing work. Refer to Appendix B for locations of survey transects completed from July 6-10.

4) No flagged buffers (30 m radii) were established around active and probable nest sites. Since no clearing was planned immediately after the surveys, it was unnecessary to install/flag any retention buffers.

Results

Surveys conducted between 6-10 July 2015 located a total of 3 active nests and 23 probable nest sites in the study area (Figure 7). Active and probable nest sites were found for 12 different bird species (see Appendix A). No provincially or federally listed bird species or their nests were observed during this survey period.

Survey observations indicated that the breeding chronology of the 2015 nesting season is likely nearing the end of the critical nesting period since several of the identified nest areas had already fledged young between the beginning and the end of the survey period. Fifty-two separate observations were made of adults feeding fledglings, suggesting that the majority of nesting birds had already successfully reared young. Gatherings of adults and their fledglings of several different species were observed, suggesting the beginning of late summer dispersal for these individuals.

Surveys found evidence of re-nesting or double-brooding. An American Robin pair whose nest was found during the 17-19 June 2015 surveys, had re-nested in the same nest and had one medium-sized nestling on 10 July. All other active nest sites that were located during earlier surveys between 17-19 June 2015, were found to be inactive when re-surveyed between 6-10 July 2015. It was assumed that these individuals had successfully reared young and had not re-nested.

In general, field observations indicated that the chronology of the nesting season was more advanced compared to most years, perhaps due to the warm and early spring experienced in much of British Columbia that can facilitate earlier arrival dates and nest initiation on the breeding grounds.

Results for the Fenceline Transect

Two surveys were conducted along this transect on 6 and 7 July 2015. Only two surveys were warranted due to the low risk nature of the fence repair work, i.e., no clearing was required and there would only be minor vegetation trampling in work areas immediately along the fenceline (Figure). In total, one probable nest site was located during surveys along the Fenceline Transect (Figure 7 and Table 1). One modified flagged retention buffer (10 m radius) was established around the probable nest area. Since there was to be no clearing during the fence repair work, a 10 m buffer was established to keep workers a reasonable distance from the nest site, thereby minimizing any disturbance to the birds (Figure). Planned subsequent fence work did not occur in this area.

Table 1: Probable nest site found along the Fenceline Transect during 6-10 July 2015 surveys.

Bird Species	4-letter Code	Nest Status	Centre Point UTM (Zone 10)		Buffer Radius
			Easting	Northing	
Clay-colored Sparrow	CCSP	Probable	630376	6231458	10 m

Figure 1: Typical minor vegetation trampling from workers working immediately along a fenceline.

Figure 2: A flagged 10 m radius modified buffer around a probable Clay-colored Sparrow nest site.

Results for the Accommodations Polygon

A single survey was conducted in selected areas of this polygon on 10 July 2015. In total, 7 probable nest sites were located during surveys in the Accommodations Polygon (Figure 7 and Table 2). Due to overlapping nest sites of more than one bird species, approximately 5 flagged retention buffers (1.4 ha) would be required to protect these nest sites, or approximately 3.7% of the 38.0 ha polygon.

Table 2: Probable nest sites found in the Accommodations Polygon during 6-10 July 2015 surveys.

Bird Species	4-letter Code	Nest Status	Centre Point UTM (Zone 10)		Buffer Radius
			Easting	Northing	
Savannah Sparrow	SASP	Probable	630424	6230419	30 m
White-throated Sparrow	WTSP	Probable	630560	6230597	30 m
Hermit Thrush & White-throated Sparrow	HETH & WTSP	Probable	630606	6230554	30 m
White-throated Sparrow	WTSP	Probable	630619	6230626	30 m
Yellow Warbler & White-throated Sparrow	YEWA & WTSP	Probable	630783	6230509	30 m

Four active nests (Chipping Sparrow [CHSP], Yellow-bellied Sapsucker [YBSA], Downy Woodpecker [DOWO] and Common Raven [CORA]) that were located during previous surveys between 17-19 June 2015 were re-surveyed on 10 July 2015 and were found to be inactive and assumed to have successfully fledged young.

Results for the East Parking Area Polygon

A single survey was conducted in the polygon on 9 July 2015. In total, one probable nest site was located during surveys in the East Parking Area Polygon (Figure 8 and Table 3). One flagged retention buffer (0.28 ha) would be required to protect this nest site, or approximately 20.0% of the 1.4 ha polygon.

Table 3: Probable nest site found in the East Parking Area Polygon during 6-10 July 2015 surveys.

Bird Species	4-letter Code	Nest Status	Centre Point UTM (Zone 10)		Buffer Radius
			Easting	Northing	
Ovenbird	OVEN	Probable	632542	6230663	30 m

Results for the East Road ROW Polygon

A single survey was conducted in the polygon on 9 July 2015. In total, 1 probable nest site was located during surveys in the East Road ROW Polygon (Figure 8 and Table 4). One flagged retention buffer (0.28 ha) would be required to protect the nest site, or approximately 2.9% of the 9.8 ha polygon. An inactive large stick nest (Figure) thought to be that of a Common Raven was also found during surveys and was likely active earlier in the year due to its robust condition.

Table 4: Probable nest site and large stick nest found in the East Road ROW Polygon during 6-10 July 2015 surveys.

Bird Species	4-letter Code	Nest Status	Centre Point UTM (Zone 10)		Buffer Radius
			Easting	Northing	
White-throated Sparrow	WTSP	Probable	632268	6230413	30 m
Inactive large stick nest (probable Common Raven)	CORA	Inactive	631849	6230364	N/A

A well-groomed and recently maintained hiking trail (Figure) was found along a 100 m length of the proposed ROW, approximately between UTMs 10/632143E/6230403N to the west and 10/632235E/6230405N to the east. The clearing of the proposed ROW would impact the current configuration and use of this hiking trail.

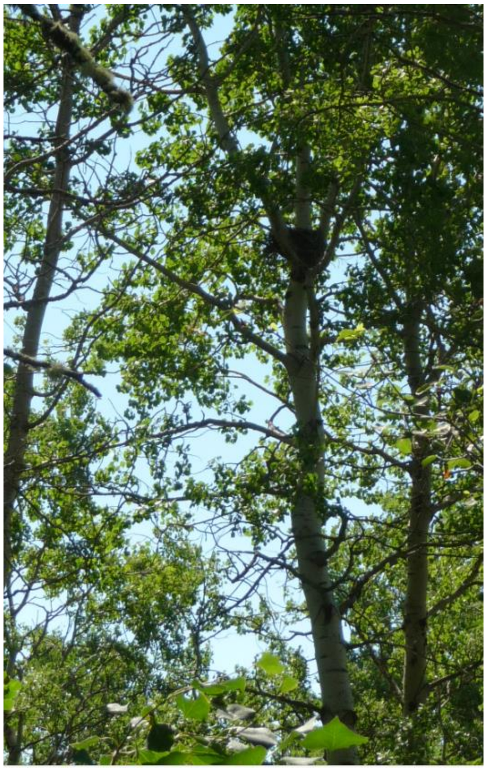 

Figure 3: Inactive Common Raven nest found along the East Road ROW (left), and a well-groomed and maintained hiking trail along a centreline portion of the proposed ROW (right).

Results for the Main Road ROW Polygon

A single survey cycle was conducted along the length of the polygon over two days on 7 and 8 July 2015. In total, 9 active and probable nest sites were located during surveys in the Main Road ROW Polygon (Figure 7 and Table 5). Due to overlapping nest sites of more than one bird species, approximately 7 flagged retention buffers (2.0 ha) would be required to protect these nest sites, or approximately 13.3% of the 14.9 ha polygon.

Table 5: Active and probable nest sites found in the Main Road ROW Polygon during 6-10 July 2015 surveys.

Bird Species	4-letter Code	Nest Status	Centre Point UTM (Zone 10)		Buffer Radius
			Easting	Northing	
Hermit Thrush	HETH	Probable	629999	6231220	30 m
White-throated Sparrow	WTSP	Probable	629963	6231140	30 m
Cedar Waxwing	CEWA	Active	629802	6230882	30 m
Ruffed Grouse	RUGR	Probable	629894	6230856	30 m
Lincoln's Sparrow	LISP	Probable	630234	6230721	30 m
Yellow-rumped Warbler & House Wren	YRWA & HOWR	Probable	630228	6230620	30 m
Yellow Warbler & White-throated Sparrow	YEWA & WTSP	Probable	630231	6230590	30 m

One active nest (House Wren [HOWR]) that was located during previous surveys between 17-19 June 2015 was re-surveyed on 7 July 2015, and was found to be inactive and assumed to have successfully fledged young.

Results for the Peace Riparian Polygon

A single survey was conducted in the polygon on 9 July 2015. In total, 3 active and probable nest sites were located during surveys in the Peace Riparian Polygon (Figure 7 and Table 6). Three flagged retention buffers (0.8 ha) would be required to protect these nest sites, or approximately 38.6% of the 2.2 ha polygon.

Table 6: Active and probable nest sites found in the Peace Riparian Polygon during 6-10 July 2015 surveys.

Bird Species	4-letter Code	Nest Status	Centre Point UTM (Zone 10)		Buffer Radius
			Easting	Northing	
American Robin	AMRO	Active	630004	6229912	30 m
Lincoln's Sparrow	LISP	Probable	630058	6229895	30 m
Lincoln's Sparrow	LISP	Probable	630052	6229846	30 m

Two active nests (Northern Flicker [NOFL] and American Robin [AMRO]) that were located during previous surveys between 17-19 June 2015 were re-surveyed on 9 July 2015. The Northern Flicker nest was found to be inactive and assumed to have successfully fledged young, while the American Robin nest was still active as a result of the pair re-nesting using the same nest structure.

Results for the West Parking Area Polygon

Three survey cycles were conducted in the polygon on 6, 7 and 10 July 2015. In total, 4 active and probable nest sites were located during these surveys in the West Parking Area Polygon (Figure 7 and Table 7). Four flagged retention buffers (1.1 ha) would be required to protect these nest sites, or approximately 30.6% of the 3.7 ha polygon. However, the last day of surveys indicated that the active House Wren* nest had fledged; consequently, only 3 buffers (0.8 ha) would be required, or approximately 22.9% of the polygon.

Table 7: Active and probable nest sites found in the West Parking Area Polygon during 6-10 July 2015 surveys.

Bird Species	4-letter Code	Nest Status	Centre Point UTM (Zone 10)		Buffer Radius
			Easting	Northing	
House Wren*	HOWR	Active	630098	6231412	30 m
White-throated Sparrow	WTSP	Probable	630079	6231302	30 m
White-throated Sparrow	WTSP	Probable	630112	6231250	30 m
White-throated Sparrow	WTSP	Probable	630021	6231373	30 m

* Young subsequently fledged on 10 July 2015.

Free-to-Clear Status: A full survey cycle (three nest surveys) for the critical nesting period was completed for the West Parking Area. Except for the 3 buffers around the White-throated Sparrow probable nest sites, the remaining area of the polygon has a free-to-clear status until and including Monday, 13 July 2015.

Discussion

The purpose of the preliminary early-July surveys was to gauge the potential number and relative abundance of bird nests that may be encountered during future proposed clearing for the Site C project.

Relative Abundance of Bird Nests

In an approximate survey area of 70.0 ha, 3 active and 23 probable nest sites were identified during surveys. Due to overlapping nest sites of more than one species and identified nest sites that subsequently fledged young, a total of 19 retention buffers (5.4 ha) would be required to protect these nest sites, or approximately 7.7% of the 70.0 ha survey area. This represents a 54% reduction in the percentage of area required for nest buffer retention from previous survey results in mid-June 2015 when a total of 37 retention buffers (10.4 ha) were required to protect identified nest sites (11 active and 44 probable), or approximately 16.7% of a 62.3 ha survey area (SRS 2015a).

Nesting Season Chronology

Observations during the survey period indicated that the nesting season was advanced and likely nearing the latter stages of the critical nesting period (BC MFLRO 2011). Several observations indicated this:

1. A 53% reduction in the number of active and probable nest sites identified during surveys from mid-June (55 nest sites) (SRS 2015a) to early July (26 nest sites) with a very similar amount of survey effort. Additionally, the number of different species observed exhibiting nesting behaviour dropped 52% from 25 species in mid-June (SRS 2015a) to 12 species in early July. These declines in species and nesting bird observations suggests that many bird species had already nested and successfully fledged young or had failed nesting and likely were not re-nesting.
2. Over 50 separate observations of adults feeding fledglings from among a wide variety of bird species, including resident birds, (e.g., Black-capped Chickadee, Black-billed Magpie, Common Raven, and Ruffed Grouse), short-distance migrants, (e.g., American Robin, Clay-colored Sparrow, Dark-eyed Junco, Evening Grosbeak, House Wren, Lincoln's Sparrow, White-throated Sparrow, Yellow-bellied Sapsucker and Yellow-rumped Warbler), and long-distance migrants (e.g., Black-and-White Warbler, Western Tanager and Yellow Warbler). In general, resident birds typically start nesting earlier in the nesting season, while short-distance migrants arrive earlier on the breeding grounds than long-distance migrants and if conditions are favourable, tend to double-brood or re-nest more often compared to long-distance migrants (Baicich and Harrison 1997). Observations of fledglings of the above species, including later breeding long-distance migrants, indicate that the breeding chronology was well-advanced for early-July.
3. Most species for which early July surveys found evidence of probable nest sites were those of short-distance migrant species, suggesting that these birds may be double-brooding or re-

nesting. However, observations were inconclusive concerning the degree of re-nesting that may be occurring. One American Robin nest that was active during mid-June surveys was used for re-nesting in the early-July surveys and had a single half-grown nestling in the nest, likely a week from fledging. American Robins frequently re-nest, but the size of the nestling indicated that re-nesting for this individual pair was well advanced for the time of year.

4. Cedar Waxwing is typically considered one of the later seasonal breeders (Environment Canada 2014) and normally nest into the caution nesting period (1-15 August) (SRS 2015b). An active Cedar Waxwing nest containing 5 eggs was found on 8 July 2015. Cedar Waxwing eggs are typically incubated for 12-14 days and nestlings are brooded in the nest for an additional 16-18 days, for a total of 28-32 days (Baicich and Harrison 1997). It was not possible to determine how many days the eggs had already been incubated, but in the most conservative estimate, the individual nest could still be occupied until 4-8 August 2015, which is well-advanced for this late nesting species.
5. Gatherings of mixed species assemblages of birds including adults and their fledglings were observed in the study area. These gatherings are the first indication of birds flocking together to begin dispersal from the spring/summer breeding grounds.

Subsequent surveys in July will require careful observations to confirm the 2015 nesting season chronology. Observations from early July surveys suggest that from a biological perspective, <u>the critical nesting season in the study area will likely end prior to the general guideline of 31 July</u> (SRS 2015b).

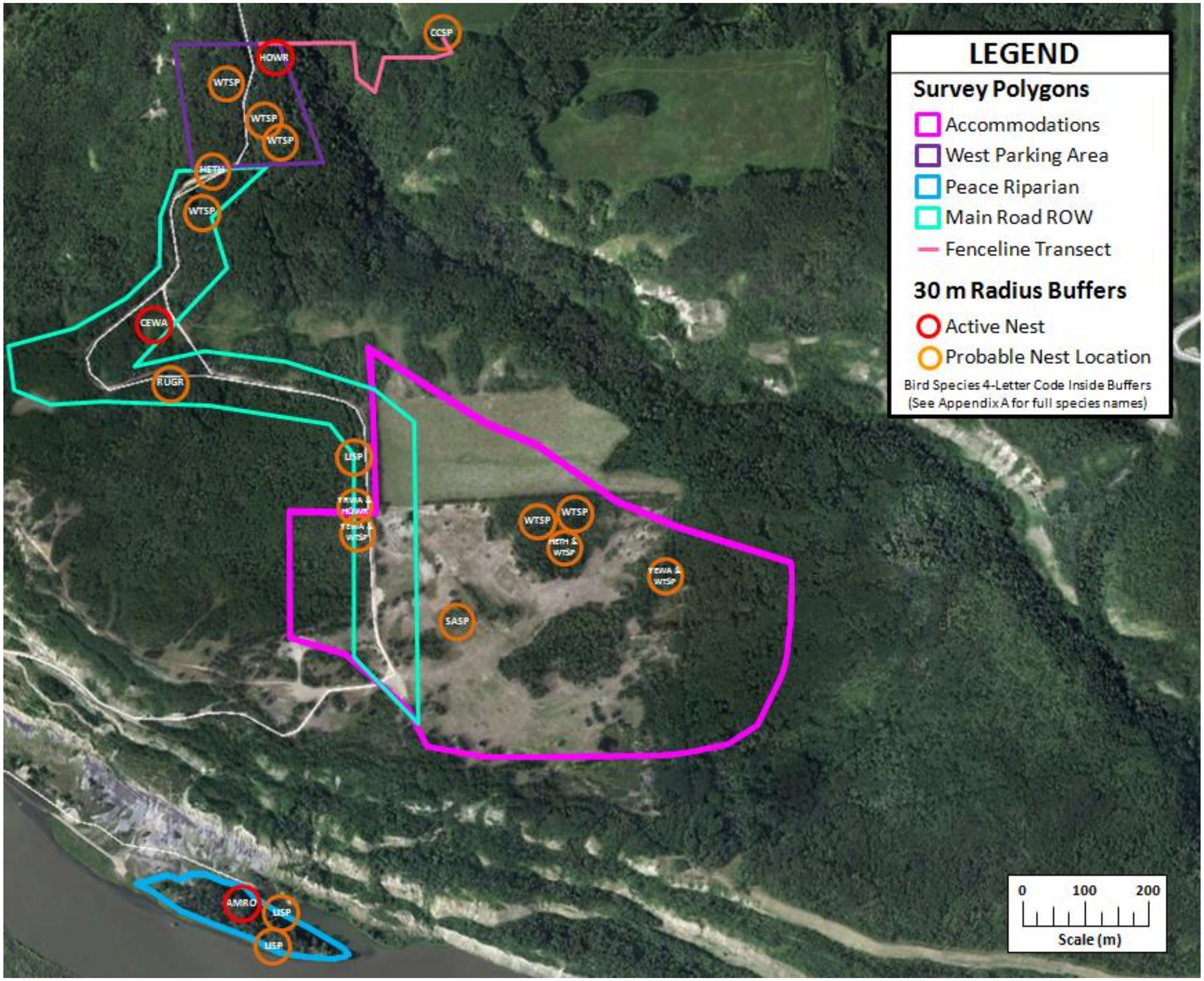

Figure 4: Active and probable nest sites located during 6-10 July surveys at proposed BC Hydro Site C west-side clearing areas (Google imagery).

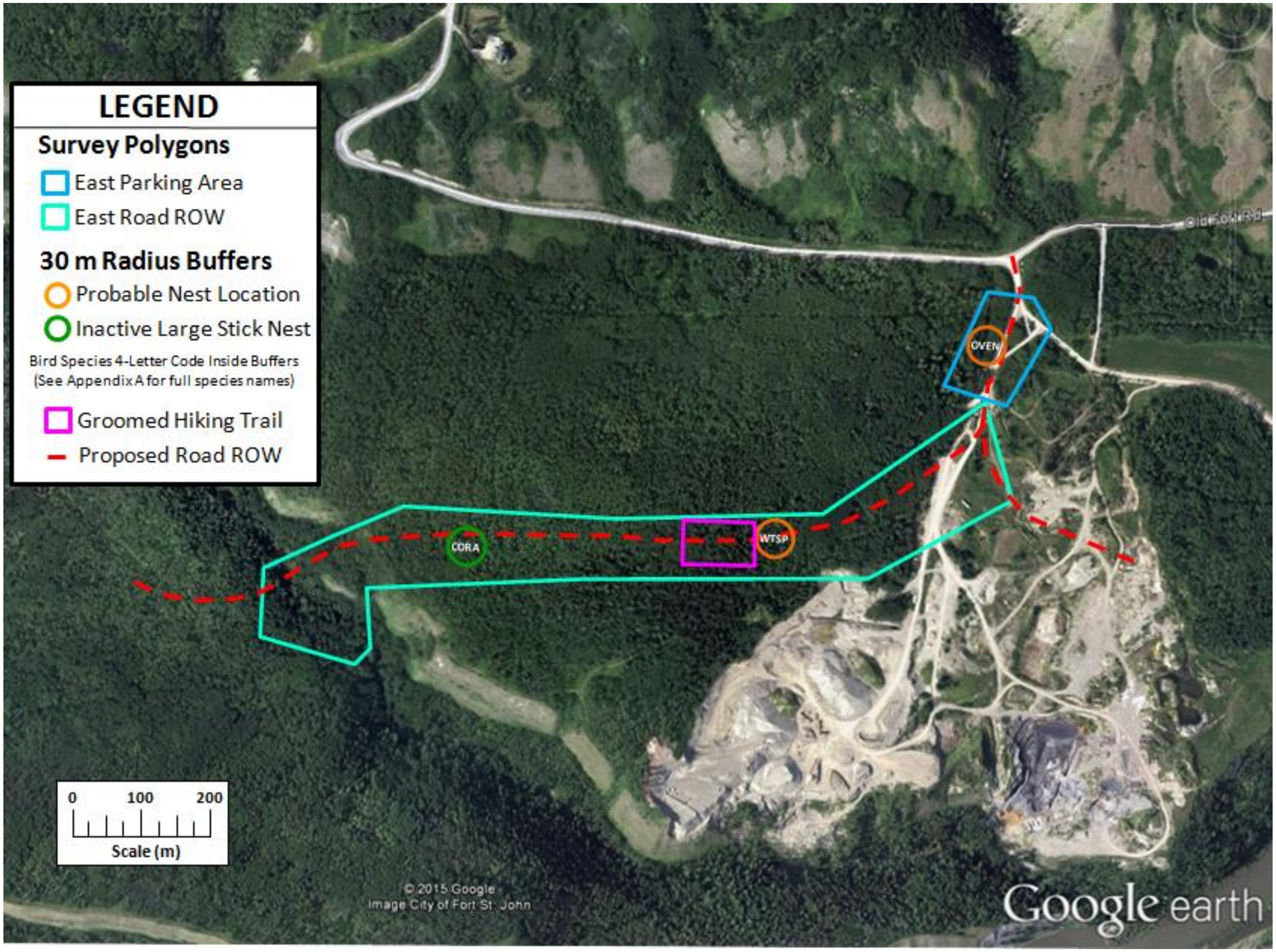

Figure 5: Probable nest sites and inactive large sick nest located during 6-10 July surveys at proposed BC Hydro Site C east-side clearing areas (Google imagery).

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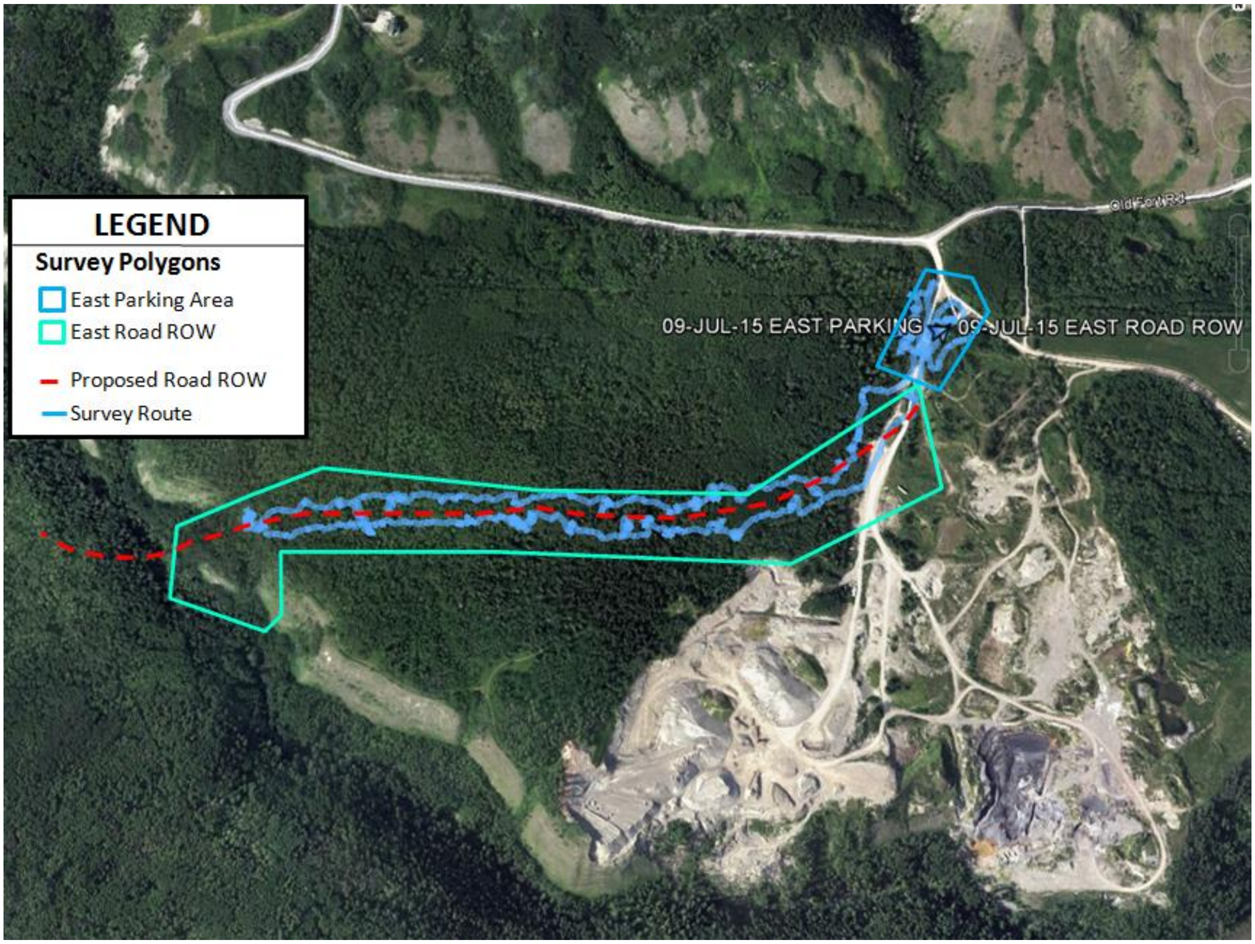
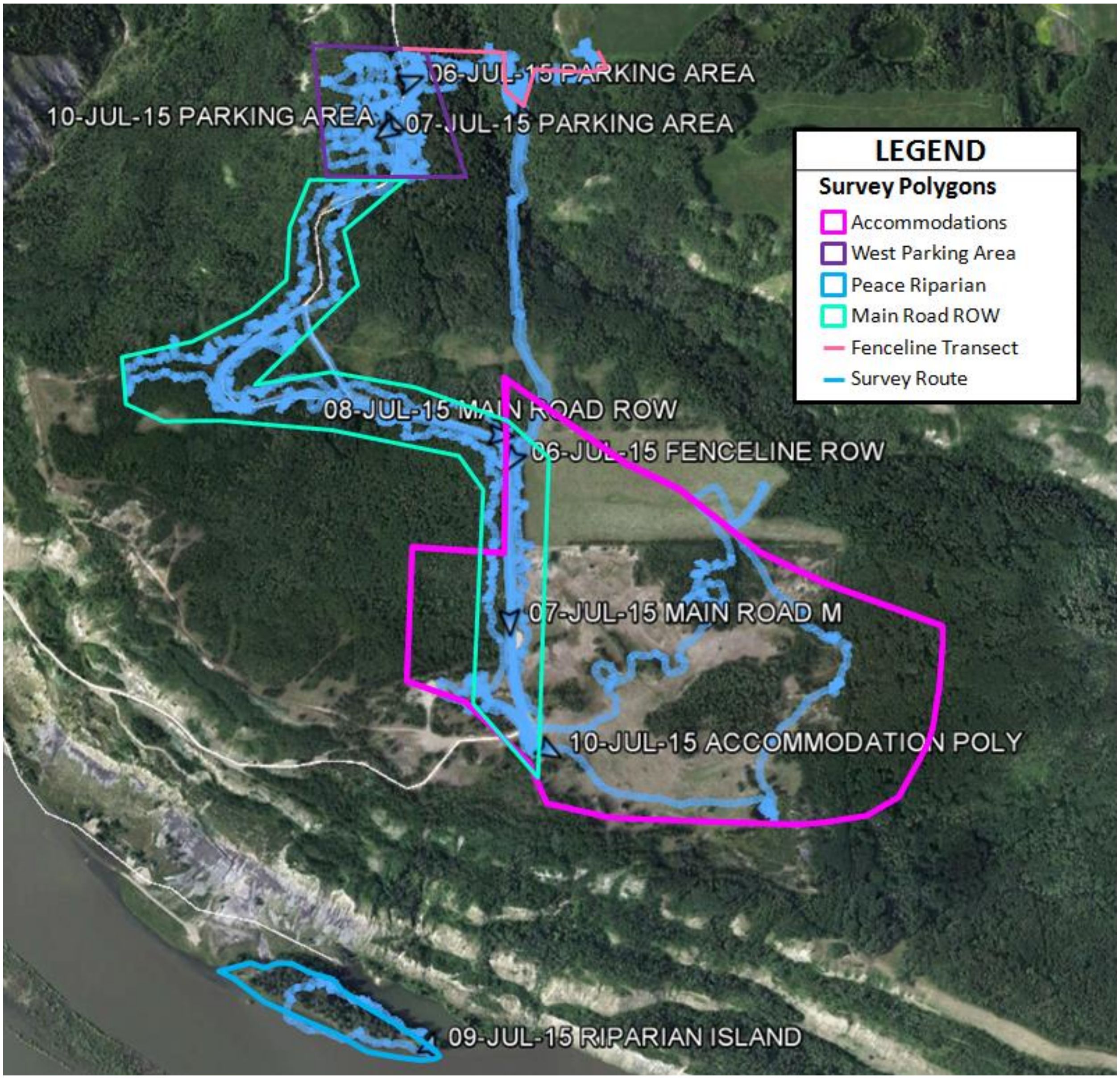
Appendix A: Four-letter codes for bird species observed at active or probable nest sites in July 2015 for proposed BC Hydro Site C clearing areas.

4-Letter Code	Bird Species
AMRO	American Robin
CCSP	Clay-colored Sparrow
CEWA	Cedar Waxwing
HETH	Hermit Thrush
HOWR	House Wren
LISP	Lincoln's Sparrow
OVEN	Ovenbird
RUGR	Ruffed Grouse
SASP	Savannah Sparrow
WTSP	White-throated Sparrow
YEWA	Yellow Warbler
YRWA	Yellow-rumped Warbler

Appendix B: Survey route centreline taken during 6-10 July 2015, for proposed BC Hydro Site C clearing area.




06-JUL-15 PARKING AREA
10-JUL-15 PARKING AREA
07-JUL-15 PARKING AREA
LEGEND
Survey Polygons
Accommodations
West Parking Area
Peace Riparian
Main Road ROW
Fenceline Transect
Survey Route
08-JUL-15 MAIN ROAD ROW
06-JUL-15 FENCELINE ROW
07-JUL-15 MAIN ROAD M
10-JUL-15 ACCOMMODATION POLY
09-JUL-15 RIPARIAN ISLAND

Pre-clearing Bird Nest Surveys for Proposed BC Hydro's Site C Construction Area (July 21-24, 2015)

Prepared by:

Todd Manning (RPBio., RPF) and Paul Chytyk
Strategic Resource Solutions (SRS)
Victoria, BC

Prepared for:

Bill Golding
Silvicon Services Inc.
Smithers, BC

26 July, 2015

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Introduction

The proposed BC Hydro Site C Dam is entering the initial clearing and construction phase of the project and will require areas of native vegetation to be cleared for project infrastructure, access and transmission corridors. Although most clearing on the proposed Site C site will occur during the bird non-nesting season (fall and winter months), some areas are planned to be cleared during the late bird breeding/nesting season. To minimize any risk of incidental take of active bird nests, BC Hydro requested pre-clearing bird nest surveys be initiated in areas proposed for cleared during the initial phases of Site C construction. Surveys were to identify any active or probable bird nest sites and establish protective buffers that would not be cleared while the nest site was active. The following report summarizes the findings of these surveys for the period July 21-24, 2015.

Study Area

The study area covered an area of approximately 20.0 ha along the north bank of the Peace River, north of the proposed Site C Dam site, and approximately 5 km southwest of Fort St. John. The survey area was divided into three survey polygons (Figure 7 and Figure 8) that are planned to be cleared during the initial phases of the proposed construction work.

The three survey polygons were as follows:

1) **East Parking Area Polygon (1.4 ha).** An area proposed to be cleared for public parking and turn-around access for visitors to the site. It is characterized by disturbed shrubby and trembling aspen areas in the east, and a mature trembling aspen (*Populus tremuloides*) stand with a minor component of white spruce (*Picea glauca*), in the west.
2) **Main Road ROW Polygon (14.9 ha).** An area proposed to be cleared and widened on either side of an existing built road in order to facilitate improved access. This polygon is a mix of mostly maturing and mature trembling aspen stands with the occasional small wetland, grassland opening, and shrubby transitional area.
3) **West Parking Area Polygon (3.7 ha).** An area proposed to be cleared for public parking and turn around access for visitors to the site, and is characterized by maturing and mature trembling aspen stands.

Methods

Strategic Resource Solutions (SRS) bird biologists conducted pre-clearing bird nest surveys following procedures developed for BC Hydro, specific to their proposed Site C project. Please refer to the document, *Protocol to Determine the Presence of Active Bird Nests* (SRS 2015b) for specific survey methodologies. Because finding active nests can be very time-consuming due to their cryptic nature, the intent of the surveys was not to find all active nests, but to identify probable nesting areas based on observed bird behaviours and surrounding habitat quality. Field surveys were conducted between 21-24 July 2015 and consisted of three separate surveys per polygon area within the four day period as required during the critical nesting period (SRS 2015b). Flagged buffers of 30 m radii were established around each identified active and probable nest area.

Results

Surveys located a total of 2 active nests and 2 probable nest sites in the study area (Figure 7). Active and probable nest sites were found for 3 different bird species (Cedar Waxwing, Hermit Thrush and White-throated Sparrow). No provincially or federally listed bird species or their nests were observed during this survey session.

Survey observations indicated that the breeding chronology of the 2015 nesting season is at the end of the critical nesting period since few active or probable nest sites were found. Most of the nest areas identified at the beginning of the survey had subsequently fledged young by end of the survey period. Additionally, many of the recently fledged family groups associated with nest areas at the beginning of the survey period had since moved from the immediate area by the end of the survey period. Seventy-two separate observations were made of adults with fledglings, suggesting that the majority of nesting birds had already successfully reared young. A few gatherings and small flocks of adults and fledglings of what were thought to be both local and outlying nesters were observed in the study area, suggesting that most nesting birds had already finished breeding and had begun to disperse.

The two identified nest areas of White-throated Sparrows and the single Hermit Thrush nest area were thought to be a result of re-nesting or double-brooding. The Cedar Waxwing nest area was thought to be a late nester, which is typical of this species.

In general, field observations indicated that the chronology of the nesting season was more advanced compared to an average year, perhaps due to the warm and early spring experienced in much of British Columbia that can facilitate earlier bird arrival dates, nest initiation and dispersal from the breeding grounds.

Results for the East Parking Area Polygon

Three full surveys were conducted in the polygon on 22, 23 and 24 July 2015. In total, no active or probable nest sites were located during surveys in the East Parking Area Polygon (Figure 8). No retention buffers are required for this polygon.

Free-to-Clear Status: A full survey cycle (three nest surveys) for the critical nesting period was completed for the East Parking Area Polygon. No active or probable nest sites were found during surveys and the entire polygon has a free-to-clear status until and including Monday, 27 July 2015.

A well-groomed and recently maintained hiking trail (Figure and Figure 8) was found along a 100 m length of the western boundary of the proposed clearing polygon, approximately between UTMs 10/632492E/6230622N to the west and 10/632571E/6230667N to the east. The clearing of the proposed polygon will likely impact the current configuration and use of this hiking trail.

Four nests of Yellow Jacket Wasps and Bald-faced Hornets (Figure) were located within the area to be cleared. Disturbed wasp and hornet nests may pose a potential risk to unsuspecting clearing crews. Wasp and hornet nests were found at the following UTMs: 10/632589E/6230664N, 10/632598E/6230658N, 10/632613E/6230637N and 10/632555E/6230673N.

Figure 1: A well-groomed and maintained hiking trail along the western edge of the proposed polygon (left) and Bald-faced Hornet nests, a potential risk to clearing crews (right).

Results for the Main Road ROW Polygon

Three full surveys were conducted in the polygon; full surveys or partial surveys were completed on each day between 21-24 July 2015. In total, 2 active and 1 probable nest sites were located during surveys in the Main Road ROW Polygon (Figure 7 and Table 5). Due to overlapping nest sites of more than one bird species, approximately 2.5 flagged retention buffers (0.7 ha) were flagged with blue ribbon to protect these nest sites, or approximately 5.1% of the 14.9 ha polygon.

Table 1: Active and probable nest sites found in the Main Road ROW Polygon during 21-24 July 2015 surveys.

Bird Species	Buffer #	Nest Status	Centre Point UTM (Zone 10)		Buffer Radius
			Easting	Northing	
Cedar Waxwing	1	Active	629890	6230957	30 m
Hermit Thrush	2	Probable	629918	6230979	30 m
White-throated Sparrow	3	Active	629716	6230867	30 m

Free-to-Clear Status: A full survey cycle (three nest surveys) for the critical nesting period was completed for the Main Road ROW Polygon. Except for the 3 buffers around the identified nest areas (Table 5), the remaining area of the polygon has a free-to-clear status until and including Monday, 27 July 2015.

A Black Bear den was located at 10/630071E/6230884N, approximately 25 m from the existing road edge and 15 m within the clearing boundary (Figure). The den was located along a side slope and the entrance of the den was approximately 80 cm across and appeared to extend 3 m into the hillside. A well demarcated trail led to the entrance; however, there was no sign of any recent use, i.e., bedding material, bear scat, foot prints or hair.

Figure 2: Entrance to Black Bear den within clearing area found along the existing Main Road right-of-way.

Results for the West Parking Area Polygon

Three full surveys were conducted in the polygon on 21, 23 and 24 July 2015. In total, 1 probable nest site was located during these surveys in the West Parking Area Polygon (Figure 7 and Table 7). One flagged retention buffer (0.29 ha) was flagged with blue ribbon (Figure) to protect the nest site, or approximately 9.5% of the 3.7 ha polygon.

Table 2: Probable nest site found in the West Parking Area Polygon during 21-24 July 2015 surveys.

Bird Species	Buffer #	Nest Status	Centre Point UTM (Zone 10)		Buffer Radius
			Easting	Northing	
White-throated Sparrow	1	Probable	630018	6231382	30 m

Free-to-Clear Status: A full survey cycle (three nest surveys) for the critical nesting period was completed for the West Parking Area. Except for the single buffer around the identified nest area (Table 7), the remaining area of the polygon has a free-to-clear status until and including Monday, 27 July 2015.

Figure 3: A flagged buffer for a probable White-throated Sparrow nest area in the West Parking Area polygon.

Discussion

The purpose of the surveys was to identify active and probable nest sites as well as gauge the potential number and relative abundance of bird nests that may be encountered during future proposed clearing for the Site C project.

Relative Abundance of Bird Nests

In an approximate survey area of 20.0 ha, only 2 active and 2 probable nest sites were identified during surveys. Due to overlapping nest sites of more than one species, a total of 3.5 retention buffers (1.0 ha) were established to protect these nest sites, or approximately 5.0% of the 20.0 ha survey area. This represents a 70% reduction in the percentage of area required for nest buffer retention from survey results obtained during the peak breeding season in mid-June 2015, when a total of 37 retention buffers (10.4 ha) would have been required to protect identified nest sites (11 active and 44 probable), or approximately 16.7% of a 62.3 ha survey area (SRS 2015a).

Nesting Season Chronology

Observations during the survey period indicated that the nesting season was advanced and likely at the end of the critical nesting period and starting the caution nesting period (BC MFLRO 2011). Several observations supported this conclusion:

1. A 93% reduction in the number of active and probable nest sites identified from surveys in the peak nest period of mid-June (55 nest sites) (SRS 2015a) to late July (4 nest sites). Survey effort was similar between the two survey periods, but the late July surveys covered only 1/3 of the area compared to the mid June surveys. Additionally, the number of different species observed exhibiting nesting behaviour dropped 88%, from 25 species in mid-June (SRS 2015a) to 3 species

in late July. These declines in both the number of nesting bird observations and nesting species suggest that the critical nesting season for most bird species has now ended in the study area.

2. Over 70 separate observations of adults feeding fledglings were documented in the study area during the survey period. This compares to only 4 separate observations of active or probable nesting behaviour. The significantly greater number of fledgling observations versus nesting observations indicates that the breeding chronology was well-advanced for late-July and likely no longer within the critical nesting period.
3. Evidence from survey observations indicated that likely only three species (Cedar Waxwing, Hermit Thrush and White-throated Sparrow) were currently nesting in the study area during the July 21-24 survey period. Both White-throated Sparrow and Hermit Thrush are known to regularly double-brood or re-nest if conditions are favourable (Baicich and Harrison 1997). It is most likely that these species were re-nesting as a warm, early spring experienced in 2015 is conducive for double-brooding. The Cedar Waxwing is typically known as a late seasonal nester (Environment Canada 2014), and the active nest identified during the survey period should not be unexpected. The three nesting species during the survey period represents 12% of the 25 nesting species observed during mid-June surveys (SRS 2015a), again suggesting the nesting season is nearing the end for most species and that it is likely no longer the critical nesting period in the study area.
4. Few gatherings of mixed bird species assemblages including adults and their fledglings were observed in the study area. The lack of these gatherings or flocks suggests that most bird species that were nesting locally within the study area have already dispersed.

Survey observations suggest that the 2015 nesting season chronology is well-advanced and from a biological perspective, the critical nesting period has now passed in the study area prior to the general guideline of 31 July (BC MFLNRO 2011). It is recommended that <u>during the next survey cycle tentatively scheduled to begin on 28 July, that the caution nesting period survey protocols (SRS 2015b) be implemented</u>.

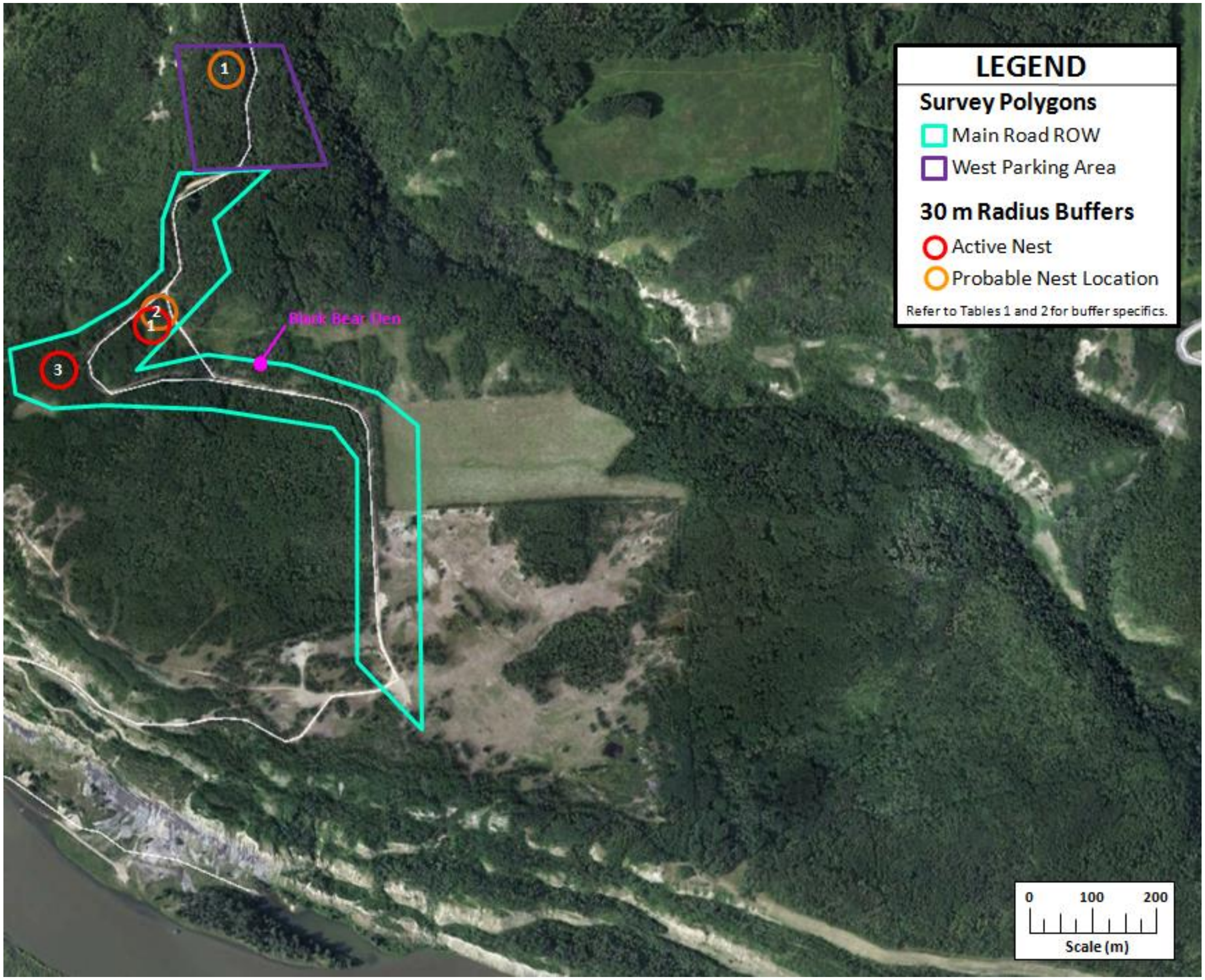

Figure 4: Active and probable nest sites located during 21-24 July surveys at proposed BC Hydro Site C west-side clearing areas (Google imagery).

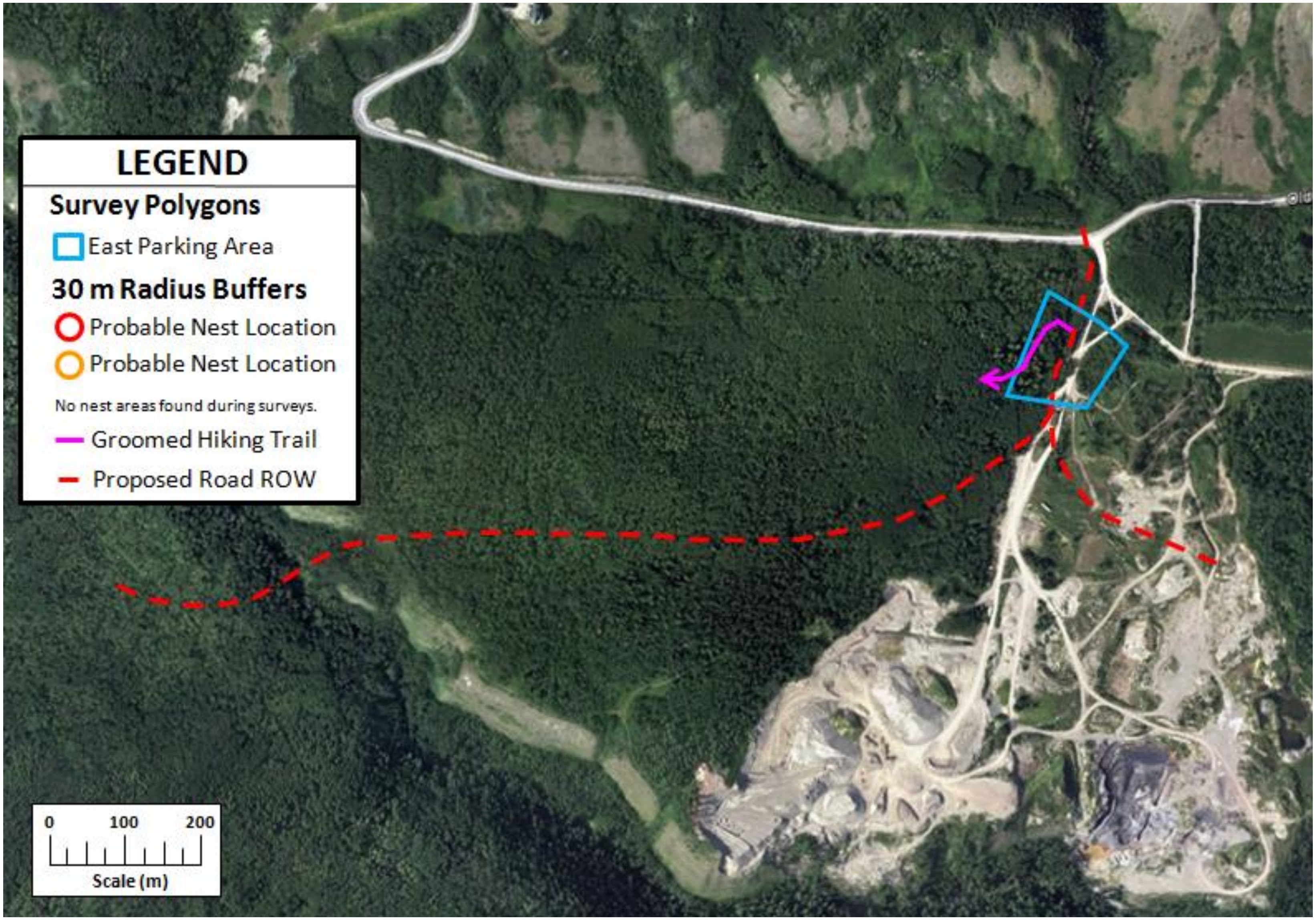

Figure 5: Results of 21-24 July surveys at proposed BC Hydro Site C east-side clearing areas (Google imagery).

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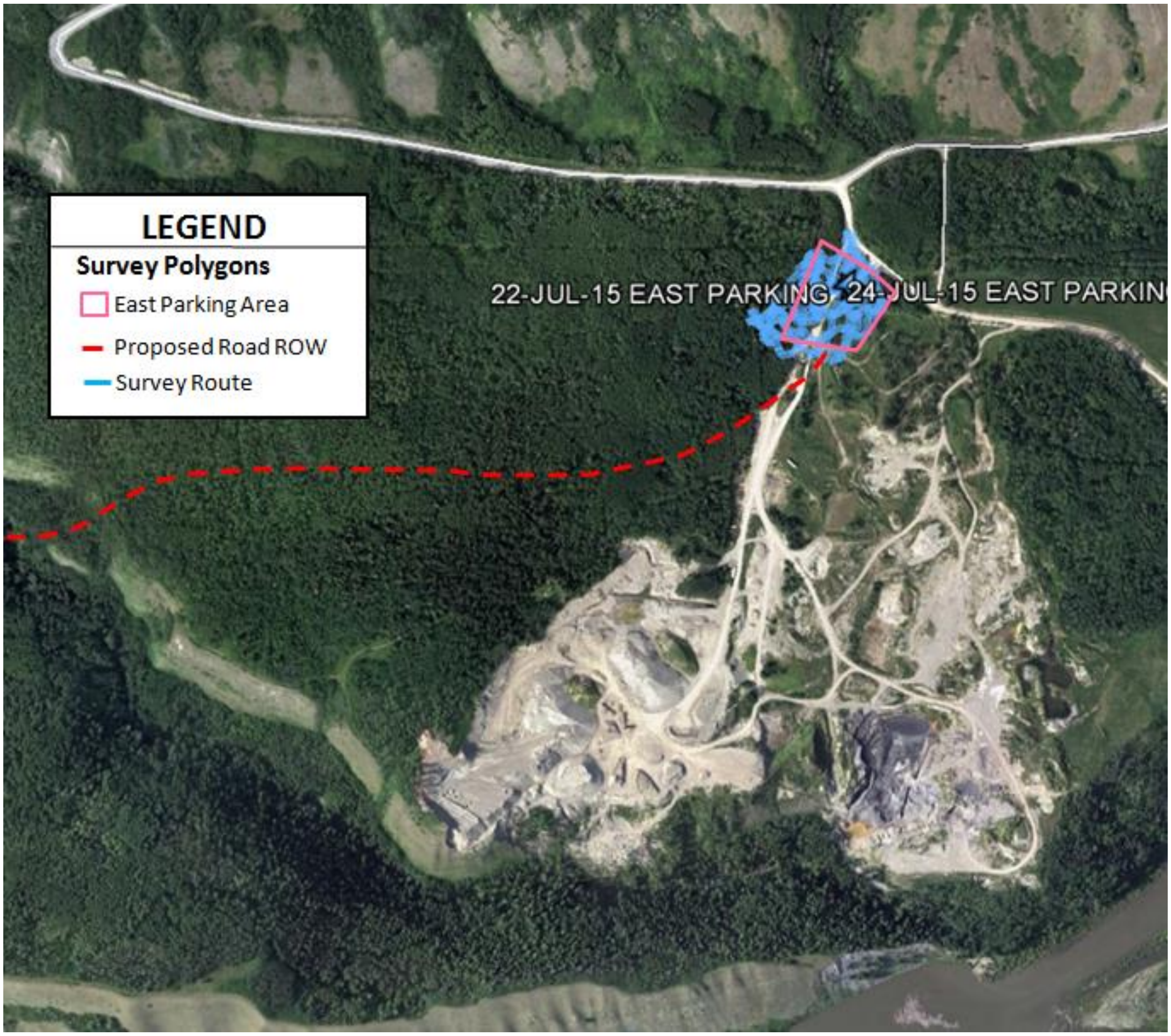
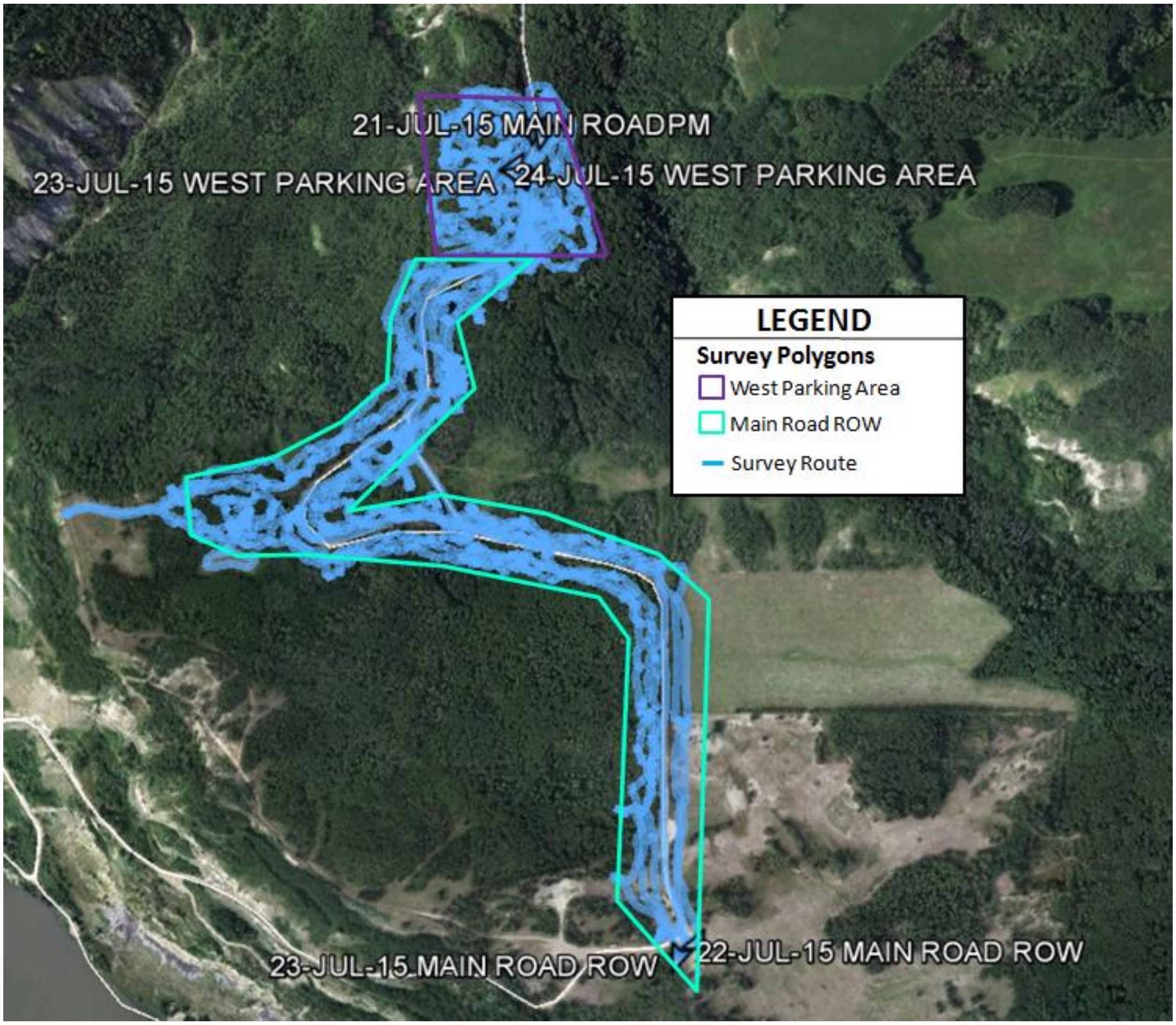
Appendix A: Survey route centreline taken during 21-24 July 2015, for proposed BC Hydro Site C clearing area.




21-JUL-15 MAIN ROADPM
23-JUL-15 WEST PARKING AREA
24-JUL-15 WEST PARKING AREA
LEGEND
Survey Polygons
West Parking Area
Main Road ROW
Survey Route
23-JUL-15 MAIN ROAD ROW
22-JUL-15 MAIN ROAD ROW

Pre-clearing Bird Nest Surveys for Proposed BC Hydro's Site C Construction Area (July 28 - August 5, 2015)

Prepared by:

Todd Manning (RPBio., RPF) and Paul Chytyk
Strategic Resource Solutions (SRS)
Victoria, BC

Prepared for:

Bill Golding
Silvicon Services Inc.
Smithers, BC

10 August, 2015

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Introduction

The proposed BC Hydro Site C Dam is entering the initial clearing and construction phase of the project and will require areas of native vegetation to be cleared for project infrastructure, access and transmission corridors. Although most clearing on the proposed Site C site will occur during the bird non-nesting season (fall and winter months), some areas are planned to be cleared during the late bird breeding/nesting season. To minimize any risk of incidental take of active bird nests, BC Hydro requested pre-clearing bird nest surveys be initiated in areas proposed for cleared during the initial phases of Site C construction. Surveys were to identify any active or probable bird nest sites and establish protective buffers that would not be cleared while the nest site was active. The following report summarizes the findings of these surveys for the period July 28 to August 5, 2015.

Study Area

The study area covers two separate survey areas: one on the north bank and one on the south bank of the Peace River. The survey area along the north bank of the Peace River is north of the proposed Site C Dam site, and approximately 5 km southwest of Fort St. John. This survey area is centered around the proposed accommodation polygon where worker temporary housing for the project is to be constructed. The other survey area is on the south bank of the Peace River, south of the proposed Site C Dam site, and approximately 9 km southwest of Fort St. John. This survey area consists of several polygons to be cleared for accessing aggregate deposits used for dam construction. Each of the two survey areas were subsequently divided into smaller survey polygons to facilitate ease of surveys and provide clearer communications between bird survey crews and construction workers.

In general, the north bank survey area consists of a mixture of open grasslands and shrublands that transition to maturing and mature trembling aspen (*Populus tremuloides*) stands with the occasional small wetland. A steep creek valley is located along the northern portion of the survey area and consists of mostly mature aspen and sporadic, small pockets of white spruce (*Picea glauca*). In general, the south bank survey area consists mostly of younger aspen stands with frequent open sedge wetlands bordered by willow and alder.

Methods

Strategic Resource Solutions (SRS) bird biologists conducted pre-clearing bird nest surveys following procedures developed for BC Hydro, specific to their proposed Site C project. Please refer to the document, *Protocol to Determine the Presence of Active Bird Nests* (SRS 2015c) for specific survey methodologies. Because finding active nests can be very time-consuming due to their cryptic nature, the intent of the surveys was not to find all active nests, but to identify probable nesting areas based on observed bird nesting behaviours.

Field surveys were conducted between 28 July and 5 August 2015 and consisted of two separate surveys per polygon area within a five day period as required during the caution nesting period (SRS 2015c). Results from previous surveys completed from 20-24 July 2015 (SRS 2015b) indicated the nesting season was well advanced and from a biological perspective the caution nesting period commenced on 28 July, a few days prior to the general guideline of 31 July (BC MFLNRO 2011).

Flagged buffers of 30 m radii were established around each identified active and probable nest area. These protective buffers remained in place until observations indicated that young had successfully fledged from the nest and were fully mobile.

Once a full survey cycle of two surveys was completed for a polygon area, a free-to-clear status report was issued indicating the specific area that was free to clear, the date until it was free to clear, and the locations of any nest area buffers.

Results

Surveys located four new probable nest site areas for White-throated Sparrow with two buffers established in both the north bank and south bank survey areas. White-throated Sparrow and Cedar Waxwing appeared to be the only two bird species for which evidence was found of current nesting in the study area by early August. Other species that appeared to be recently finishing nesting in the study area included: American Robin, Clay-colored Sparrow, Dark-eyed Junco, Hermit Thrush, House Wren, Least Flycatcher, Lincoln's Sparrow, Mourning Warbler, Red-eyed Vireo and Yellow Warbler. Many of these species were probably double-brooding, or nesting for the second time during the breeding season. It is quite likely that individuals of these latter species were still nesting within the study area during the survey period, but no survey observations were made to confirm this conjecture.

Survey observations indicated that the breeding chronology of the 2015 nesting season is at the end of the caution nesting period since few active or probable nest sites were found. Only four probable nest areas were located during surveys, of which two already had recent fledglings. Over 195 separate observations were made of adults with fledglings, suggesting that the majority of nesting birds had already successfully reared young. Additionally, many of the family groups observed with recent fledglings were easily dislodged from their original observation location and 'pushed' in front of observers, indicating that they had already dispersed from their specific nesting areas. Small flocks of adults and fledglings of mixed species including flocks of up to 20 American Robin were observed in the study area, suggesting that most nesting birds had already finished breeding and had begun to gather and disperse.

In general, field observations indicated that the chronology of the 2015 nesting season was more advanced compared to an average year, perhaps due to the warm and early spring experienced in much of British Columbia, which in can facilitate earlier bird arrival dates, nest initiation, rearing of young and dispersal from the breeding grounds.

Small flocks of 5-15 White-winged Crossbills were beginning to arrive in the study area during the current survey period. Crossbills are generally nomadic and stop in an area to breed if there is a sufficiently large conifer cone crop, their predominant food source. Crossbills may nest at any time of year and typically time their breeding activities to coincide with the ripening of cones. A heavy cone crop was observed on white spruce in the study area (Figure). However, these cones were still green, indicating that it may be still some time until crossbills initiate nesting in the study area. Future surveys will continue to monitor crossbill numbers and attempt to determine if and when they start initiating nesting in the study area.

Figure 1: Heavy crops of green cones on white spruce were observed in the study, a main food source for nesting crossbills.

Gray Jays were observed in the south bank survey area, but likely also occur in the north bank survey area, though they were not observed there. Gray Jays are early seasonal nesters that may initiate nesting as early as March, but may nest earlier if weather conditions are favourable.

The federally listed (Threatened) and provincially blue-listed species, Canada Warbler (BC CDC 2015), was observed in the study area. A pair of Canada Warbler was observed or heard over several days in the eastern portion of the L3 Creek Riparian survey polygon. This pair likely bred in the area as it was in suitable habitat, though no fledglings were observed.

Results for the North Bank Survey Area

Surveys were conducted in the North Bank survey area on 29 and 30 July and 1-3 and 5 August (Figure 7). Prior surveys conducted from 20-24 July 2015 (SRS 2015b) had established four 30 m radii nest buffers (Buffers #1-4) around active or probable nest sites (Table 5).

Surveys completed on 28 July in the White-throated Sparrow Buffer #4 in the West Parking Area indicated that there were two or more actively mobile fledgling sparrows present within the buffer area, so the buffer was removed to allow for clearing. Additional surveys on 28 July located another probable nest site for White-throated Sparrow indicated by agitated behaviour from an adult pair and the male carrying food. The probable nest site was located along the Main Road ROW and Buffer #5 was established around it, centered on UTM: 10U/629973E/6231219N.

Table 1: Protective buffers established around active and probable nest sites found in the north bank survey area during 28 July and 5 August 2015 surveys.

Buffer #	Bird Species	Centre Point UTM (Zone 10)		Survey Polygon
		Easting	Northing	
1	Cedar Waxwing	629890	6230957	Main Road ROW
2	Hermit Thrush	629918	6230979	Main Road ROW
3	White-throated Sparrow	629716	6230867	Main Road ROW
4	White-throated Sparrow	630018	6231382	West Parking Area
5 (new)	White-throated Sparrow	629973	6231219	Main Road ROW
6 (new)	White-throated Sparrow	631178	6230313	Temporary Roads

Also on 28 July, observations indicated the White-throated Sparrow Buffer #3 along the Main Road ROW had failed due to depredation or abandonment. The three eggs that were present on 24 July were no longer present in the nest on 28 July and there was no evidence of any adult sparrows in the immediate buffer area. The buffer was subsequently removed to allow for clearing.

Survey observations on 30 July in the Hermit Thrush Buffer #2 along the Main Road ROW indicated that there were up to two actively mobile fledgling thrushes present within the buffer area. However, the buffer was left in place as it was adjacent to and provided additional protection for the Cedar Waxwing Buffer #1.

Also on 30 July, an adult Cedar Waxwing was observed carrying nest material of what appeared to be seed fluff in the western portion of the L3 Creek Riparian polygon at UTM: 10U/630261E/6231117N. Four subsequent visits to the area did not detect any further evidence of nesting behaviour for this species. Cedar Waxwings are known as late seasonal nesters. In general, adult pairs and family groups with recent fledglings were seen more commonly in the study area than during previous survey periods, suggesting that this species is still likely nesting in the study area.

Surveys conducted on 3 August in the Cedar Waxwing Buffer #1 along the Main Road ROW found five actively mobile fledglings and two adult waxwings present within the buffer area. Consequently, both Buffer #1 and the adjoining Hermit Thrush Buffer #2, which was free-to-clear since 30 July, were removed to allow for clearing.

Additional surveys along the Temporary Roads on 3 August located another probable nest site for White-throated Sparrow where an adult pair was exhibiting agitated behaviour indicative of active nesting. Buffer #6 was established around this area, centered on UTM: 10U/631178E/6230313N.

Free-to-clear status reports for the north bank were issued to clearing crews on 28 July, 3 and 5 August.

Results for the South Bank Survey Area

Surveys were conducted in the South Bank survey area on 31 July and 2, 4 and 5 August (Figure 8). No prior surveys had been conducted in the South Bank survey area during previous survey periods.

Surveys on 4 August located a probable nest site for White-throated Sparrow located in the southwest polygon (Table). Surveys identified a partially developed young that had likely fledged the nest in the past day. The young had poorly developed wings and tail and was incapable of flying. An agitated adult male was also observed in the immediate area. The protective Buffer #1 was established around the area, centered on UTM: 10U/632533E/6226484N, as the young was not sufficiently agile to escape danger represented by clearing equipment, nor was it certain if there were any other young still present in the yet undiscovered nest.

Table 2: Protective buffers established around active and probable nest sites found in the south bank survey area during 28 July and 5 August 2015 surveys.

Buffer #	Bird Species	Centre Point UTM (Zone 10)		Survey Polygon
		Easting	Northing	
1 (new)	White-throated Sparrow	632533	6226484	Southwest
2 (new)	White-throated Sparrow	633416	6226857	Road Daylighting

Also on 4 August, surveys located another probable nest site of White-throated Sparrow along the road daylighting polygon. Surveys identified at least one partially developed young that had likely fledged the nest within that day. The young had poorly developed wings and was incapable of flying. An agitated adult pair was also observed in the immediate area. The protective Buffer #2 (Figure) was established around the area, centered on UTM: 10U/633416E/6226857N, as the young was not sufficiently agile to escape danger represented by clearing equipment.

Figure 2: Retained flagged (blue) White-throated Sparrow Buffer #2 on the left and cleared road right-of-way on the right.

A free-to-clear status report for the south bank was issued to clearing crews on 4 August.

Discussion

The purpose of the surveys was to identify active and probable nest sites as well as gauge the chronology of the breeding season based on field observations of bird behaviour and signs or evidence of nesting activity.

Nesting Season Chronology

Observations during the current survey period indicated that the nesting season was advanced and likely at the end of the caution nesting period and the start the exemption nesting period (BC MFLRO 2011). Several observations supported this conclusion:

1. A 95% reduction in the number of active and probable nest sites identified from surveys in the peak nest period of mid-June (55 nest sites) (SRS 2015a) to the early August period (3 nest sites). Survey duration between the two periods was similar, but the early August period had approximately double the survey effort as the peak nest period of mid-June due to having two crews surveying instead of one. Additionally, the number of different species observed exhibiting current nesting behaviour dropped 92%, from 25 species in mid-June (SRS 2015a) to 2 species in early August. <u>These declines in both the number of nesting bird observations and nesting species suggest that the caution nesting season for most bird species has now ended in the study area</u>.
2. Over 195 separate observations of adults feeding fledglings were documented in the study area during the survey period. This compares to only 4 separate observations of active or probable nesting behaviour. The significantly greater number of fledgling observations versus nesting observations indicates that the breeding chronology was well-advanced for early August and is likely no longer within the caution nesting period.
3. Small gatherings of mixed bird species assemblages including adults and their fledglings were observed in the study area. These gatherings or flocks suggest that most bird species are done nesting and are already dispersing from the study area and from areas beyond.
4. Local bird experts typically provide some of the best information on nesting species and breeding chronology due to their knowledge of an area acquired by years of local and regional field observations. Local bird expert Mark Phinney tends to advise August 1 as a reasonable date to end pre-clearing surveys for most passerines in northeast British Columbia (M. Phinney, pers. comm. July 2015). He estimates that >99% of the birds have finished nesting by that time and any nests found after this period are likely those of outlier individuals.
5. Evidence from survey observations indicated that likely only two species (Cedar Waxwing and White-throated Sparrow) were currently nesting in the study area in early August. White-throated Sparrow is known to regularly double-brood or re-nest if conditions are favourable (Baicich and Harrison 1997). It is most likely that this species was re-nesting as a warm, early spring experienced in 2015 is conducive for double-brooding. The Cedar Waxwing is typically known as a late seasonal nester (Environment Canada 2014). An adult Cedar Waxwing was observed carrying nest material on 30 July in the L3 Creek Riparian polygon, but subsequent

observations in the area did not find any further evidence of nesting. In general, it takes waxwings 28-33 days to nest, from egg laying to young fledging (Baicich and Harrison 1997). Extrapolating, the individual waxwing observed on 30 July, if nesting successfully, would require an active nest buffer until near the end of August, perhaps suggestive of an end date for pre-nesting surveys for this particular species. Similar observations of late nesting Cedar Waxwings have been documented previously in the study area. In 2014, a Cedar Waxwing nest was observed on the south bank with a female on the nest until early September. The female later abandoned the nest with eggs still unhatched (Anonymous, pers. comm. July 2015).

Survey observations suggest that the 2015 nesting season chronology is well-advanced and from a biological perspective, the caution nesting period has now passed in the study area prior to the general guideline of 15 August (BC Hydro survey protocol, SRS 2015c). The authors recommend that during the next survey cycle tentatively scheduled to begin on 6 August, that the exception nesting period survey protocols (SRS 2015c) be implemented at that date.

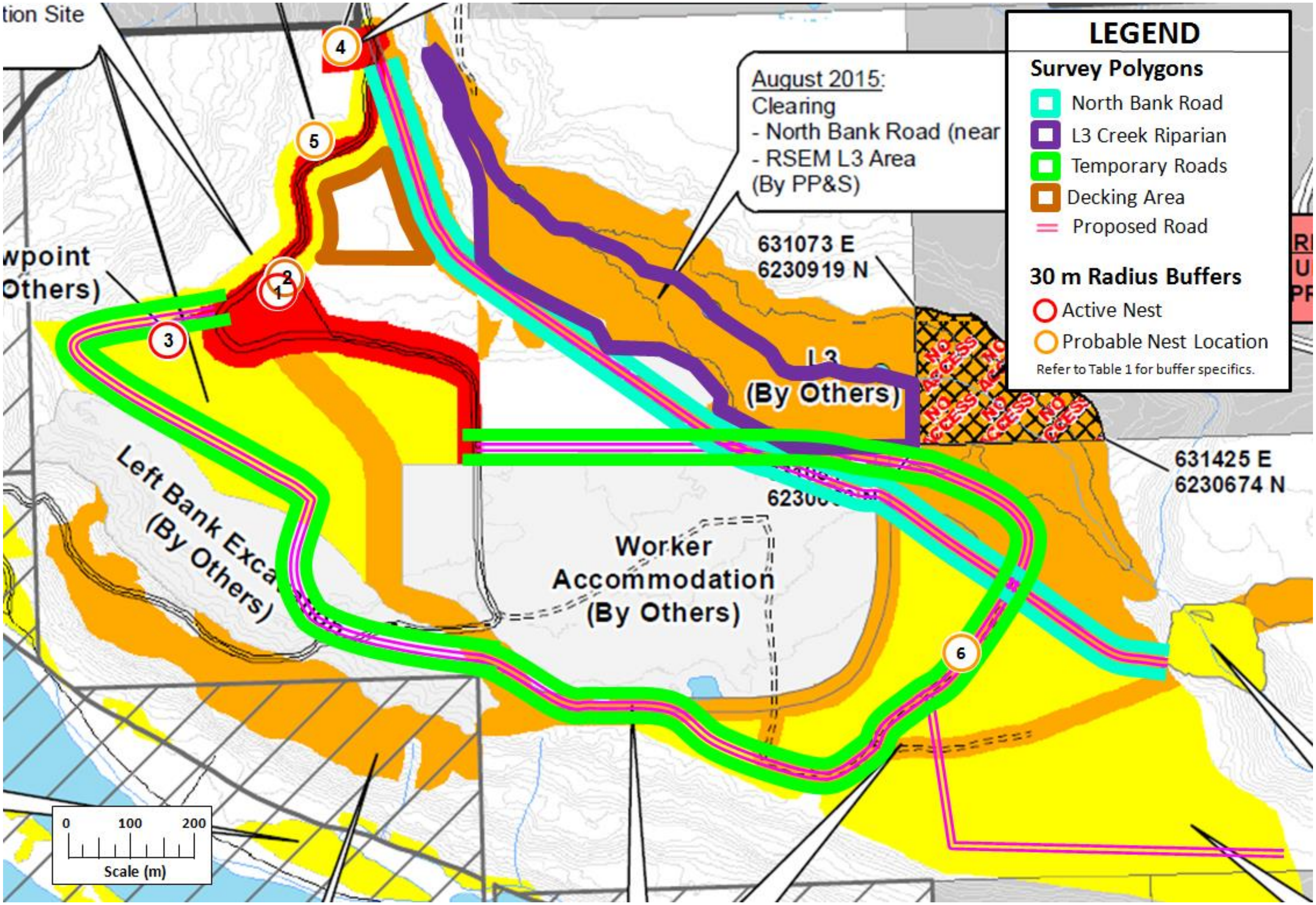

Figure 3: Active and probable nest sites located during 28 July to 5 August surveys at proposed BC Hydro Site C (north bank).

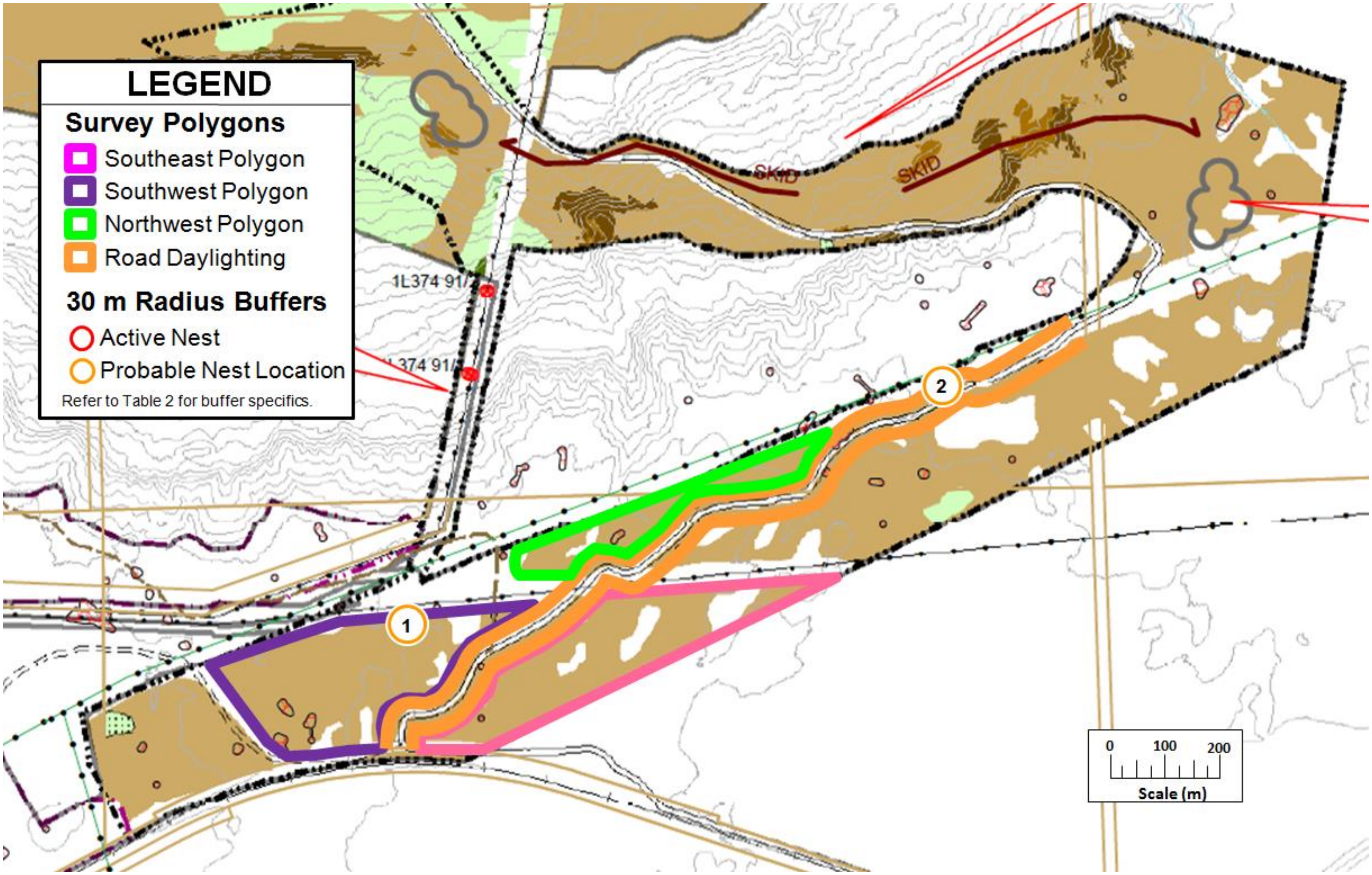

Figure 4: Active and probable nest sites located during 28 July to 5 August surveys at proposed BC Hydro Site C (south bank).

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Personal Communications

Anonymous. Contract biologist who prefers to remain anonymous, Fort St. John, BC.

Phinney, Mark. Environmental Advisor. Encana Corporation, Dawson Creek, BC.

Pre-clearing Bird Nest Surveys for Proposed BC Hydro's Site C Construction Area (August 6-20, 2015)

Prepared by:

Todd Manning (RPBio., RPF) and Paul Chytyk
Strategic Resource Solutions (SRS)
Victoria, BC

Prepared for:

Bill Golding
Silvicon Services Inc.
Smithers, BC

15 September, 2015

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Introduction

The BC Hydro Site C Dam is entering the initial clearing and construction phase of the project and will require areas of native vegetation to be cleared for project infrastructure, access and transmission corridors. Although most clearing on the Site C site will occur during the bird non-nesting season (fall and winter months), some areas are planned to be cleared during the late bird breeding/nesting season. To minimize any risk of incidental take of active bird nests, BC Hydro requested pre-clearing bird nest surveys be conducted in areas proposed for cleared during the initial phases of Site C construction. Surveys were to identify any active or probable bird nest sites and establish protective buffers that would not be cleared while the nest site was active. The following report summarizes the findings of these surveys for the period 6-20 August, 2015.

Study Area

The study area covers two separate survey areas: one on the north bank and one on the south bank of the Peace River. The survey area along the north bank of the Peace River is north of the proposed Site C Dam site, and approximately 5 km southwest of Fort St. John. This survey area is centered around the accommodation polygon where worker temporary housing for the project is to be constructed. The other survey area is on the south bank of the Peace River, south of the proposed Site C Dam site, and approximately 9 km southwest of Fort St. John. This survey area is centred on several polygons to be cleared for accessing aggregate deposits used for dam construction. Each of the two survey areas were subsequently divided into smaller survey polygons to facilitate ease of surveys and provide clearer communications between bird survey crews and clearing crews.

In general, the north bank survey area consists of a mixture of open grasslands and shrublands that transition to maturing and mature trembling aspen (*Populus tremuloides*) stands with the occasional small wetland. A small creek valley is located along the northern portion of the survey area and consists of mostly mature aspen and sporadic, small pockets of white spruce (*Picea glauca*). In general, the south bank survey area consists mostly of younger aspen stands with frequent open sedge wetlands bordered by willow and alder. Small areas of young and mature aspen mixed with spruce occur on upland benches and along riparian areas of the Peace River.

Methods

Strategic Resource Solutions (SRS) bird biologists conducted pre-clearing bird nest surveys following procedures developed for BC Hydro, specific to their Site C project. Please refer to the document, *Protocol to Determine the Presence of Active Bird Nests* (SRS 2015b) for specific survey methodologies. Since finding active nests can be very time-consuming due to their cryptic nature, the intent of the surveys was not to find all active nests, but to identify probable nesting areas based on observed bird nesting behaviours.

Results from previous surveys completed from 28 July to 5 August 2015 (SRS 2015a) indicated the nesting season was generally completed for most songbird species, except for potentially Cedar Waxwing and

White-winged Crossbill. Based on field observations and from a biological perspective, the caution nesting period ended on 5 August in the study area, a week and a half prior to the general guideline of 15 August, as suggested by SRS biologists (SRS 2015b). Regional guidelines did not provide suggested dates for the caution nesting period for songbirds, instead these guidelines had the critical nesting period ending on 31 July, immediately followed by the exceptions nesting period starting on 1 August (BC MFLNRO 2011).

Field surveys in the study area were conducted between 6-14 and 18-20 August 2015, and consisted of one survey per polygon area within a five day period as required during the exceptions nesting period (SRS 2015b). If active or probable nesting areas were identified, then flagged buffers of 30 m radii were to be established around each nest area. These protective buffers would remain in place until observations indicated that the nest had failed or young had successfully fledged from the nest and were fully mobile.

Once a full survey cycle of one survey was completed for a polygon area, a free-to-clear status report was issued indicating the specific area that was free to clear, the date until it was free to clear, and the locations of any nest area buffers.

Results

Surveys found no evidence of active nesting for any species during the survey period in the study area. Consequently, no protective buffers for active or probable nest areas were established during the survey period.

Cedar Waxwing and White-winged Crossbill were a primary focus for the pre-clearing bird nest surveys. Individual birds and family groups of Cedar Waxwing were observed regularly during the survey period, particularly in the north bank survey area. However, their numbers appeared to diminish towards the latter part of the survey period. White-winged Crossbill numbers continued to grow during the survey period. Most observations were of small wandering flocks that were foraging on the abundant, ripening spruce cone crop. Three observations were made of singing crossbills, which can be indicative of the initial phases of territory establishment or nesting. However, despite their presence, no specific observations were made to confirm nesting for either Cedar Waxwing or White-winged Crossbill during the survey period.

White-throated Sparrow was a late nesting species that had still been nesting in the study area during the previous survey period. Approximately 65 individual observations of adults with fledglings were made for this species during the current survey period. Although still present in relatively large numbers, no observations indicated that White-throated Sparrow was currently nesting in the study area.

Gray Jays were observed in the south bank survey area, but likely also occur in the north bank survey area, though they were not observed there. Gray Jays can be early seasonal nesters that may initiate nesting as early as March, but may nest earlier if weather conditions are favourable.

The federally listed (Threatened) and provincially blue-listed species, Canada Warbler (BC CDC 2015), was also observed in the study area. Individual adult birds were observed along the L3 Creek Riparian

Polygon on both 7 and 8 August at UTM: 10U/630195E/6231336N and 10U/630777E/6230794N, respectively. This species had been observed in this area during previous survey periods and was likely nesting within the survey polygon during the summer as it contained suitable nesting habitat.

Small flocks of mixed bird species assemblages were observed in the study area, particularly along movement corridors such as roadways and riparian areas of the Peace River. Surveys also had over 167 separate observations of adults with fledglings during the survey period; however, many of these family groups appeared to be dispersed from locales outside of the study area, suggesting that fall migration had commenced.

No observations were made that would have indicated any active breeding within the study area. By the end of the survey period, field observations indicated that breeding for 2015 had ended in the study area for all songbird species, except for perhaps White-winged Crossbill. As a result, on 21 August pre-clearing bird nest surveys were discontinued and a free-to-clear status was granted for all areas, except for polygons that contained mature white spruce, i.e., potential nesting habitat for White-winged Crossbill (Appendix A).

Results for the North Bank Survey Area

Surveys were conducted in the north bank survey area on 6-8, 10, 12-14 and 18-20 August (Figure 7 and Figure 8). Prior surveys conducted between 28 July and 5 August 2015 (SRS 2015a) had established one 30 m radii nest buffer (Buffer #1) around a probable White-throated Sparrow nest area (Table 5) that was still in effect during the current survey period. The buffer was established on 3 August in the Temporary Roads SE Polygon (UTM: 10U/631178E/6230313N) after surveys identified an adult pair exhibiting agitated behaviour indicative of active nesting. A subsequent survey on 6 August found an adult feeding a mobile fledgling young in the immediate area, and the buffer was subsequently removed.

Table 1: Protective buffers established around probable nest sites found in the north bank survey area during previous pre-clearing surveys.

Buffer #	Bird Species	Centre Point UTM (Zone 10)		Survey Polygon	Date Established	Date Removed
		Easting	Northing			
1	White-throated Sparrow	631178	6230313	Temporary Roads SE	3 August	6 August

No other nesting behaviour was observed for any species in the survey area and consequently, no protective buffers were established during the survey period on the north bank. Daily free-to-clear status reports for the north bank were issued to clearing crews on 6-12, 14, and 18-20 August.

Cedar Waxwings were observed regularly throughout the north bank survey area (Table). Most observations were of individual birds, family groups or small flocks flying overhead, perched or foraging in trees. No nesting or breeding behaviour for Cedar Waxwing was observed during the survey period.

Table 2: Observations of Cedar Waxwings for the north bank survey area during the 6-20 August 2015 survey period.

Date	Survey Polygon
6 August	Temporary Road SW
7 August	L3 Creek Riparian NW
8 August	L3 Creek Riparian SE
8 August	Atco Loop Road
8 August	North Bank Road (East)
10 August	Morgan Tie-In Road
10 August	Atco Loop Road
12 August	L3 Creek Riparian SE
13 August	Temporary Road SW
14 August	Temporary Road SW
18 August	L Spur
19 August	Temporary Road SE
19 August	Atco Loop Road
20 August	L3 Creek Riparian SE
20 August	L3 Creek Riparian SE

Numerous White-winged Crossbills were observed in the survey area during the survey period (Table). Most observations were of one or two birds or small flocks of up to 15-20 birds flying overhead. However, single observations in both the North Bank Road (East) Polygon and Temporary Road SE Polygon were of singing birds that were perhaps indicative of the initial phases of territory establishment or nesting behaviour. No other specific nesting behaviour for White-winged Crossbill was observed during the survey period.

Table 3: Observations of White-winged Crossbills for the north bank survey area during the 6-20 August 2015 survey period.

Date	Centre Point UTM (Zone 10)		Survey Polygon	Behaviour
	Easting	Northing		
7 August	630626	6231204	L3 Creek Riparian NW	Flying overhead.
8 August	632204	6230384	North Bank Road (East)	Large flock flying overhead.
8 August	631173	6230576	Atco Loop Road	Flying overhead.
8 August	631050	6230749	L3 Creek Riparian SE	Flying overhead.
11 August	632367	6230423	North Bank Road (East)	Perched and singing.
12 August	631033	6230377	Atco Loop Road	Flying overhead.
14 August	631465	6230210	Temporary Road SW	Flying overhead.
18 August	631263	6229968	L Spur	Flying overhead.
19 August	630179	6230299	Temporary Road SE	Flying overhead.
19 August	630930	6230263	Temporary Road SE	Perched and singing.
20 August	632528	6230474	L3 Creek Riparian NE	Flying overhead.

Results for the South Bank Survey Area

Surveys were conducted in the South Bank survey area on 7-9, 11, 13, 14, 18 and 19 August (Figure and Figure). Prior surveys conducted between 28 July and 5 August 2015 (SRS 2015a) had established two 30 m radii nest buffers (Buffers #1 and #2) around probable White-throated Sparrow nest areas (Table) that were still in effect during the current survey period.

Table 4: Protective buffers established around probable nest sites found in the south bank survey area during previous pre-clearing surveys.

Buffer #	Bird Species	Centre Point UTM (Zone 10)		Survey Polygon	Date Established	Date Removed
		Easting	Northing			
1	White-throated Sparrow	632533	6226484	Southwest	4 August	9 August
2	White-throated Sparrow	633416	6226857	Road Daylighting	4 August	9 August

On 4 August, a protective buffer (Buffer #1) was established around a probable White-throated Sparrow nest area in the Southwest Polygon (UTM: 10U/632533E/6226484N) after surveys identified a poorly developed young incapable of flying and an agitated adult male. Subsequent surveys on 7 and 9 August found no evidence of any young or adults present and it was assumed the birds had successfully fledged and the buffer was removed on 9 August.

Also on 4 August, a protective buffer (Buffer #2) was established around a probable White-throated Sparrow nest area in the Road Daylighting Polygon (UTM: 10U/633416E/6226857N) after surveys identified at least one poorly developed young incapable of flying. Subsequent surveys on 7 and 9 August again found no evidence of any young or adults present and it was assumed that the birds had successfully fledged and the buffer was removed on 9 August.

No other nesting behaviour was observed for any species in the survey area and consequently, no protective buffers were established during the survey period on the south bank. Daily free-to-clear status reports for the south bank were issued to clearing crews on 7-9, 11, 13, 14, 18 and 19 August.

Cedar Waxwings were observed occasionally in the south bank survey area (Table). Most observations were of individual birds or family groups flying overhead. No nesting or breeding behaviour for Cedar Waxwing was observed during the survey period.

Table 5: Observations of Cedar Waxwings for the south bank survey area during the 6-20 August 2015 survey period.

Date	Survey Polygon
11 August	Southwest
13 August	Northeast
13 August	Southwest-West
14 August	Area K-1

Few White-winged Crossbills were observed in the survey area during the survey period (Table). One observation was of a few birds flying overhead and one was of a singing bird in the Southwest-West Polygon that may have been indicative of initial phases of territorial establishment or nesting behaviour. No other specific nesting behaviour for White-winged Crossbill were observed during the survey period. A flock of 10-12 Red Crossbills were also observed flying overhead in the Southwest-West Polygon on 13 August.

Table 6: Observations of White-winged Crossbills for the south bank survey area during the 6-20 August 2015 survey period.

Date	Centre Point UTM (Zone 10)		Survey Polygon	Behaviour
	Easting	Northing		
8 August	632140	6226371	Southwest-West	Perched and singing.
9 August	633796	6226864	Northeast	Flying overhead.

Discussion and Recommendations

The purpose of the surveys was to identify active and probable nest sites as well as gauge the chronology of the breeding season based on field observations of bird behaviour and signs or evidence of nesting activity.

Nesting Season Chronology

By the end of the survey period, observations indicated that the nesting season had generally ended in the study area for all songbird species, except for perhaps White-winged Crossbill. As such, on 21 August protocols for the "Exceptions Period with no breeding activity expected" (Appendix A) was initiated and all pre-clearing bird nest surveys were discontinued. Several observations supported these conclusions:

1) Surveys found no evidence of active nesting for any species during the survey period in the study area.
2) Although surveys had over 167 separate observations of adults with fledglings during the survey period, many of these family groups were associated with small flocks or were of species that do not breed in the study area (e.g., Black-polled Warbler). Small flocks of mixed songbird species were observed along movement corridors such as roadsides and the Peace River. These observations suggested that many of the study area's breeding species had already dispersed and fall migration had commenced.
3) Cedar Waxwings, one of the latest breeding songbirds (Environment Canada 2014), were regularly observed throughout much of the study area. Most observations were of individual birds, family groups or small flocks; however, no nesting or breeding behaviour for this species was observed during the survey period.
4) White-winged Crossbills, a species that can breed at any time of the year when there are favourable spruce cone crops (Benkman 2012), were increasingly observed in the survey area during the survey period. Most observations were of one or two birds or small flocks of up to 15-

20 individuals flying overhead. Three observations were of singing birds that were perhaps indicative of initial phases of territorial establishment or nesting behaviour. No other specific nesting behaviour for White-winged Crossbill were observed during the survey period. The spruce cone crop appeared to be heavy and was beginning to ripen on most trees, suggesting that suitable nesting conditions were present for crossbills in the study area.

Survey observations suggest that the 2015 nesting season had ended in the study area for all songbird species, except for perhaps White-winged Crossbill. Pre-clearing bird nest surveys are no longer required for all areas, except for polygons that contained mature white spruce that represent potential nesting habitat for White-winged Crossbill (Appendix A). Surveys and habitat assessments for White-winged Crossbill in these spruce areas should be conducted prior to the end of August following the protocols outlined in Appendix B. Pre-clearing bird nest surveys should recommence in mid to late February, depending on seasonal conditions, for early nesters such as Gray Jay, owls and raptors (Environment Canada 2014).

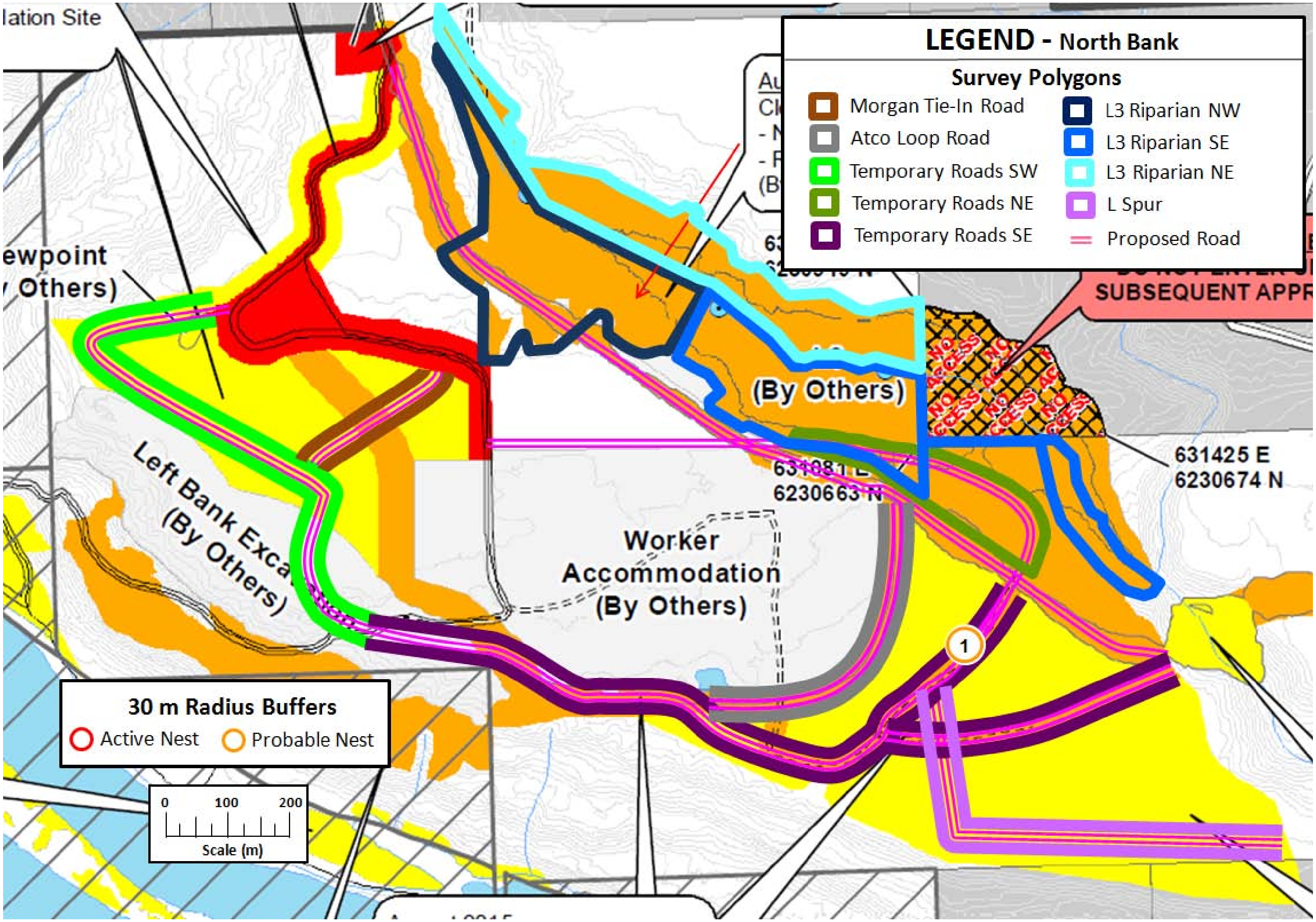

Figure 1: Areas surveyed during 6-20 August 2015 at BC Hydro Site C (north bank).

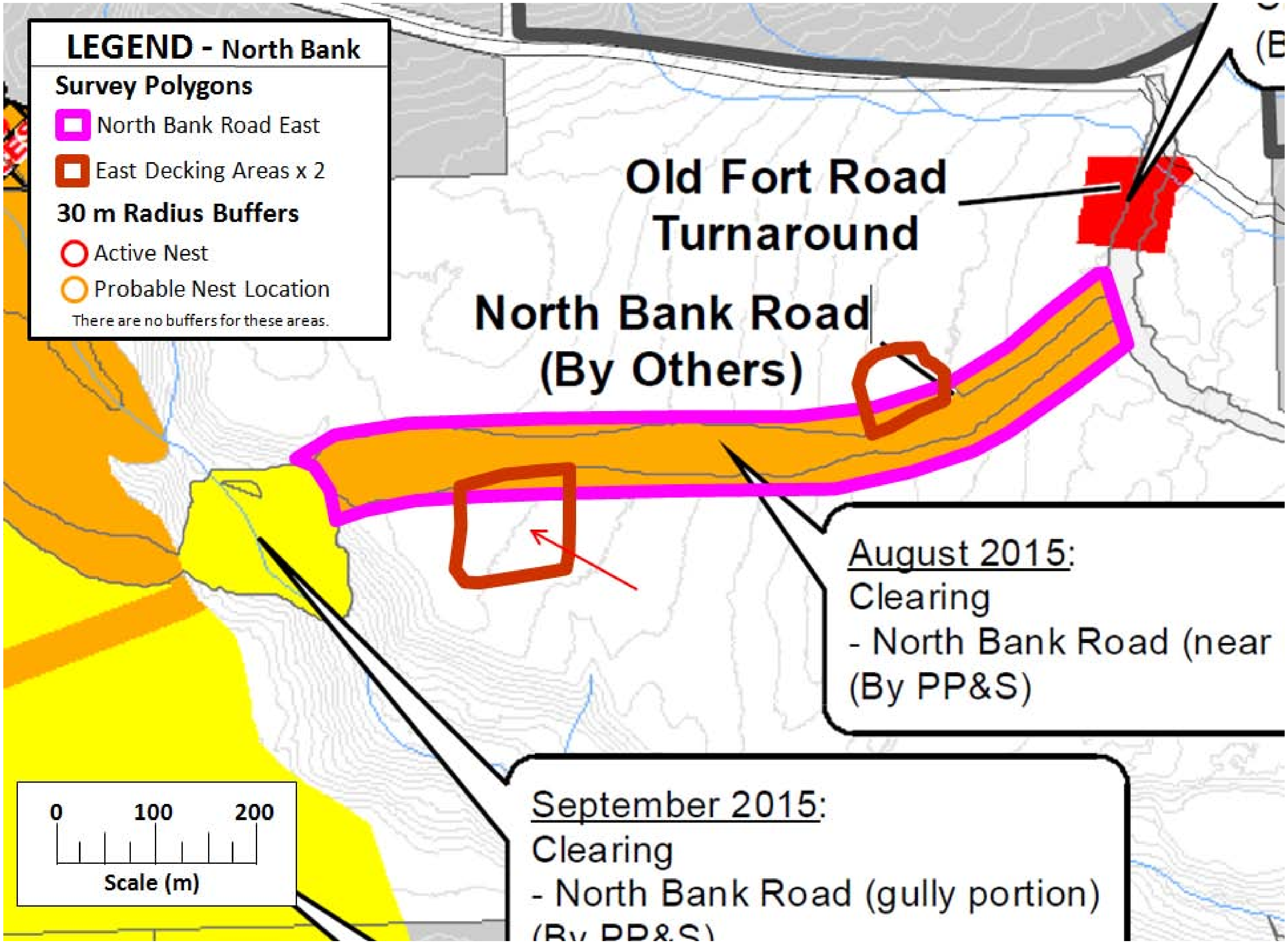

Figure 2: Areas surveyed during 6-20 August 2015 at BC Hydro Site C (north bank road east).

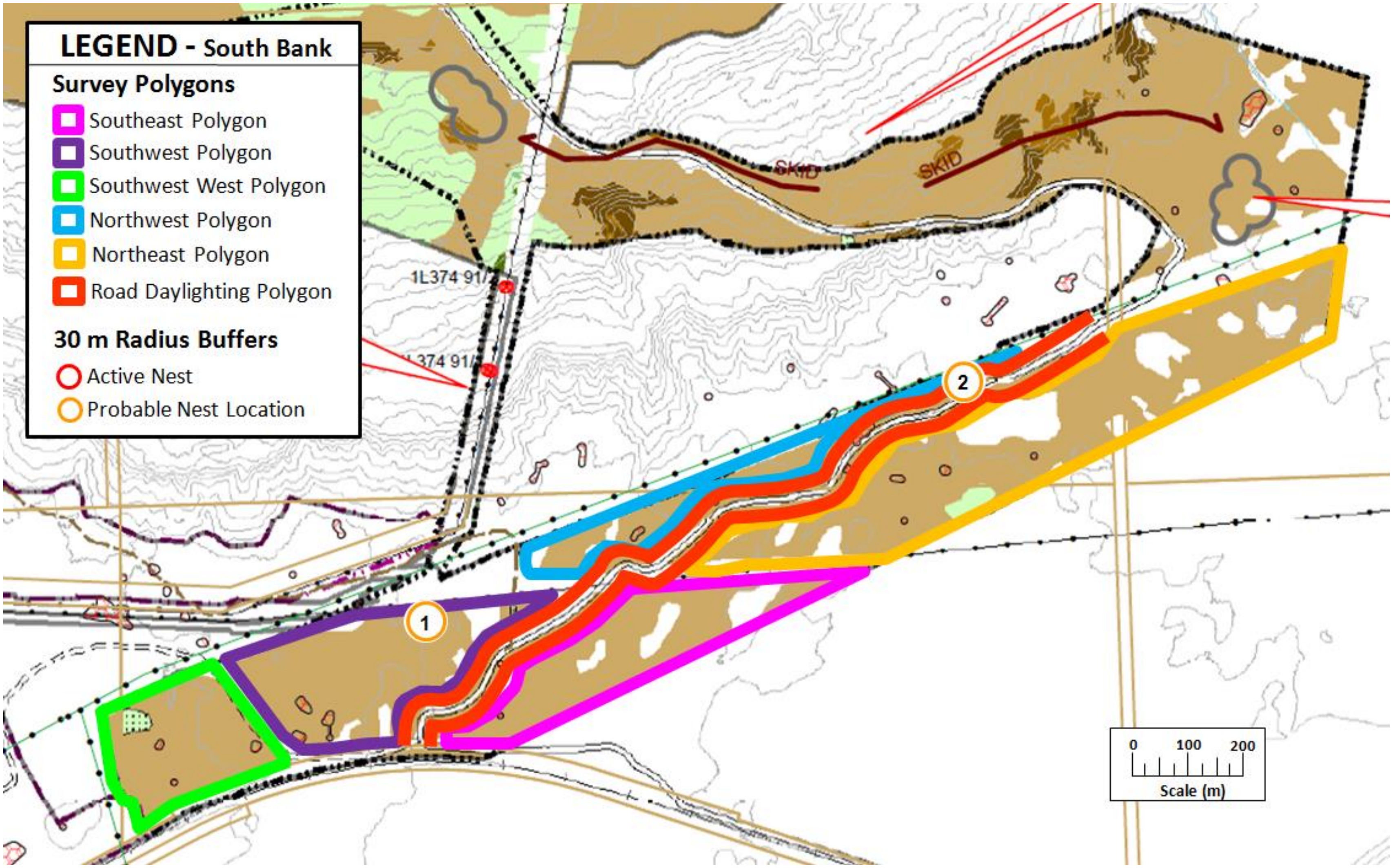

Figure 3: Areas surveyed during 6-20 August 2015 at BC Hydro Site C (south bank).

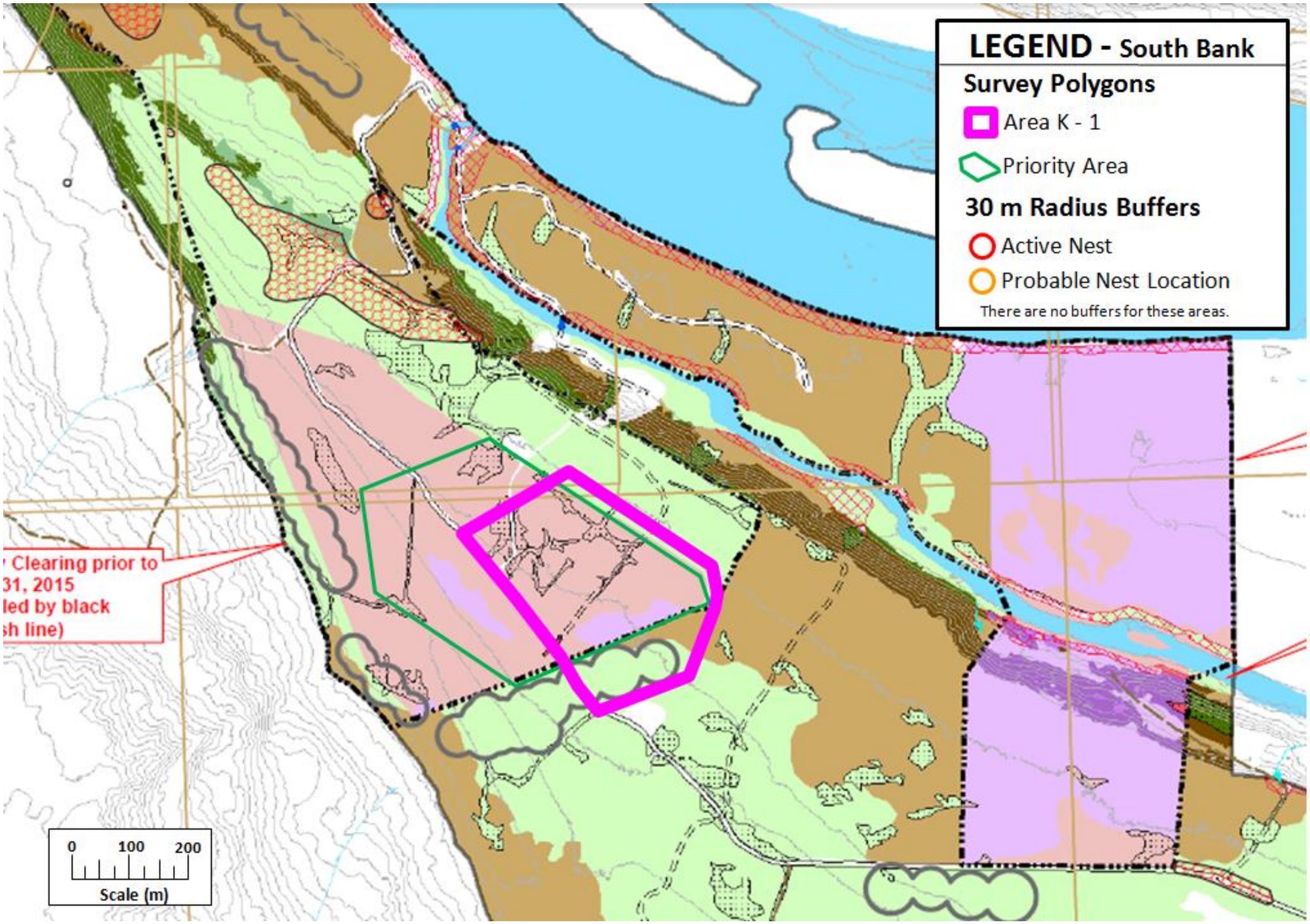

Figure 4: Areas surveyed during 6-20 August 2015 at BC Hydro Site C (south bank Area K - 1).

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Appendix A: Letter of 20 August 2015 indicating the end of pre-clearing bird nest surveys.

Strategic Resource Solutions (SRS)
5148 William Head Rd.
Victoria, British Columbia. V9C4H5
Ph. (250) 478-7822
Email: etmanning@shaw.ca

To: Paul Veltmeyer (RPF)
Vegetation Project Manager
BC Hydro, Site C Clean Energy Project

Aug. 20, 2015

Site C Breeding Bird Nest Survey Recommendations

As you know, SRS biologists have been conducting forest breeding bird nest surveys since mid-June 2015, using protocols described in SRS (2015). Since then we have progressed through the Critical and Cautionary nest survey periods, and as of Aug. 6 we have been conducting nest surveys as per the Exceptions Period protocols (SRS 2015a). However, based on our recent field observations over the past two weeks, it is now clear that as of Aug. 21, we will be in what we are now calling the" Exceptions Period with no breeding activity expected" (see SRS 2015b, attached below).

Please find below my recommendations concerning continued bird nest survey protocols during the Exceptions Period for the Site C project footprint areas.

1) Based on observations of bird abundance, distribution and behaviour over the past 2 weeks, it is clear that the overall bird activity in the project area has slowed down significantly. Many songbirds are forming multiple-species flocks which is a clear indication of the commencement of fall migration.
2) Consequently, beginning on Aug. 21 we will be operating in what we are calling the "Exceptions Period with no breeding activity expected" (SRS 2015b). This means there will be a **blanket "free to clear" status for all operational areas going forward as of Aug. 21 unless it becomes apparent that species-specific protocol needs to be implemented at certain locations or time slots** (e.g., spruce stands with confirmed breeding for crossbills or locations with active stick nests for winter-breeding owls).
3) We are recommending that an SRS crew (3 biologists) spend 4 days later this month (Aug. 28-31) doing broader sweep-style recce surveys focusing on areas with spruce and mixed wood stands in order to determine the breeding chronology/activity of crossbills that may be in the project area (this species feeds on spruce seeds and nests in spruce). This information will help inform what sorts of surveys (timing, location) need to be conducted in the fall and winter. The most likely results will be surveys for owls and some corvids (jays, ravens) beginning around mid-

February 2016, but depending on what we find out at the end of August, a few fall surveys for crossbills may be prudent.

4) Obtain forest cover maps for areas scheduled for clearing over the next 1-4 months. Emphasis on spruce dominant and mixed wood stands is of most use from our perspective.

Please don't hesitate to contact me directly if you have any questions about the above recommendations.

Sincerely,

Todd Manning (RPBio., RPF)

Strategic Resource Solutions (SRS)

Literature Cited

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Strategic Resource Solutions (SRS). 2015b. Addendum to the Exceptions Nesting Period surveys. Prep. by Strategic Resource Solutions, Victoria, BC. Aug. 18, 2015. 2 pp.

3.2.7.3 During the Exceptions Nesting Period

Appendix B: Draft survey protocols for the exceptions nesting period.

The Exceptions Nesting Period survey protocol is typically employed at times of year when very few bird species are expected to be breeding. Due to the highly variable nature of bird nesting behavior at this time, overall and species specific protocols have been designed to minimize risk of non-compliance with the *BC Wildlife Act*, *MBCA* and *SARA.*

General Application of the Exceptions Nesting Period Protocol (no breeding activity expected)

For time periods (generally September 1 to February 15) when the bird biologist determines that bird breeding activity is unlikely, then no formal surveys will be conducted and "free to clear" status can be implemented until breeding evidence is detected. These determinations should also be habitat specific (example: aspen forest is "free to clear", but proposed clearing in spruce stands and bogs require a survey). Breeding assessments should be conducted semi-regularly in areas scheduled for clearing;the frequency of surveys during the Exceptions Period will be dependent on observations of local bird breeding activity and the type of habitat (e.g., spruce vs. aspen) slated for clearing. Breeding assessments will consist of a walk-through of different habitat types, looking specifically for breeding activity of target species. If no breeding evidence is detected then a "free to clear" status can continue. If breeding evidence is found, then species-specific survey protocols will be implemented as described below.

Application of the Exceptions Nesting Period Protocol (late breeding activity expected or detected)

During August and occasionally extending into September, several species of songbirds frequently exhibit breeding behavior, including nest building, egg laying and the successful fledgling of young. Nest sites are typically distributed widely over the landscape, but can usually be detected relatively easily. Therefore, once the Caution Nest Period is over, the following protocol can be implemented for the Exceptions Period, generally until August 31. Assessments will consist of a single nest survey that will allow clearing to occur following the survey for a 5 day period. If clearing does not occur within these 5 days, then a new nest survey should be completed which would commence a new 5 day period where clearing is allowed. This protocol should generally be followed until August 31 unless local breeding chronology and species observations suggest otherwise.

Application of the Exceptions Nesting Period Protocol (early breeding activity expected)

For several species such as Gray Jays and some owls, nesting activity will likely commence in mid-late February. White-winged Crossbills begin nesting in response to the availability of ripening cone crops, and can potentially nest at any time of year. Species-specific survey protocols will be implemented as determined by the bird biologist. If the onsite bird biologist determines that breeding activity is advancing early, then in this circumstance the Caution Nesting Period survey protocol could be implemented sooner.

Species-specific Survey Protocols during the Exceptions Nesting Period

White-winged Crossbill

In years of heavy spruce cone crops (as in 2015), White-winged Crossbills are expected to be breeding as early as late August or September, continuing until spruce seed (their main food source) availability becomes limited. The species nests almost exclusively in mixed-wood or spruce dominant stands. When it is determined by the onsite bird biologist that crossbills are widespread and settling in spruce areas, then a general walk-through survey of areas scheduled to be cleared over the subsequent two months should be conducted. Surveyors will note the locations of mixed-wood and spruce stands where crossbills are occurring, documenting numbers of birds and breeding evidence (e.g., persistent singing, nest building, courtship). Locations that are being actively used for feeding should then be visited again within a week to re-assess the breeding status. If a spruce stand is occupied and breeding activity is continuing, then a polygonal buffer should be established that encompasses the majority of spruce trees within a 50 m radius of the suspected nest area. White-winged Crossbills are at times semi-colonial nesters with several pairs potentially utilizing even a small spruce stand, and are somewhat reliant on the cone crop immediately surrounding the nest tree for feeding their young. Such sites should then be monitored on a schedule determined by the bird biologist, considering breeding phenology and the timing of proposed clearing operations. Once sufficient evidence is found to declare active nesting, then monitoring should continue until evidence of breeding activity has ceased.

Appendix C. Spring waterfowl and shorebird survey report

Site C Clean Energy Project

Early Migration Waterfowl use of the Peace River

Prepared by:
Claudio Bianchini, RP.Bio.
Bianchini Biological Services
11879 83 Avenue, Delta, British Columbia, V4C 2H6
and
John Boulanger, RP.Bio.
Integrated Ecological Research,
924 Innes, Nelson, British Columbia, V1L 5T2

Prepared for:

André McIntosh, Senior Environmental Coordinator
Site C Clean Energy Project,
Suite 1500, Four Bentall, 1055 Dunsmuir Street,
Vancouver, BC
V7X 1V5

December 2015

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This report was prepared exclusively for BC Hydro by Bianchini Biological Services and Integrated Ecological Research. The quality of information, conclusions, and estimates contained herein is consistent with the level of effort expended and is based on:

i) Information available at the time of preparation;
ii) Data collected by Bianchini Biological Services and/or supplied by outside sources; and
iii) The assumptions, conditions, and qualifications set forth in this report.

This report is intended to be used by BC Hydro only, subject to the terms and conditions of its contract with Bianchini Biological Services. Any other use or reliance on this report by any third party is at that party's sole risk.

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LIST OF ACRONYMS

AGL……………………………………………………………………………………………………….ABOVE GROUND LEVEL
ANCOVA……………………………………………………………………………………..ANALYSIS OF COVARIANCE
BBS…………………………………………………………………………………….BIANCHINI BIOLOGICAL SERVICES
BC...BRITISH COLUMBIA
BCH………………………………………………………………………………………………….BRITISH COLUMBIA HYDRO
CWS..CANADIAN WILDLIFE SERVICE
EAO 21…………ENVIRONMENTAL ASSESSMENT CERTIFICATE #E14.02 SCHEDULE B CONDITION 21
FDS 16.3.6…FEDERAL DECISION STATEMENT FOR THE SITE C ENERGY PROJECT CONDITION 16.3.6
GPS…...GLOBAL POSITIONING SYSTEM
KM……KILOMETRES
KM/H……………………………………………………………………………………………………..KILOMETRES/HOUR
PROJECT...SITE C CLEAN ENERGY PROJECT
RISC .... RESOURCE INVENTORY STANDARDS COMMITTEE
USA..UNITED STATES of AMERICA

Executive Summary

This report documents the results of spring migration waterfowl surveys along the Peace River and adjacent large lakes conducted on March 18, April 2 and 10, 2015. The aerial surveys were initiated gather information on the population status and distribution of waterfowl during the early and mid-phase spring migrations that may be impacted by the proposed Site C Clean Energy Project.

The 2015 survey flights were conducted using a single engine Cessna 206 flying at 150 m AGL and a speed of 100 km/h.

The Peace River main stem was the only open body of water observed during all three 2015 surveys. A total of 4867 waterfowl in mixed groups of six species were observed with species diversity increasing for each survey. Abundance of waterfowl was relatively even throughout the study area except for higher abundances in downstream areas during the second survey. Trumpeter Swans were recorded along the Peace River during two of the three surveys with all swans observed upstream of the proposed Site C dam site. The largest concentration of Trumpeter Swans were observed during the latter two surveys with both observations located approximately 10 km upstream of the proposed Site C dam site, across from Wilder Creek.

A number of large lakes along the transmission route were also surveyed for waterfowl presence. These lakes were mostly frozen during all three surveys. An unnamed lake situated between Boucher and Rene Lakes was beginning to thaw during the April 2nd survey and two Trumpeter Swans were observed within the narrow strip of open water along the southern shore during the April surveys. During the last survey, two additional Trumpeter Swans were observed on a lake situated approximately 7.5 km northeast of Boucher Lake.

Spring migration data collected in 2012, 2014 and 2015 were analyzed to determine if species composition, abundance and distribution was consistent or varied across the survey years. The multi-year analysis confirmed that abundance varied between applicable survey dates during each year surveyed. A total of 24 waterfowl species were observed during the 2012 to 2015 surveys. Seventeen species recorded in 2012 to 2014 surveys (March to June) were not observed during the 2015 surveys (March to April). The American Coot, Canvasback, Redhead and Surf Scoter were only observed downstream of the proposed Site C dam site during the 2012 to 2014 surveys. Pied-billed Grebes, Ruddy Ducks, and Wood Ducks were only observed upstream of the proposed Site C dam site. None of the above mentioned species were observed during the 2015 surveys. Species diversity displayed an increasing trend within each year with higher diversity in latter surveys of 2012, 2013 and 2014 compared to 2015 surveys.

Trumpeter Swans were recorded along the Peace River during 2013, 2014 and 2015 surveys. In 2015 forty-four Trumpeter Swans were observed. The earliest Trumpeter Swan detection occurred on March 28, 2013 and the greatest number (n=60) observed upstream of the proposed Site C dam site on April 17, 2013.

1.0 Introduction

Three early spring migration waterfowl surveys of the Peace River from the Peace Canyon Dam to the Alberta border and select large lakes adjacent to the Peace River were conducted in 2015. Typically, in the Peace Region, the Peace River is the main open body of water available to waterfowl during the early spring and mid-migration periods. The aerial surveys were initiated as per Condition 9.3 of the Federal Decision Statement (EC 2014) and Condition 21 of Schedule B Table of Conditions issued by the Province (EAO 2014) which required BC Hydro to:

- develop a plan to monitor and mitigate potential disturbance of breeding migratory birds in and adjacent to the Project Activity Zone (FDS 9.3)
- monitor waterfowl and shorebird populations and their use of natural wetlands, created wetlands, and artificial wetland features (EAO 21)

These surveys add to data collected on previous surveys conducted by the Canadian Wildlife Service (CWS) in 2012 and 2013 and by Keystone Wildlife Research in 2013 and 2014.

2.0 Objectives

The objectives of these surveys were to:

- identify waterfowl abundance and distribution, species composition and species diversity within the main stem of the Peace River and on large lakes adjacent to the Peace River during the survey periods.
- Complete a multiyear (2012-2015) analysis to determine overall trends in waterfowl abundance, distribution and species composition during spring migration.
- Record the extent of ice on large lakes adjacent to the Peace River.

2.1 Survey Limitations

The previous surveys (2012-2014) were conducted using a twin engine helicopter flying at elevations of 15-50 m AGL and speeds between 75-80 km/h. The required high altitude flight (150 m AGL) and faster speed (100 km/h) of the single engine fixed wing aircraft potentially affected species identification, particularly between similar looking species such as Common Goldeneye (*Bucephala clangula*) and Common Merganser (*Mergus merganser*) males when seen from a distance. The higher survey height limited the disturbance and dispersal of waterfowl which, in turn, limited the potential for double counting of individuals.

3.0 Study Area

The study area is defined as the Peace River main stem from the Peace Canyon dam to the Alberta border (**Figure 1**). Thirty segments, running east-west along the shoreline of the Peace River were designated in previous surveys and these were reused for consistency (Jones et al. 2013). Each segment was 5 km long and of unlimited width. Seventeen of the segments are located between the Peace Canyon dam and the proposed Site C dam site (Upstream). Thirteen segments are located between the proposed Site C dam site and the Alberta border (Downstream; **Figure 1**). The shoreline of each lake was considered one segment.

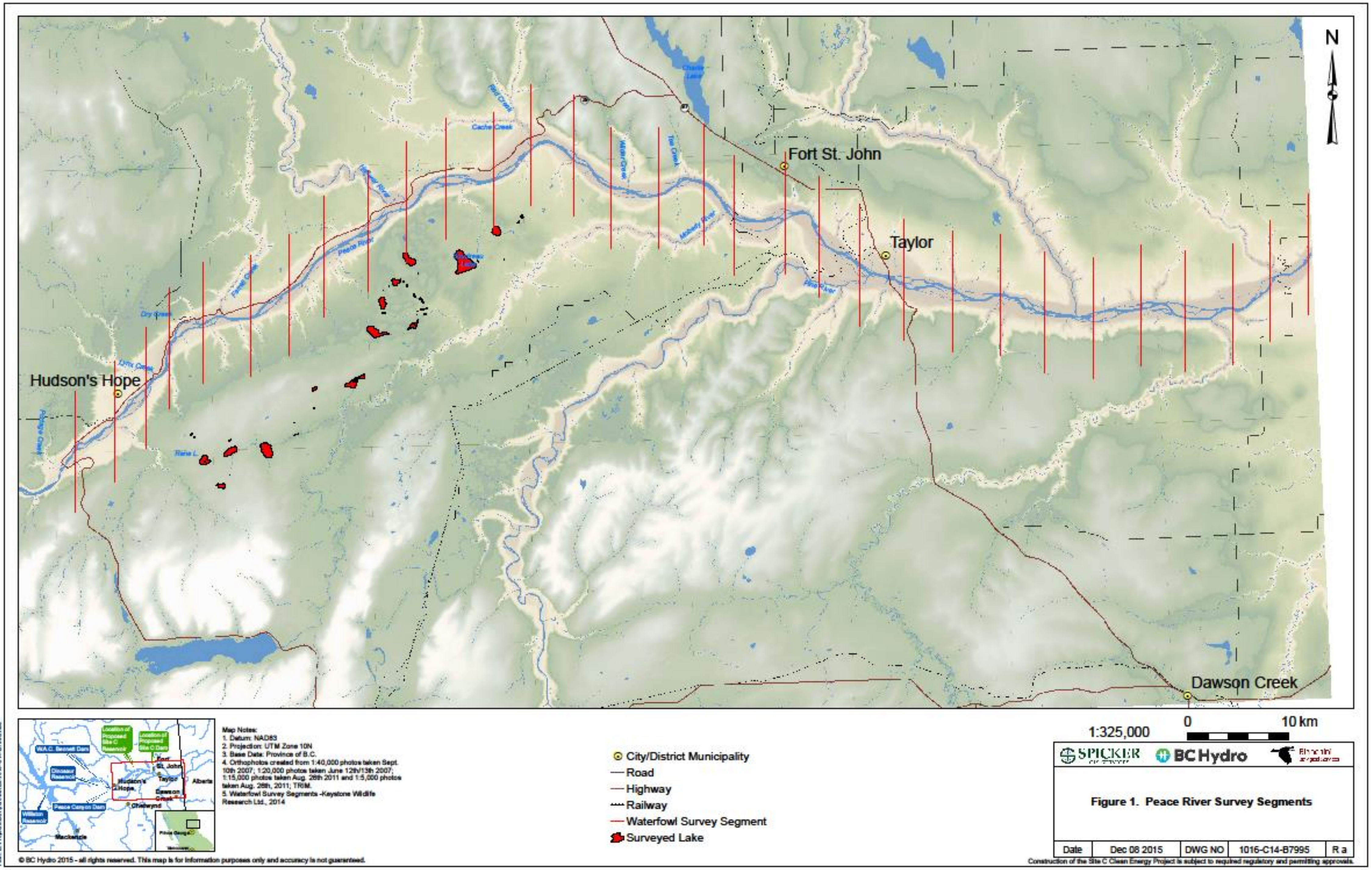

Figure 1. Survey segments of the Peace River study area.

4.0 Methods

4.1 Sampling Design and Effort

The 2015 surveys were completed using a single engine fixed winged Cessna 206 flying at 500' (152 m) elevation and speeds of 100 km/h.

Sampling design and effort replicated the 2013 and 2014 inventories (Jones et al. 2013 and Churchland et al. 2014). After examination of waterfowl arrival dates, temperature, abundance and diversity and discussions with waterfowl experts, surveys were classified as early, mid or late migration. Early migrants were considered species observed prior to April 10. Mid-migrants were considered species observed between to April 10 and May 10. Late migrants were considered species observed after May 10. The 2015 surveys were conducted mid-March, early April, and mid-April. All 30 segments were inventoried on each visit.

Each survey commenced at the Alberta border and segments were surveyed in a westward direction in order to avoid potential glare as the sun rose from the east. An Apple iPad™ connected to a Garmin GLO™ GPS receiver running Motion X GPS HD™ mapping software was used to record the survey route and to ensure that surveyors knew at all times which segment was being inventoried.

The goal of the surveys was to document 100% of the waterfowl present. Within each segment, one pass parallel to each shore was flown. The flight path looped around islands and backchannels to ensure all shoreline areas were included.

The survey plane was equipped with bubble windows to maximize the surveyor's observation area. An observer sat in the front beside the pilot so observations could be made to the front, right, and below the plane as it followed the river. A second observer/recorder sat behind the pilot for better observation on the left side and marked segment start and end locations with Motion X GPS HD™. All birds observed were recorded, including incidental observations of non-waterfowl species (shorebirds, corvids and raptors). Waterfowl were identified and counted to species, gender and age, where possible. Information was recorded on RISC standard data forms modified for this project.

4.2 Data Analysis

The objective of the data analysis was to assess whether differences in overall species abundance and species diversity differed significantly between waterfowl observed upstream and downstream of the proposed dam site and between years.

Species abundance was summarized by the number of waterfowl counted per kilometer using the data from 5 km segments along the river.

Species diversity indices consider both the abundance and richness of species in an area. An area that has a higher density of dominant species but with few unique species will exhibit a lower species diversity index than an area that has abundance spread over many species. Species diversity was estimated using the Shannon-Weiner H' function (Krebs 1998) calculated with a natural logarithm which made the estimates equitable to previous estimates from Churchland et al. (2014).

To statistically test the relationship between abundance/species diversity and location (upstream/downstream) a mixed model analysis of covariance (Milliken and Johnson 2002) was used to control for dominant factors affecting abundance and allowing a statistical comparison of survey location. The main factors that potentially influenced the response variables (abundance or diversity) were yearly variation due to differences in survey methods or biological factors, seasonal changes due to migration periods and weather factors, and finally the location of the survey relative to the proposed dam. By adding the year, year*Julian day, these extraneous factors affecting abundance and diversity were controlled for therefore allowing a more powerful test of whether the location of the dam influenced diversity or abundance (**Table 1**).

Table 1: Analysis of covariance (ANCOVA) model terms used in analyses

Model term	Type	Rationale
Year	Categorical	Estimated year-specific variation in response variable which could be due to methods or yearly variation.
Year*Julian day	Continuous	Estimated change in response due to seasonality.
Location	Upstream/downstream of dam site	Tested if there was a difference in response in upstream and downstream areas.

For this analysis, counts of waterfowl per km or the Shannon Weiner H' were the response variables. Counts per kilometre were log-transformed because variance is proportional to counts: count data violates the assumption of equal variances across treatments for parametric ANCOVA methods. Various model formulations were tested to obtain the best fit and most powerful statistical model. The collection of using repeated surveys within the same stretches of the river is an additional factor that could affect comparisons given that these types of observations are not statistically independent. A compound symmetric covariance matrix was used with the ANCOVA model which accounted for repeated surveys and correlated data. Analyses were done using PROC MIXED in SAS statistical package (Littell et al. 1996, Milliken and Johnson 2002).

5.0 Results

5.1 2015 Surveys

The total effort per survey and segment as well as the total waterfowl count and number of waterfowl species observed are summarized in **Table 2**.

Table 2. Total effort per survey and segment as well as the total waterfowl count and number of waterfowl species observed.

Survey Date	Total Survey Time (hh:mm:ss)	Average Time per Segment (mm:ss)	Total Waterfowl Count	Number of Waterfowl Species Observed
March 18, 2015	03:44:07	07:12	1490	4
April 2 02, 2015	03:00:00	06:00	2289	6
April 10, 2015	03:43:00	07:26	1502	5

5.1.1 2015 Survey Conditions

The surveys were conducted on March 18, April 2 and April 10, 2015. The surveys were conducted at a flight altitude of 500' (152 m) AGL and a ground speed of 54 knots (100 km/h) Weather conditions were favourable with clear skies and low to moderate winds. The air temperature at the start of the surveys ranged between -2^{o}C and +5^{o}C and increased to 5^{o}C to 9^{o}C by the end of each survey. Each survey occurred during relatively bright light conditions resulting in some glare from the water surface in the latter half of the survey. The weather conditions of each survey are summarized in **Table 3**.

Table 3. 2015 survey weather conditions.

Survey	Date	Start Cloud Cover*	Start Wind (Beaufort)	Start Temp. (ºC)	Start Precipitation**	End Cloud Cover*	End Wind (Beaufort)	End Temp. (ºC)	End Precipitation**
1	March 18, 2015	1	1	-2	N	1	1	5	N
2	April 2 02, 2015	1	2	3	N	1	2	4	N
3	April 10, 2015	1*	3	5	N**	1	4	9	N

*1= clear **N=Nil

In addition to the Peace River, Rene Lake, Boucher Lake, Boudreau Lake and several un-named lakes were surveyed. Rene, Boucher and Boudreau Lakes remained frozen for the duration of surveys. By the April 10, 2015 survey the ice along the edges of the unnamed lake (10 V 579632 6206844) between Rene Lake and Boucher Lake was beginning to thaw and another un-named lake, situated approximately 7.5 km northeast of Boucher Lake (10 V 588396 6212655), had small, melted holes scattered throughout.

While the main stem of the Peace River was ice free ice, most side channels of the Peace River were beginning to thaw during the early April survey.

5.1.2 Record Keeping

Record keeping detail in accordance with Federal Condition 18 is provided below in **Table 4**.

Table 4. Record keeping detail in accordance with Federal Condition 18.

Sampling location	Peace River main stem from the Peace Canyon dam to the Alberta border.
Date(s) of sampling	March 18, April 2 and 10, 2015.
Time of sampling	March 18: 09:50-13:35
	April 2: 12:21-15:21
	April 10: 08:01-11:44
Analysis performed	Shannon-Weiner H' function (Krebs 1998)
Date of analysis	September 2015
Person(s) who collected sample(s)	Claudio Bianchini, Damian Power
Person(s) who conducted analysis	John Boulanger

5.1.3 Abundance

Abundance of waterfowl was relatively even except for higher abundances in downstream areas on April 2nd (**Figure 2**). The effect of location (downstream/upstream) or survey date was not significant in mixed model analysis at alpha=0.05.

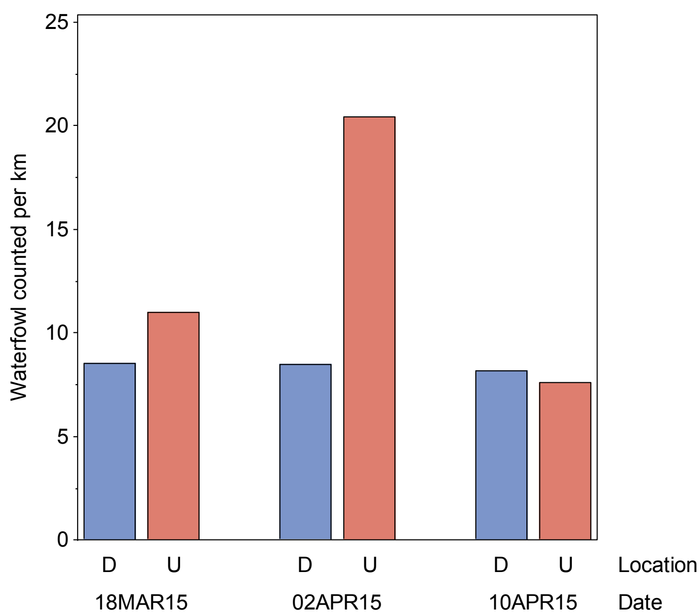

Figure 2. Waterfowl abundance downstream (D) and upstream (U) during the 2015 surveys.

5.1.4 Species Composition

A total of six waterfowl species were observed during the 2015 surveys (**Table 5**). Each species had been recorded during previous spring waterfowl surveys conducted along the Peace River in 2012, 2013 and 2014 (**Table 6**).

Five species recorded in 2012 were not observed during the March and April 2015 surveys. These were American Wigeon (n=2), Barrow's Goldeneye (n=1), Bufflehead (n=7), Pied-billed Grebe (n=1) and Redhead (n=1) (**Table 6**).

Nine species recorded in 2013 were not observed during the March and April 2015 surveys. These were American Coot (n=8), American Wigeon (n=254), Bufflehead (n=93), Canvasback (n=2), Hooded Merganser (n=4), Ring-necked Duck (n=44), Northern Pintail (n=64), Ruddy Duck (n=3) and Wood Duck (n=1) (**Table 6**).

No early migration surveys were conducted in March of 2014. Thirteen species not recorded in 2015 were recorded during the April 2014 survey included American Wigeon (n=16), Bufflehead (n=3), Cackling Goose (n=1) and Hooded Merganser (n=2) (**Table 6**).

Table 5. All Species Observed During the 2015 Surveys.

Waterfowl Species	Scientific Name	March 18	April 02	April 10	Total
Canada Goose	*Branta Canadensis*	1008	1363	599	2970
Common Goldeneye	*Bucephala clangula*	408	695	334	1437
Common Merganser	*Mergus merganser*	69	101	187	357
Green-winged Teal	*Anas crecca*	0	28	0	28
Mallard	*Anas platyrhynchos*	5	22	10	37
Trumpeter Swan	*Cygnus buccinators*	0	17	21	38
Grand Total		1490	2226	1151	4867

Table 6. All Species Observed During 2012 to 2014 Early Migration Surveys.

Species	Scientific Name	March 19 2012 (CWS)	March 18, 2013 (CWS)	March 19m 2013 (BCH)	April 17, 2013 (BCH)	April 10, 2014 (BCH)	May 2, 2014 (BCH)	Totals
American Wigeon	*Anas americana*	2	20	0	234	16	789	1061
American Coot	*Fulica americana*	0	0	0	8	0	0	8
Barrow's Goldeneye	*Bucephala islandica*	1	0	0	0	0	0	1
Bufflehead	*Bucephala albeola*	7	0	1	92	3	14	117
Cackling Goose	*Branta hutchinsii*	1	0	0	0	1	0	2
Canada Goose	*Branta canadensis*	1633	3662	632	2364	2834	587	11712
Canvasback	*Aythya valisineria*	0	0	0	2	0	0	
Common Goldeneye	*Bucephala clangula*	90	131	178	499	5	0	903
Common Merganser	*Mergus merganser*	457	607	521	501	596	396	3078
Green-winged Teal	*Anas crecca*	0	0	0	0	16	159	175
Hooded Merganser	*Lophodytes cucullatus*	0	0	0	4	2	0	6
Lesser Scaup	*Aythya affinis*	0	0	0	0	0	60	60
Mallard	*Anas platyrhynchos*	33	0	90	4	373	542	1042
Northern Pintail	*Anas acuta*	0	0	0	64	0	168	232
Pied-billed Grebe	*Podilymbus podiceps*	1	0	0	0	0	0	1
Redhead	*Aythya americana*	1	0	0	0	0	0	1
Ring-necked Duck	*Aythya collaris*	0	8	0	36	0	0	44
Ruddy Duck	*Oxyura jamaicensis*	0	0	0	3	0	0	3
Surf Scoter	*Melanitta perspicillata*	0	0	0	0	0	1	0
Trumpeter Swan	*Cygnus buccinator*	0	7	0	69	8	15	99
Wood Duck	*Aix sponsa*	0	0	0	1	0	0	1
Grand Total		**2226**	**4435**	**1422**	**3879**	**3854**	**2730**	**18546**

5.1.5 Distribution

66% of waterfowl detections occurred upstream of the Site C dam site and 34% downstream (**Table 7**). Canada Goose, Common Goldeneye and Common Merganser were observed both upstream and downstream of the dam site. Trumpeter Swans were only observed upstream of the proposed Site C dam site while Green-winged Teal and Mallard were only observed downstream.

Table 7. Total Count of Waterfowl during 2015 Surveys Upstream and Downstream of the Proposed Site C Dam Site.

Species	Total Upstream	Total Downstream	Grand Total
Canada Goose	1914	1056	2970
Common Goldeneye	1016	421	1437
Common Merganser	258	99	357
Green-winged Teal	0	28	28
Mallard	0	37	37
Trumpeter Swan	38	0	38
Grand Total	3226	1641	4867

5.1.6 Species Diversity

Species diversity increased across each survey in 2015. The effect of survey date on estimates was significant ($F_{1,2}$=23.73, p=0.0397) but the effect of location or interaction of location and date was not significant. This means that there was no significant difference between upstream and downstream location mean abundance, or change in abundance by date. (**Figure 3**).

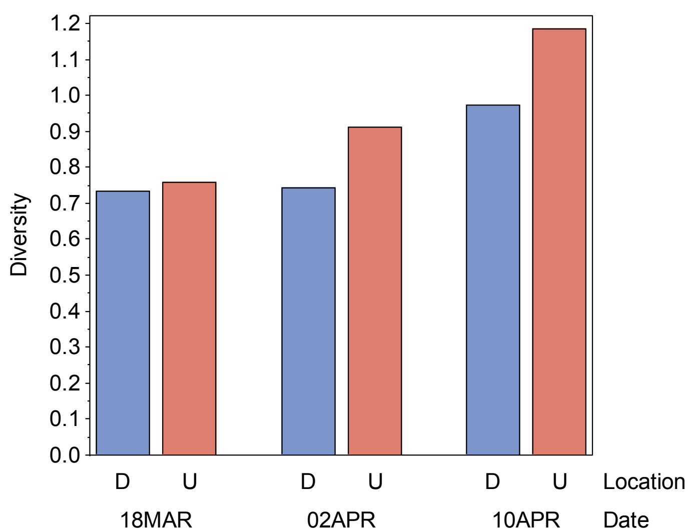

Figure 3. Shannon-Wiener Index of diversity during the 2015 Surveys.

One way to conceptualize species diversity and abundance is plots of species sighted and their relative abundance (**Figure 4**). It can be seen that in March surveys the number of species identified was lower and relative abundance was dominated by the Canada Goose (CAGO) and Common Goldeneye (COGO). Although more species appeared in the April 2 survey counts were still dominated by CAGO and COGO. On the April 10th the counts were more evenly distributed across 3-4 species which increased the species diversity scores.

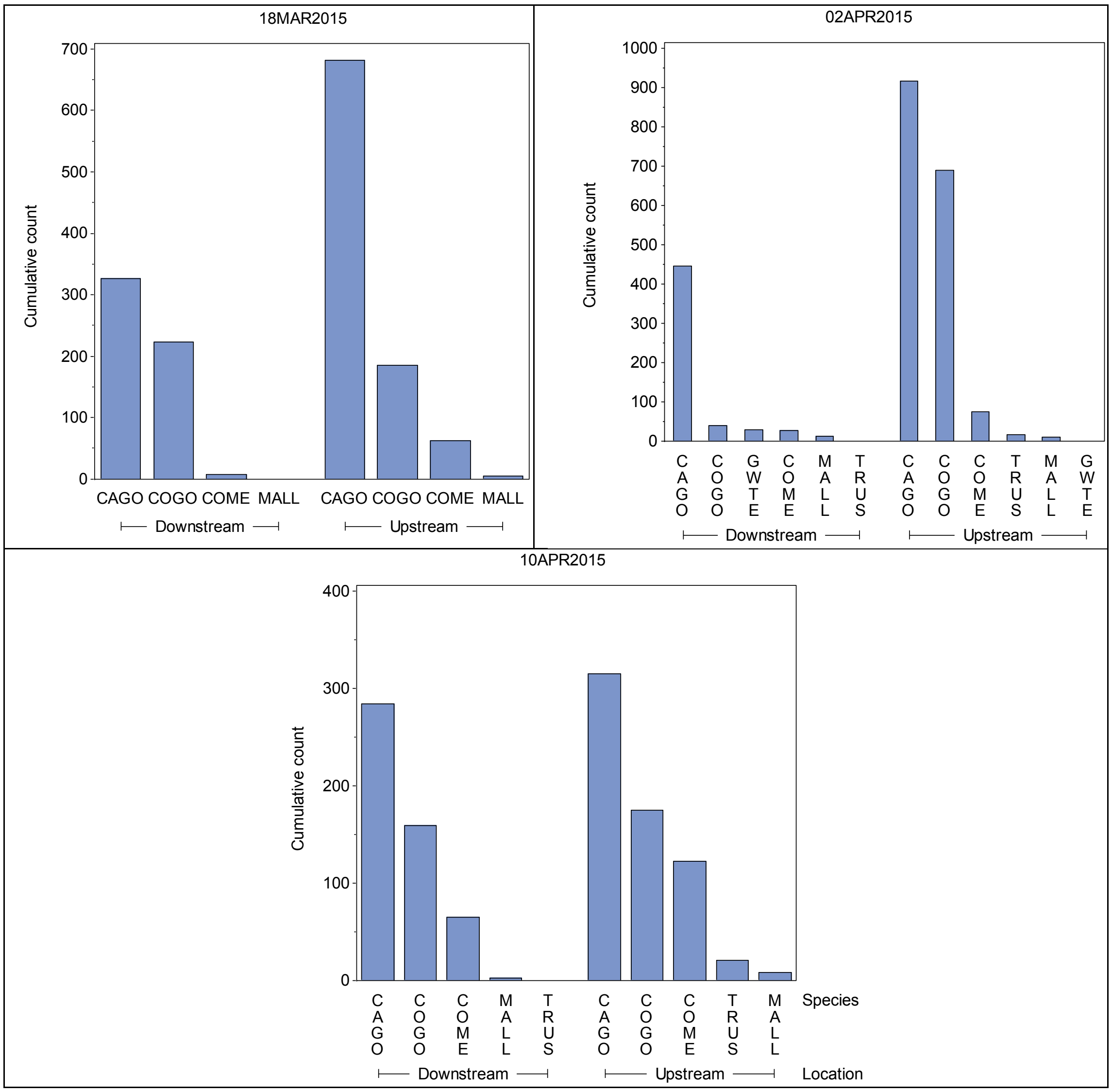

Figure 4. Plots of species sighted and their relative abundance during each of the 2015 surveys.

5.1.7 Trumpeter Swan

Trumpeter Swans were recorded along the Peace River during two of the three surveys in 2015 (**Table 5**). All swans were observed upstream of the proposed Site C dam site. The largest concentration of Trumpeter Swans (n=10) were observed on April 2nd and April 10th with both observations located approximately 10 km upstream of the proposed Site C dam site, across from Wilder Creek.

On April 2nd and 10th an unnamed lake situated between Boucher and Rene Lakes was beginning to thaw and two Trumpeter Swans were observed within the narrow strip of open water along the southern shore. On April 10th, two additional Trumpeter Swans were observed within a lake situated approximately 7.5 km northeast of Boucher Lake (10 V 588396 6212655). This frozen lake had small, melted holes scattered throughout and two Trumpeter Swans were observed foraging within one of these openings.

5.2 Multi-year Analysis

5.2.1 Temperature and Ice Cover

The average monthly March temperature in Fort St. John is -4.4°C (Environment Canada 2015). The mean monthly temperatures recorded in 2014 and 2015 were above the average, while temperatures in 2013 were below average and in 2012 were about average (**Figure 5**). The average temperature during 2015 surveys ranged from -9.8 to 14.2°C.

Ice accumulation along the shores and back channels of the Peace River is common in March, with the tributaries usually remaining frozen. While ice was still present along the Kiskatinaw, Beatton, Moberly and Halfway Rivers during the 2015 surveys, no ice was present along the Peace River main stem.

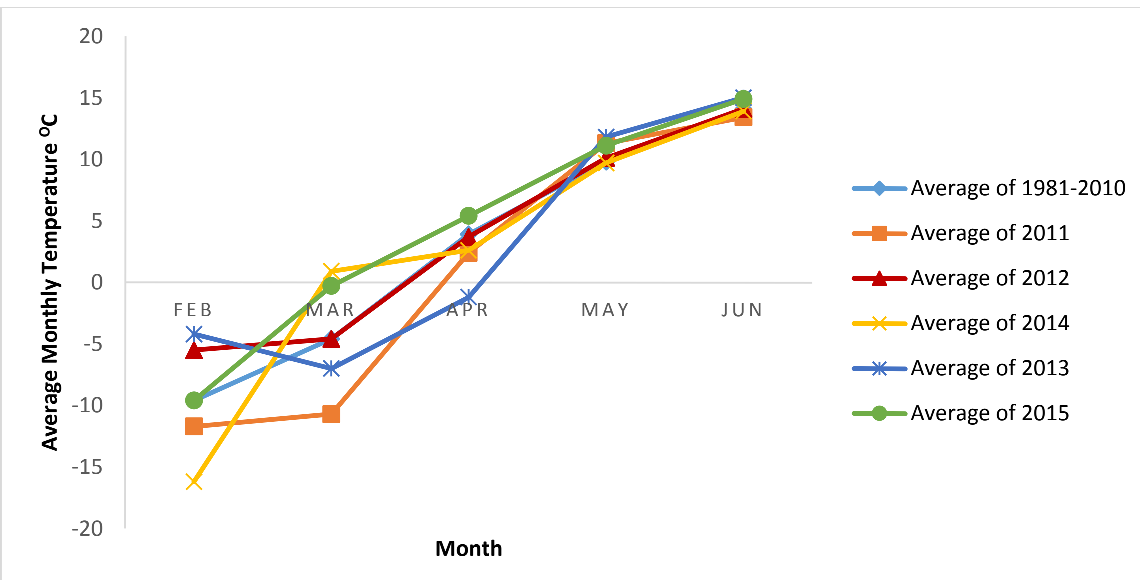

Figure 5. Average Monthly Temperature at Fort St. John.

The multi-year analysis used data from early migrant surveys conducted by CWS in March of 2012, 2013, and by BC Hydro in March of 2013 and 2015. Mid-migrant surveys included BC Hydro surveys conducted in April of 2013, 2014 and 2015, and early May 2014. Late migrant surveys included BC Hydro surveys conducted in June of 2013 and late May of 2014 (**Table 8**).

Table 8. Average temperatures recorded during each survey.

Surveyors	Year	Date	Average Temperature day of survey	Migration Period
CWS	2012	March 24	-7.0	Early
CWS	2013	March 19	-9.8	Early
BC Hydro	2013	March 28	-0.3	Early
BC Hydro	2013	April 17	1.4	Mid
BC Hydro	2013	June 13	13.7	Late
BC Hydro	2014	April 10	6.3	Mid
BC Hydro	2014	May 02	3.1	Mid
BC Hydro	2014	May 14	14.2	Late
BC Hydro	2015	March 18	0.4	Early
BC Hydro	2015	April 2	2.4	Early
BC Hydro	2015	April 10	8.2	Mid

5.2.2 Abundance

Waterfowl abundance between upstream and downstream varied between each survey with no definitive trend (**Figure 6**). In 2013 abundance increased between survey whereas it decreased in 2014 and was roughly even in 2015. In 2012 only one survey was conducted. The 2012 and 2013 data were pooled for modelling year-specific trends (under the assumption of similar trends in 2012 and 2013). A model with year-specific variation in abundance (F=0.80, df=3,10, p=0.5233), and year-specific trends in abundance (F=2.46, df=3,10, p=0.1224) was fit to the data. Location (upstream or downstream) was not significant (F=2.53, df=1,10, p=0.1426) when these covariate terms were included in the model. This result means that there was no statistically significant difference in abundancy for downstream and upstream sites when the effect of yearly abundance and yearly trends in abundance were statistically controlled for. An alternative model formulation that considered period-specific trend also did not contain any significant model terms.

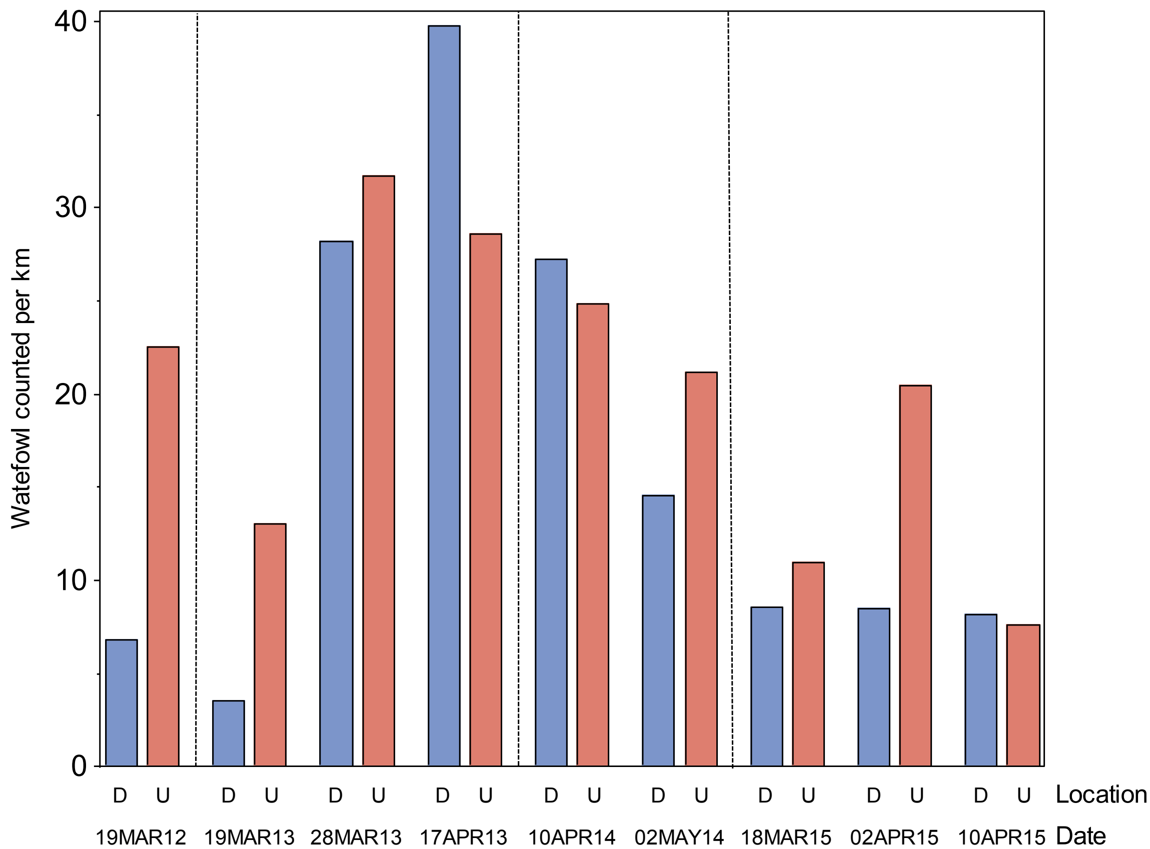

Figure 6. Waterfowl counted per kilometre during each survey (2012-2015).

5.2.3 Species Composition

A total of 24 waterfowl species have been documented using the Peace River during spring migration between 2012 and 2015 (**Table 9)**. These observations covered the early, mid and late spring migrations. With the exception of Cackling Goose (n=3), Lesser Scaup (n=87), and Surf Scoter (n=1), each of the remaining 21 species had been recorded previously during waterfowl surveys conducted along the Peace River in 2012, 2013 and 2014. Seventeen species recorded between 2012 and 2014 were not observed during the 2015 surveys (**Table 5**).

Table 9. Waterfowl Observations Categorized as Early, Mid or Late Migrants.

Species	Early Migrants	Mid Migrants	Late Migrants
American Coot		●	
American Wigeon	●	●	●
Barrow's Goldeneye	●	●	●
Bufflehead	●	●	●
Blue-winged Teal		●	●
Canada Goose	●	●	●
Cackling Goose		●	●
Canvasback		●	
Common Goldeneye	●	●	●
Common Merganser	●	●	●
Gadwall			●
Green-winged Teal	●	●	●
Hooded Merganser		●	
Lesser Scaup		●	●
Mallard	●	●	●
Pied-billed Grebe	●		
Redhead	●		
Northern Pintail		●	●
Northern Shoveler			●
Surf Scoter			●
Ring-necked Duck	●	●	●
Ruddy Duck		●	
Trumpeter Swan	●	●	●
Wood Duck		●	

5.2.4 Distribution

The American Coot (n=8), Canvasback (n=2), Redhead (n=1) and Surf Scoter (n=1) were only observed downstream of the proposed Site C dam site during the 2012 to 2014 surveys. Pied-billed Grebes (n=1), Ruddy Ducks (n=3), and Wood Ducks (n=1) were only observed upstream of the proposed Site C dam site. None of these species were detected during the 2015 surveys (**Appendix 1**).

5.2.5 Species Diversity

Species diversity displayed an increasing trend within each year with higher diversity in latter surveys in 2012, 2013 and 2014 compared to 2015 surveys (**Figure 7**). As with the abundance analysis, an ANCOVA model was used which pooled 2012 and 2013 to model year-specific trends in diversity. For the ANCOVA model with year-specific diversity ($F=3.26, df=2,10$, $p=0.0850$), day of survey ($F=39.13, df=1,10$, $p<0.001$) and year-specific slopes for the effect of day (F-$2.76, df=2,10, p=0.113$) was used to test for the effect of location on species diversity. Location for this ANCOVA model was not significantly different ($F=1.7$, $df=1,10$, $p=0.2211$). This result means that species diversity was not significantly different for upstream and downstream locations when year-specific, and year-specific trends in diversity were statistically controlled for.

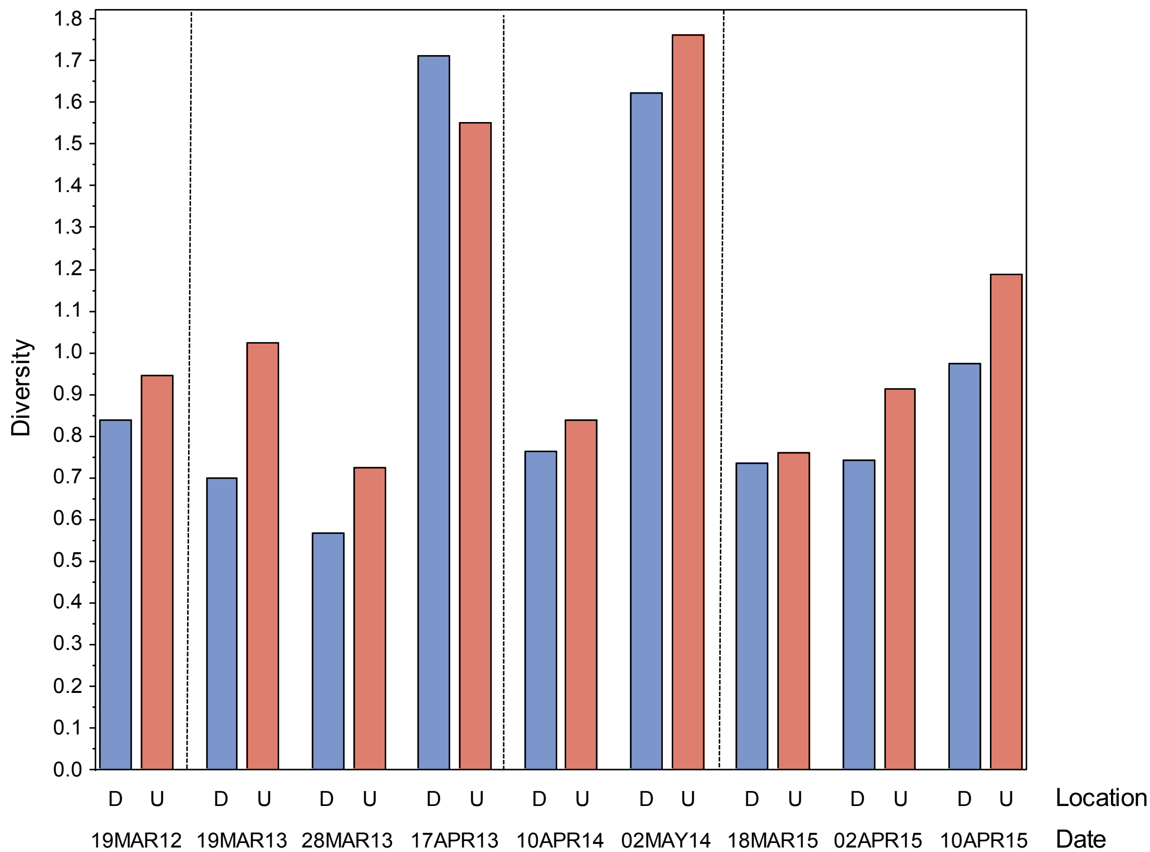

Figure 7. Shannon-Wiener Index of diversity downstream and upstream of the proposed Site C Dam Site.

5.2.6 Trumpeter Swan

Trumpeter Swans were recorded along the Peace River each year. The number of individuals observed during surveys was less than 60. The earliest detection (n=7) occurred on March 28, 2013. The greatest number of Trumpeter Swans (n=60) was observed upstream of the of the dam site in April 17, 2013. Trumpeter Swans typically arrive in northern nesting areas in early May (BC Conservation Data Centre 2015). The earliest historical arrival records (1983 to 1988) ranged from April 4th to May 10th (Siddle 2010).

6.0 Discussion

The data analysis shows:

- When year-specific, and within-year factors are controlled for by the ANCOVA model, there is no statistical difference between upstream and downstream spring waterfowl survey results for the years 2012, 2013, 2014 and 2015.
- The change in survey methods from a helicopter to plane in 2015 may have decreased the number of individuals documented and affected the ability to differentiate species due to the higher altitude and faster flight speed.
- The higher altitude of the plane reduced the number of birds that flushed, reducing the number of individuals that moved and were double counted. Differences between 2015 and other years should be interpreted cautiously.

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Appendices

Appendix 1

Appendix 1. Waterfowl species detected and total numbers observed upstream and downstream during each of the 2012 to 2015 surveys.

	CWS				BCH														
	2012		2013		2013						2014				2015			
	Mar		Mar		Mar		Apr		Jun		Apr		May		Mar		Apr	
Species	U	D	U	D	U	D	U	D	U	D	U	D	U	D	U	D	U	D
American Coot								8										
American Wigeon	2		4	16			32	202	23	24	2	14	537	350				
Barrow's Goldeneye	1												3	1				
Blue-winged Teal									1	4			9	7				
Bufflehead	6	1			1		35	57	9	9		3	20	5				
Cackling Goose												1	2					
Canada Goose	1302	331	2080	1582	459	173	1155	1209	176	238	1465	1369	766	680	682	326	1232	730
Canvasback								2										
Common Goldeneye	74	16	97	34	173	5	274	225	7	25	5				185	223	831	198
Common Merganser	390	67	461	146	472	49	396	105	53	72	500	96	456	58	62	7	196	92
Gadwall									2	1				2				
Green-winged Teal			3				11	57	9	21		16	187	48				28
Hooded Merganser							2	2			2							
Lesser Scaup													58	29				
Mallard	5	28	42	48		4	410	549	208	74	111	262	553	251	5		18	14
Northern Pintail							36	28	1				54	118				
Northern Shoveler										2			2	3				
Pied-billed Grebe	1																	
Redhead		1																

Appendix 1 (concluded)

Appendix 1 (concluded). Waterfowl species detected and total numbers observed upstream and downstream during each of the 2012 to 2015 surveys.

	CWS				BCH													
	2012		2013		2013						2014				2015			
	Mar		Mar		Mar		Apr		Jun		Apr		May		Mar		Apr	
Species	U	D	U	D	U	D	U	D	U	D	U	D	U	D	U	D	U	D
Ring-necked Duck			2	6			3	33	1									
Ruddy Duck							3											
Surf Scoter														1				
Trumpeter Swan			7				60	9	5		5	3	16	16			38	
Wood Duck							1											

*U = upstream, D = downstream

Appendix D. Fall waterfowl and shorebird survey report

Fall Migration Waterfowl Surveys for the Site C Clean Energy Project

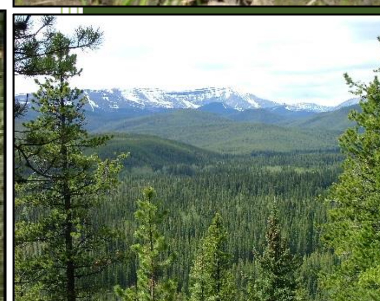
–Prepared for BC Hydro –

December 2015

V2





Prepared by:

M. Mushanski, J. Vitt, L. Ross

Native Plant Solutions / Ducks Unlimited Canada

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i) Information available at the time of preparation;

ii) Data collected by Native Plant Solutions and/ or supplied by outside sources; and,

iii) The assumptions, conditions, and qualifications set forth in this report.

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Fall Migration Waterfowl Surveys for the Site C Clean Energy Project

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Introduction

The Site C Clean Energy Project (the "Project"), currently under construction, will be a third dam and hydroelectric generating station on the Peace River in northeast BC. The Federal Decision Statement (CEAA 2014) requires BC Hydro to:

- 10.3.3: Include measures to mitigate the changes in aquatic and riparian-related food resources and other habitat features associated with a change from a fluvial to a reservoir system; and
- 11.1: Mitigate the potential effects of the Designated Project on wetland habitat used by migratory birds, species at risk and for current use of lands and resources for traditional purposes by Aboriginal people.

Condition 12 of the Schedule B Table of Conditions (September 2014) issued by the Province of B.C. requires BC Hydro to:

- Develop a Wetland Mitigation and Compensation Plan. The Wetland Mitigation and Compensation Plan must include an assessment of wetland function lost as a result of the Project that is important to migratory birds and species at risk (wildlife and plants).

One of the objectives of the fall waterfowl and shorebird surveys was to continue to build the pre-project database on the presence and use of habitats in the Project area by waterfowl and shorebirds during fall migration. The 2015 program was expanded to collect additional data to assist in informing the wetland function assessment and wetland mitigation plan.

With the aim of fulfilling EAC condition 12 and FDR condition 11.1 Native Plant Solutions (NPS), in conjunction with BC Hydro, developed a wetland function assessment methodology to identify the relative importance of wetlands to specific migratory birds, other wildlife species and rare plants. In order to better inform the wetland function assessment tool aerial waterbird surveys conducted during fall migration in 2015 will document the relative use of wetland habitats by migratory waterfowl and shore birds along the plateau between the transmission line right-of-way and the Peace River. The river and wetlands in the study area are suspected to be important habitat for waterbirds during fall migration. Wetland habitats are also used by migrating individuals for staging before engaging in long, energetically demanding flights to wintering grounds. To survive these journeys birds must increase their fat stores prior to leaving (O'Neal et al. 2012). This means that habitats providing sufficient food resources for a wide range of bird species must be available along the migration route.

The data collected during these surveys will assist in:

- Documenting changes in species composition and numbers as a result of Project construction and operations.
- Comparing waterfowl and shorebird use data to pre-project baseline data.
- Documenting how waterfowl and shorebirds respond to changes in aquatic and riparian-related food resources (fish and insects) associated with the change from a fluvial to a reservoir system.

Methodology

Survey Area

The survey area includes the main channel of the Peace River from Hudson's Hope to the Alberta border, the southern transmission line that runs between Hudson's Hope and Moberly River, and the area in between these two features (the Plateau) (Figure 1).

The survey area falls within the Peace River Basin ecoregion. This ecoregion is a wide plane surrounded by rolling uplands and dissected by the Peace River and its tributaries. The survey area is also within the Peace Lowlands ecosection. This area is dominated by Trembling aspen (*Populus tremuloides*), Balsam poplar (*Populus balsamifera*), white spruce (*Picea glauca*), black spruce (*Picea mariana*), logepole pine (*Pinus contorta*) and tamarack (*Larix laricina*).

Sampling Design and Effort

Fall migration surveys were conducted three times during the fall migration season between late September to mid-October, to detect early, mid- and late migrants within the survey area. In addition to transects along the Peace River, four (4) survey transects were established along the Plateau (Figure 1, Table 1).

Table 1. Longitude and latitude coordinates of the start and end points for each transect surveyed with the approximate length.

Transect	Start coordinates		End coordinates		Approximate Length (km)
1	56.001	-121.971	56.146	-120.001	150.0
2	56.025	-121.887	56.222	-121.119	52.6
3	55.975	-121.950	56.202	-120.942	67.6
4	55.973	-121.910	56.182	-120.905	67.3
5	55.987	-121.986	56.166	-120.843	77.9

Transect 1 was flown along the Peace River beginning at the Alberta border and ending at Hudson's Hope. This transect was divided into 30 - 5 km segments, with 17 between Hudson's Hope and the proposed dam site and 13 between the dam site and the Alberta border. This was consistent with past surveys conducted along the Peace River to allow for comparison with previous data. Transects 2-4 included wetlands between the Peace River and the transmission line (Figure 1). Transect 5 followed the transmission line from Hudson's Hope to Moberly River (Figure 1). Each transect was 400 m wide, extending 200 m out from both sides of the plane.

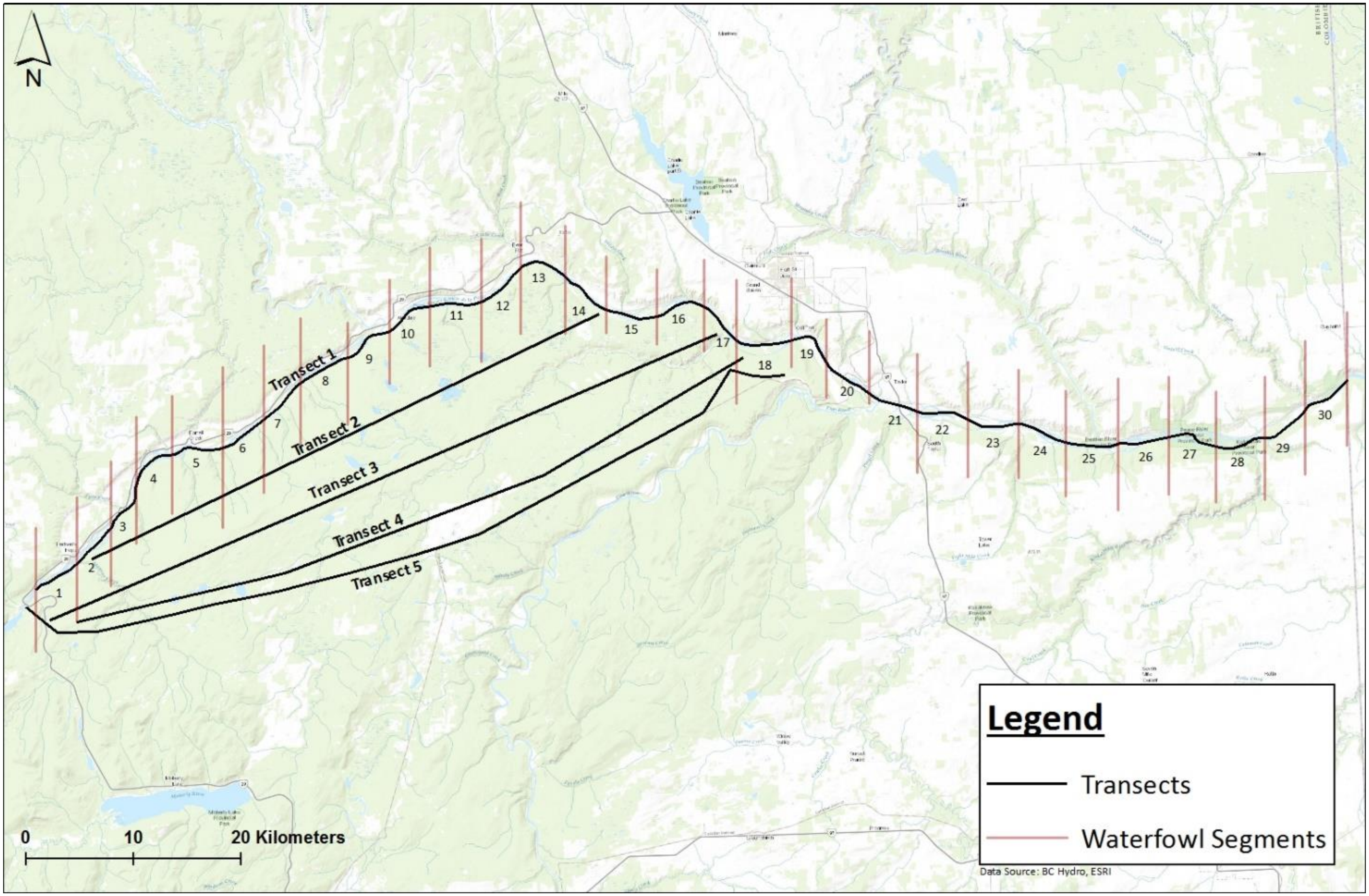

Figure 1. Map of study area showing the 5 transects that were flown for each survey.

Transect boundaries were estimated by determining the angle from the window at eye height to the plane strut that each observer had to look at to observe 200 m on the ground. The extent of the five transects ensures that sufficient wetland area was surveyed to obtain a statistically significant understanding of habitat use by migrating waterfowl (at least 2% of the study area). Each transect was flown with a Cessna 180 following the approximate centreline of the Peace River and of each transect. The flight elevation of the survey was approximately 500m. The flight path was recorded using a handheld Garmin GPSmap76CSx GPS as well as BU-353 USB GPS receivers which were linked to ArcMap on laptop computers. The Garmin GPS units were set up to record a track log which recorded a GPS point every second for the duration of the flights. The GPS receivers used in conjunction with ArcMap were used to aid in navigating each transect and ensured that both observers knew which transect was being surveyed at all times. A 200m buffer was also created on either side of each transect, and viewed in ArcMap to allow observers to estimate the extent/width of each transect.

The goal of the surveys was to document 100% of the waterfowl and shorebirds present along each transect. Two observers were present for each survey. One was situated in the front right, next to the pilot, while the other sat in the back left. Each observer recorded all species seen on their side of the plane. All birds observed were recorded, including incidental observations of non-waterfowl species (corvids and raptors) using a Sony IC voice recorder. For each observation the time of detection was recorded, in addition to species and count, to allow for the observation to be linked to the time stamped GPS locations recorded by the handheld GPS unit.

Data Entry and Analysis

To begin, field data on the voice recorders was transcribed to data sheets by the observer who recorded the observations. Figure 2 is an example of a data sheet used to transcribe observations from the recorded data on the voice recorders. The observation data from these data sheets (time of observation, species, and count) was then entered into an excel spreadsheet along with weather observations that were made at the beginning of each survey.

NPS's SITE C Aerial Surveys 2015

STUDY AREA: __________ SURVEY: _____ DATE (MM/DD/YY): ___/____/2015 SURVEY TYPE:

Obs. Initials: _____ | Crew: ______ Front Right: _____ Rear Left: _____ Pilot: ________ Transcription Time(s):___________________

Flight time: Start: ___:___:___ Finish: ___:___:___ | Weather: Temperature: _____°C Cloud Cover: _____ Precipitation: ____ Wind Dir. and Speed: _______

		Grid Weather					Time Stamp (24 hr: hh:mm:ss)										
Transect #		Temperature (°C)	Cloud Cover	Precipitation	Wind Dir. and Speed		In Time	Out Time	Survey Dir.	Waterbody Type	Pass 1st or 2nd	Window (F, L or R)	Species		Count	Observation Time (24 hr hh:mm:ss)	Comments
							: :	: :								: :	
							: :	: :								: :	
							: :	: :								: :	
							: :	: :								: :	
							: :	: :								: :	
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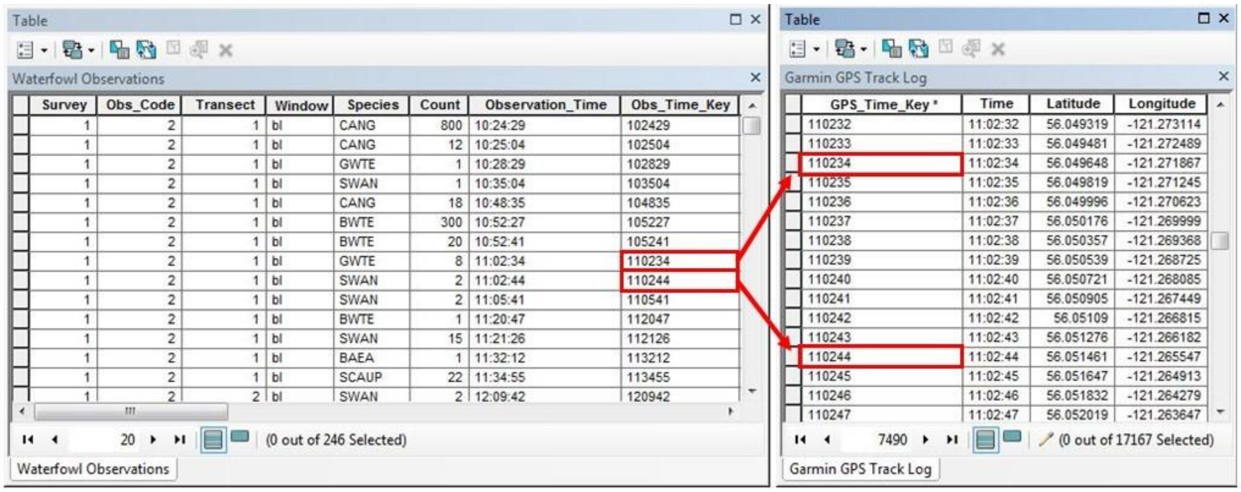
Figure 2. Data sheet used to transcribe waterfowl observations from recorders used during surveys.

The data analysis portion consisted of linking the voice recorded observation data with a GPS location in order to determine the habitat that the waterfowl were occupying at the time of detection. Using ArcMap, the excel table containing the observations was converted into a table within an ArcGIS geodatabase in preparation to be linked to the GPS data. The track logs recorded by the Garmin GPS were exported from the device and converted into a point feature class within a geodatabase. Every point in this track log feature class contained the associated GPS coordinates at that position along with a time stamp. The track log was joined to the observations table using the time stamp field as the common key so that each record in the observations table had a GPS coordinate associated with it (i.e., every waterfowl observation had a GPS coordinate associated with it) (Figure 3). Once joined each observation was plotted as a point in a feature class to be used to determine the habitat type that each of the observations occurred in.



Table

Waterfowl Observations

Survey	Obs_Code	Transect	Window	Species	Count	Observation_Time	Obs_Time_Key
1	2	1	bl	CANG	800	10:24:29	102429
1	2	1	bl	CANG	12	10:25:04	102504
1	2	1	bl	GWTE	1	10:28:29	102829
1	2	1	bl	SWAN	1	10:35:04	103504
1	2	1	bl	CANG	18	10:48:35	104835
1	2	1	bl	BWTE	300	10:52:27	105227
1	2	1	bl	BWTE	20	10:52:41	105241
1	2	1	bl	GWTE	8	11:02:34	110234
1	2	1	bl	SWAN	2	11:02:44	110244
1	2	1	bl	SWAN	2	11:05:41	110541
1	2	1	bl	BWTE	1	11:20:47	112047
1	2	1	bl	SWAN	15	11:21:26	112126
1	2	1	bl	BAEA	1	11:32:12	113212
1	2	1	bl	SCAUP	22	11:34:55	113455
1	2	2	bl	SWAN	2	12:09:42	120942

20 (0 out of 246 Selected)

Waterfowl Observations

Table

Garmin GPS Track Log

GPS_Time_Key *	Time	Latitude	Longitude
110232	11:02:32	56.049319	-121.273114
110233	11:02:33	56.049481	-121.272489
110234	11:02:34	56.049648	-121.271867
110235	11:02:35	56.049819	-121.271245
110236	11:02:36	56.049996	-121.270623
110237	11:02:37	56.050176	-121.269999
110238	11:02:38	56.050357	-121.269368
110239	11:02:39	56.050539	-121.268725
110240	11:02:40	56.050721	-121.268085
110241	11:02:41	56.050905	-121.267449
110242	11:02:42	56.05109	-121.266815
110243	11:02:43	56.051276	-121.266182
110244	11:02:44	56.051461	-121.265547
110245	11:02:45	56.051647	-121.264913
110246	11:02:46	56.051832	-121.264279
110247	11:02:47	56.052019	-121.263647

7490 (0 out of 17167 Selected)

Garmin GPS Track Log

Figure 3. Joining the track log feature class to the observations table in order to assign GPS coordinates to each waterfowl observation.

The observation data was then linked to the Terrestrial Ecosystem Mapping (TEM) habitat data in order to quantify the habitat use by waterfowl and shorebirds during the surveys. This was done using the Identity tool within ArcMap, which assigns the attributes from a polygon (TEM habitat data in this case) to any point that falls within it (waterfowl observations) (Figure 4). Once the observation data was appended to the habitat data, it was summarized by habitat type, species and count.

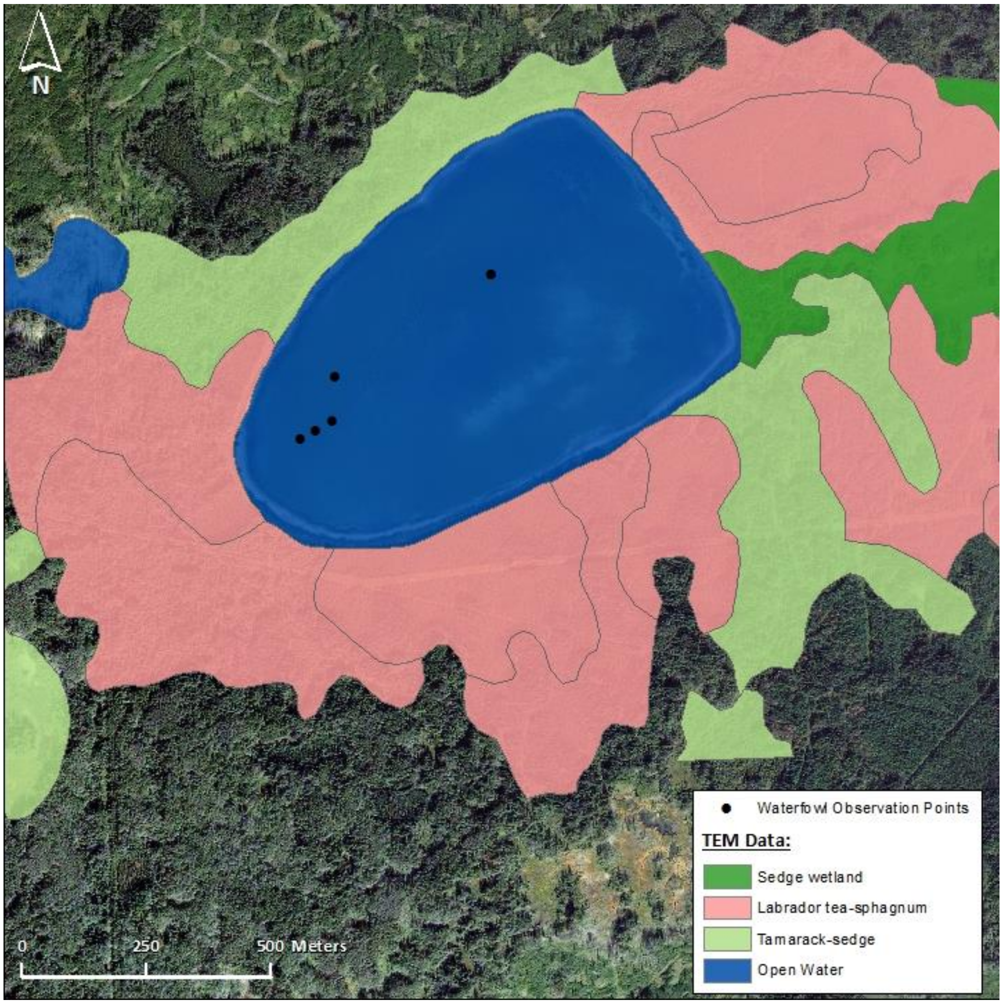


Figure 4. Assigning a habitat code from the TEM data to each waterfowl observation using the Identify tool in ArcMap.

Waterfowl abundance along the Peace River was divided into upstream (transects 1-17) and downstream (transects 18-30) of the Site C Dam. Abundance was summarized by the number of waterfowl counted on each 5 km segment. Waterfowl diversity was calculated using the Shannon-Wiener diversity index for each survey as well as to compare the upstream and downstream sections of the Peace River. This index takes into account how common a species is within the area, with higher values indicating higher diversity (Keylock 2005)

Results

Surveys were completed on September 1, 15 and 29 using a Cessna 180 fixed-wing aircraft. They were conducted at flight speeds of approximately 150 km/hr and heights of 500 ft (152.4 m). Surveys were completed in favorable weather conditions only. Wind speeds ranged from 13-18 km/h with temperatures ranging from 10-14°C. There was no precipitation recorded on any day that surveys were conducted. Survey time ranged from 4 hours and 4 minutes to 4 hours and 40 minutes (Table 2). The average time to complete each transect varied from 48 to 56 minutes (Table 2).

Table 2. Summary of waterfowl survey effort with counts of individuals and species detected, and habitats used.

Waterfowl Survey Effort					
Survey Dates	Total Survey Time (hh:mm:ss)	Average Time/Transect (hh:mm:ss)	Total bird count	Species Richness	Total Habitats Types Used
01-Sep-15	4:40:12	0:56:02	1762	8	7
15-Sep-15	4:04:24	0:48:53	1463	12	12
28-Sep-15	4:22:04	0:52:25	882	8	10

Waterfowl Abundance

A total of nine waterfowl species comprising 4059 individuals were observed. Five groups of waterfowl that could not be identified to the species level were also observed (Table 3). The number of species observed peaked on the second survey. The number of individual birds detected was highest on the first survey and decreased with each subsequent survey (Table 3).

Table 3. Species abundance detected for each survey (See Appendix 2 for non-waterfowl species).

Species		Species Abundance by Survey			
Common Name	**Scientific Name**	**1**	**2**	**3**	**Total**
Barrow's goldeneye	*Bucephala islandica*	0	1	0	1
Blue-winged teal	*Anas discors*	370	61	0	431
Canada goose	*Branta canadensis*	1174	672	309	2155
Common merganser	*Mergus merganser*	0	21	8	29
Green-winged teal	*Anas crecca*	15	17	0	32
Mallard	*Anas platyrhynchos*	54	75	3	132
Northern pintail	*Anas acuta*	5	24	40	69
Northern shovelor	*Anas clypeata*	0	7	0	7
Trumpeter swan	*Cygnus buccinator*	61	33	14	108
Unidentified duck		11	402	165	578
Unidentified gull		0	90	295	385
Unidentified scaup		26	0	38	64
Unidentified swan		32	29	7	68
Total		1748	1432	879	4059

Waterfowl observations were linked to 13 different habitat types. The widest use of habitats was seen during survey 2, which also had the highest species richness (Table 2). Non-waterfowl observations are summarized in Appendix 2.

Table 4. Number of observations of each species detected within each habitat type (see Appendix A for a list of wetland habitat types).

Species	Habitat													
Common Name	**BL**	**BT**	**Fm02**	**GB**	**LA**	**OW**	**PD**	**RI**	**SE**	**SW**	**TS**	**WH**	**WS**	**Total**
Barrow's goldeneye		1												1
Blue-winged teal				50	57			322			2			431
Canada goose	7		21	57	156			1790	69	35	11		9	2155
Common merganser								29						29
Green-winged teal					17			1	6		8			32
Mallard		2	12	10	56			14	11		27			132
Northern pintail				6	18			45						69
Northern shoveler					7									7
Trumpeter swan		2		1	18	2		66	11	2		2	4	108
Unidentified scaup					4			60						64
Unidentified swan	4	20		15	4			13	8			4		68
Unidentified gull								385						385
Unidentified duck	4	34	1		175		6	187	9		150	3	6	578
Total:	15	52	34	139	512	2	6	2912	114	37	168	7	15	4059

Species Composition

The most commonly detected species was the Canada goose, making up 52% (n=2155) of all observations. The second most common group of birds was unknown ducks (14%, n=578). Of the ducks that could be identified to species level the most common were the blue-winged teal (10.5%, n=431) and mallard (9%, n=132). The remaining species detected made up 3% or less of the observations (Table 5).

Habitat Use

The habitat used most often by fall migrating waterfowl was the Peace River (RI) with 72% of all detections. Followed by lakes (LA, 12.5%) and tamarack sedge wetlands (TS, 4%).

Table 5. Habitat type with habitat mapping code, relative waterfowl usage and Shannon-Wiener diversity index of each habitat (%).

Habitat Type	Habitat Code	Relative Waterfowl Usage (%)	Diversity Index
Lingonberry-coltsfoot	BL	0.4	1.06
Labrador tea-sphagnum	BT	1.3	1.05
Red-osier dogwood	Fm02	0.8	0.77
Gravel bar	GB	3.4	1.37
Lake	LA	12.5	1.70
Shallow open water	OW	0.05	0.00
Pond	PD	0.1	0.05
River	RI	72.0	1.39
Sedge wetland	SE	2.8	1.34
Wildrye-peavine	SW	0.9	0.21
Tamarack-sedge	TS	4.1	0.82
Willow-horsetail-sedge	WH	0.2	1.06
Willow-sedge	WS	0.4	1.19

The remaining habitats were used minimally in relation to the above mentioned three habitats (Table 5). Based on Shannon-Wiener diversity index calculations, which take into account both species richness and abundance, Lake Habitat (LA) had the most individuals of the most species, the river (RI), then gravel bars (GB). Open water (OW) habitat had diversity indices of zero, which means they had few species with low abundances (Figure 5).

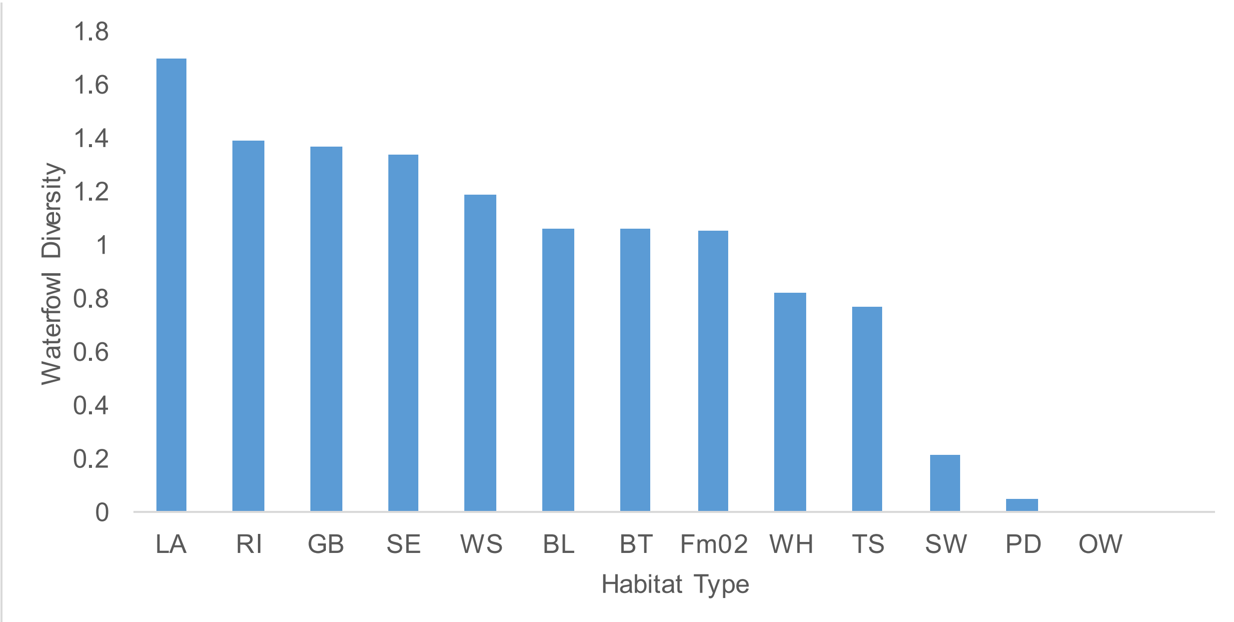


Figure 5. Shannon-Wiener Diversity Index for each wetland habitat.

All species, with the exception of unidentified swans, barrow's goldeneyes, green-winged teals, northern shovelers and mallards, were found most often on river (RI) habitats (Table 4). Common mergansers and gulls used river (RI) exclusively, while the remaining species made use of multiple habitat types (Table 4). Only Barrow's goldeneye and northern shoveler were not found using the river (Table 4). Green-winged teals, mallards and northern shovelers used lakes (LA) most commonly; the northern shoveler using it exclusively (Table 4). Only Barrow's goldeneye and Unidentified Swans did not have river (RI) or lake (LA) as their most frequently used habitat type. Goldeneye's were present only in Labrador-sphagnum habitats (BT), while unidentified swans used gravel bars (GB) most often although they also made use of Labrador tea-sphagnum wetlands (BT) and river (RI) in lower numbers (Table 4).

River Transect

The survey of transect one, the Peace River, was divided into 30 segments with segments both upstream and downstream of the proposed dam site (Table 6).

Table 6. Waterfowl observations along the Peace River broken into 30-5 km segments.

River Segment	Survey				General Location
	1	2	3	Total	
1	0	1	0	1	Proposed Reservoir/Upstream of proposed dam
2	6	5	0	11	
3	37	8	19	64	
4	22	5	25	52	
5	2	0	50	52	
6	0	44	36	80	
7	0	46	140	186	
8	5	2	89	96	
9	78	10	43	131	
10	2	100	2	104	
11	0	6	7	13	
12	0	20	0	20	
13	0	4	0	4	
14	2	42	1	45	
15	14	19	6	39	
16	23	56	27	106	
17	44	1	4	49	Upstream n=1053
18	365	88	6	459	Downstream of proposed dam
19	24	0	9	33	
20	24	6	52	82	
21	0	158	72	230	
22	0	77	0	77	
23	0	165	0	165	
24	1	1	60	62	
25	10	0	2	12	
26	0	0	4	4	
27	18	0	0	18	
28	873	0	12	885	
29	62	0	0	62	
30	0	1	0	1	
Total:	1612	865	666	3143	Downstream n=2090

The portion of the river that is downstream of the dam site yielded nearly double the waterfowl observations compared to the portion upstream of the dam site (Table 6). The large difference in bird abundance between the upstream to downstream segments is a result of two downstream observations that occurred during the first survey: a group of 800 Canada geese and a group 300 blue-winged teals. The highest abundance of waterfowl was detected during the first survey, downstream of the dam (n=1377), followed by survey 2, downstream of the dam (n=496) then survey 3, upstream of the dam (n=449). Average count/segment followed the same order (Table 7). The Shannon-Wiener diversity index showed highest species diversity in the upstream portion of the river with the highest diversities being seen during surveys 1 and 2. In survey 3 highest diversity was seen downstream of the dam (Table 7).

Table 7. Sum of observations, average count/segment, and Shannon-Wiener diversity index for each survey divided by upstream and downstream.

	Upstream			Downstream		
Survey	**1**	**2**	**3**	**1**	**2**	**3**
Sum of Count	235	369	449	1377	496	217
Average Count/Segment	13.8	21.7	26.4	105.9	38.2	16.7
Diversity Index	1.62	1.38	0.97	0.72	1.11	1.11

Discussion

Survey one had the highest bird counts suggesting that migration was peaking at this time. The majority of birds detected along the Peace River were found using the downstream portion of the river (transects 18-30 east of the Site C dam). Only during the third survey was the highest number of birds observed upstream of the dam site. When looking at the diversity of species using the river, the highest diversity was found upstream of the dam during the first two surveys. Diversity was highest downstream of the dam during the third survey. Diversity takes into account the number of species present as well as the abundance of each species. When abundances of each species are similar the diversity index will be greater. If the bird abundance is dominated by one group of birds, such as Canada geese, as was the case on Survey one, on the Peace River, the diversity index will be lower. These trends in diversity are consistent with past migratory surveys conducted on the Peace River in the springs of 2012-2015. All but two surveys in 2013 found diversity highest upstream of the Site C dam site.

Several waterfowl species were not detected during fall 2015 surveys that had been detected during previous migratory surveys (Churchland et al. 2015). This included ring neck duck (n=37), ruddy duck (n=3), and canvasback (n=2) which were detected in 2013, and hooded merganser (n=2), common goldeneye (n=5), gadwall (n=2), bufflehead (n=28) and American wigeon (n=903) which were detected in 2014. There are many reasons why a species may not have been observed in the same area, including timing, variations of resources available, and environmental conditions. It is not expected that the same species will be observed in the same locations year after year (Churchland et al. 2015). It is also possible that early migrants had departed prior to the first survey (i.e., ruddy duck, and American wigeon), or late migrants were not highly active along the river yet (i.e., hooded merganser, bufflehead, canvasback), and therefore were not observed.

Past survey were conducted in a helicopter, rather than a fixed-wing aircraft, which has greater maneuverability to pause over, or return to, flocks for identification purposes. They also have the capability to fly lower and slower, allowing observers a greater visual opportunity to identify waterfowl. The change in survey methods from a helicopter to a plane in 2015 may have decreased the number of individuals documented and affected the ability to differentiate species due to the higher altitude and faster flight speed. Spring migration surveys conducted in 2015 also used a fixed-wing aircraft and also saw a decline in species richness compared to previous years (Bianchini 2015).

Other notable observations of wetland use include:

- Use of Tamarack sedge (TS) wetlands by mallards, blue-winged teals, green-winged teals, and other unidentifiable duck species.
- Use of gravel bars along the Peace River by a large diversity of waterfowl species.

Recommendations

- Consider starting 2016 fall migration surveys earlier in August to determine when migration begins and if additional species are observed.

- Include maps indicating the distribution of observations across survey transects.
- Identify the number of wetland habitats (by wetland type) available across the survey transects versus the number of wetland habitats where observations occurred.

References

Bianchini, C. 2015. Site C Clean Energy Project Early Migration Waterfowl use of the Peace River. Report to BC Hydro Power and Authority, Vancouver, BC.

Churchland, C., Routledge, T., Simpson, L. 2015. Site C Clean Energy Project Spring Waterfowl Use of the Peace River. Document 06-136. Report to BC Hydro Power and Authority, Vancouver, BC.

Keylock, C. J. 2005. Simpson diversity and the Shannon–Wiener index as special cases of a generalized entropy. Oikos, 109(1), 203-207.

Appendix A – Habitat Type Acronyms

Table A.1. List of acronyms of each habitat used by water birds during fall migratory surveys.

Habitat Type	Habitat Code
Lingonberry-coltsfoot	BL
Labrador tea-sphagnum	BT
Red-osier dogwood	Fm02
Gravel bar	GB
Lake	LA
Shallow open water	OW
Pond	PD
River	RI
Sedge wetland	SE
Wildrye-peavine	SW
Tamarack-sedge	TS
Willow-horsetail-sedge	WH
Willow-sedge	WS

Appendix B – Non Waterfowl Observations

Table B.1. Table listing non waterfowl species and the habitat they were found in during the fall migratory surveys.

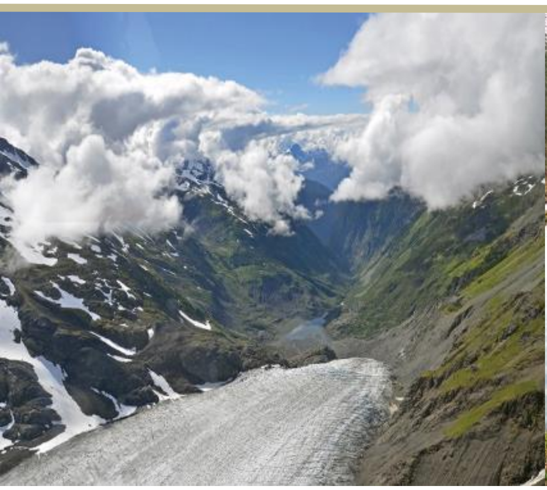
Species		Habitat					
Common Name	**Scientific Name**	**AM**	**BT**	**GB**	**RI**	**WS**	**Total**
American crow	*Corvus brachyrhynchos*				28	1	29
Bald eagle	*Heliaeetus leucocephalus*	1	1	1	3		6
Common Raven	*Corvus corax*				3		
Unidentified swallow					10		10
Total:		1	1	1	13	0	45

Appendix E. Bird transmission collision risk assessment

TETRA TECH EBA

OQM | Organizational Quality Management Program

Bird-Transmission Line Collision Risk Assessment



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Tetra Tech EBA Inc.
Suite 1000 – 10th Floor, 885 Dunsmuir Street
Vancouver, BC V6C 1N5 CANADA
Tel 604.685.0275 Fax 604.684.6241

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APPENDICES

Appendix A Tetra Tech EBA's General Conditions

LIMITATIONS OF REPORT

This report and its contents are intended for the sole use of British Columbia Hydro and Power Authority and their agents. Tetra Tech EBA Inc. (Tetra Tech EBA) does not accept any responsibility for the accuracy of any of the data, the analysis, or the recommendations contained or referenced in the report when the report is used or relied upon by any Party other than British Columbia Hydro and Power Authority, or for any Project other than the proposed development at the subject site. Any such unauthorized use of this report is at the sole risk of the user. Use of this report is subject to the terms and conditions stated in Tetra Tech EBA's Services Agreement. Tetra Tech EBA's General Conditions are provided in Appendix A of this report.

1.0 INTRODUCTION

On behalf of the Saulteau EBA Environmental Services Joint Venture (SEES JV), Tetra Tech EBA Inc. (Tetra Tech EBA) is pleased to provide this assessment of the potential risk for bird-transmission line collisions with the two proposed 500-kV transmission lines connecting the new Site C substation to the existing Peace Canyon substation along and adjacent to an existing 77-km right-of-way (ROW). The assessment has three components:

- A literature review summarizing known contributors to avian collisions with transmission lines. The primary goal of the review was to identify: (a) structural features of high voltage transmission lines that are associated with bird collisions, (b) landscape features that may increase collision probabilities, and (c) landscape and habitat use patterns of bird species prone to collisions.
- A spatially explicit model of collision risk along the proposed ROW that differentiates ROW segments of varying potential for bird collisions with the proposed transmission line.
- A qualitative risk assessment of the proposed ROW and the proposed tower types and conductor arrangements. This assessment will focus on those features identified during the literature review that are relevant to the landscape surrounding the proposed ROW.

2.0 LITERATURE REVIEW

2.1 Structural Features

Several structural features of high voltage (i.e., 500-kV) transmission lines are associated with bird collision risk (Table 2-1). In general, these features all relate to the visibility of the structures to flying birds.

Table 2-1: Structural Features of High Voltage Transmission Lines associated with Bird Collision Risk

Characteristic	Risk Feature	Interaction	Literature Cited
Shield/grounding wire	Diameter and location	Tend to be smaller than and placed above conductors, thereby limiting visibility. Most avian collisions are thought to occur with shield wires. Elimination of shield wires is considered the best design measure to reduce avian mortalities.	Savereno et al. 1996; Jenkins et al. 2010; Rioux et al. 2013
Conductor configuration	Horizontal plane versus vertical offset.	Few collisions when conductors arranged in horizontal plane.	APLIC 2012
Conductor spacers	Overall visibility	Using conductor spacers can increase overall visibility, thereby decreasing collision risk	APLIC 2012
Tower lighting	Light spectrum and deployment.	In low light or low visibility conditions, birds can be attracted to constant source (i.e., non-strobe) lights of specific spectra. Attraction to the transmission line increases risk of collision.	Evans Ogden 1996; Manville 2005; Longcore et al. 2008
Guy wires	Diameter and location	Tend to be smaller than conductors, thereby limiting visibility.	Longcore et al. 2008; APLIC 2012

Characteristic	Risk Feature	Interaction	Literature Cited
Co-location of lines	Density of anthropogenic features	▪ Clustering lines within single ROWs may increase the visual 'footprint', thereby increasing the probability of generating avoidance behaviours. ▪ Increased obstacle density can increase collision risk in low light or low visibility conditions.	Bevanger 1998; Drewitt and Langston 2008; APLIC 2012

2.2 Landscape Features

Landscape features that influence either transmission line visibility or bird movement paths have been linked to bird collision risk are summarized in Table 2-2.

Table 2-2: Landscape Features associated with Bird Collisions with High Voltage Transmission Lines

Characteristic	Risk Feature	Interaction	Literature Cited
Ridge lines	Ridge lines tend to concentrate flight activity and bird densities in a narrow altitudinal band.	Collision risk higher for transmission lines running on top of and parallel to ridge lines.	Savereno et al. 1996; Janss and Ferrer 2000; Martin and Shaw 2010
Topographical depressions (e.g., river valley)	Tendency for depressions to be used as travel corridors	Collision risk higher for transmission lines spanning topographical depressions (i.e., perpendicular to flight paths).	McNeil et al. 1985; Janss and Ferrer 2000; Martin and Shaw 2010; APLIC 2012
Standing vegetation	Height of transmission line relative to nearby vegetation	Collision risk decreases when transmission lines (i.e., conductors) are below the height of surrounding vegetation.	APLIC 2012
Wetlands	Waterfowl/waterbird congregations; hunting areas for raptors	Close proximity of wetlands and transmission lines (i.e., within 500 m) increases the frequency with which collision-susceptible birds could interact with transmission lines.	APLIC 2012

2.3 Biological Features

Collision data provide a consistent assessment of which bird groups are most at risk from transmission line collisions (APLIC 2012, Rioux et al. 2013, and references therein): waterfowl (*Anseriformes*), grebes (*Podicipedidae*), gulls and shorebirds (*Charadriiformes*) and cranes (Gruiformes). Additional bird groups that demonstrate susceptibility to transmission line collisions include herons (*Pelecaniformes*), grouse (*Galliformes*) and raptors (*Accipitriformes* and *Falconiformes*). Bird species within each of these groups exhibit multiple behavioural or physical characteristics that contribute to increased collision risk (Table 2-3).

Table 2-3: Behavioural and Physical Features of Birds associated with Increased Collision Risk

Characteristic	Risk Feature	Interaction	Example Possible or Known Species in Project Area with Risk Feature	Literature Cited
Morphology	Low wing aspect ratio (i.e., short and broad wings). High wing loading (i.e., high body weight relative to wing size).	Low aspect ratio and high wing loading lead to lower maneuverability in flight.	Trumpeter Swan (*Cygnus buccinator*) Canada Goose (*Branta canadensis*) Common Merganser (*Mergus merganser*) Common Goldeneye (*Bucephala clangula*)	Bevanger 1998; Janss 2000; Rubolini et al. 2005
Flocking	Tendency to travel in dense flocks.	Travelling in dense flocks can limit visibility and maneuverability.	Canada Goose Sandhill Crane (*Grus canadensis*)	Bevanger 1998; Drewitt and Langston 2006; Murphy et al. 2009
Flight height	Tendency to fly at heights of transmission lines (i.e., under 60 m).	Birds can only collide with transmission lines when flying at the height of transmission lines.	Trumpeter Swan Canada Goose Common Merganser Common Goldeneye Sandhill Crane	Bevanger 1998; Jenkins et al. 2010
Flight behaviour	Non-transit behaviours during flight (e.g., aerial courtship displays, hunting).	Complex flight behaviours or flight activities can draw attention away from surroundings.	Northern Harrier (*Circus cyaneus*) Short-eared Owl (*Asio flammeus*)	Martin 2011; APLIC 2012
Sight	Poor depth perception or visual acuity.	Species with eye adapted for underwater vision (e.g., waterfowl) tend to be nearsighted in air.	Common Merganser Common Goldeneye	Jones et al. 2007; Martin and Shaw 2010; Martin 2011
Age	Younger birds are inexperienced flyers.	Inexperience lowers maneuverability and limits awareness of risk factors (i.e., young birds naïve to risk posed by obstacles).	All	Drewiit and Langston 2008; Jenkins et al. 2010
Nocturnal or crepuscular activity	Tendency to fly in low light conditions.	Low light conditions can limit response times to obstacles in flight paths.	Short-eared Owl	Brown and Drewien 1995

3.0 RISK ASSESSMENT

Tetra Tech EBA developed a spatially explicit model of collision risk along the proposed ROW with the goal of differentiating ROW segments of varying potential for bird collisions with the proposed transmission line. This model was augmented with a qualitative risk assessment of the proposed tower types and conductor arrangements, in the context of those features identified (Table 2-2) during the literature review that are associated with increased or decrease bird collision risk.

3.1 Spatially Explicit GIS Model of Landscape-based Risk Features

3.1.1 Model Development

3.1.1.1 Generalized Avian Risk

Tetra Tech EBA delineated the ROW as the outer two lines of a kml file provided by British Columbia Hydro and Power Authority (BC Hydro) on September 29. 2015, and extracted proposed tower locations from the same file. The study area for the model was defined as 500 m on either side of the ROW as this distance is consistent with the extent of available TEM data provided by BC Hydro (the buffer is less than 500 m in some locations). The corridor was collapsed to a single centerline feature and divided into 500 m segments starting at the eastern end of the alignment, with a remaining segment of 354 m at the western end of the alignment.

Tetra Tech EBA visually identified valleys and ridges using TRIM contour data at an interval of 20 m and a slope layer derived from TRIM contours. Open-water wetlands and waterbodies capable of utilization by waterfowl (e.g., ducks and geese) and waterbirds (e.g., grebes, rails) were identified from TEM mapping by selecting polygons with the following site codes in any of the three deciles: Lake (LA), Shallow Open Water (OW), Pond (PD), Reservoir (RE), River (RI), and Willow-Horsetail-Sedge-Riparian Wetland (WH).

To qualitatively assess potential for bird collision risk, Tetra Tech EBA developed a simple risk score method for each segment based on three features:

- Segment crosses a topographical depression or runs parallel to a ridge (score = 1.0);
- Segment is within 100 m of a wetland (score = 1.0); and
- Segment is within 100 m to 500 m of a wetland (score = 0.5).

Each segment was given an overall score of 0.0 to 2.5 based on the sum of the three criteria. A high score indicates higher potential risk.

Wetlands within 100 m of the corridor were identified by buffering the centerline by 140 m and intersecting the buffer with the wetland layer. The additional 40 m was added to account for half the average width of the corridor. Wetlands within 100 m to 500 m of the corridor were identified by buffering the centerline by 540 m, removing the area within 140 m of the centerline, and intersecting the buffer with the wetland layer.

3.1.1.2 Species-Specific Risk Assessments

In addition to the generalized avian risk assessment, Tetra Tech EBA developed five species-specific assessments to evaluate potential risk to protected species (e.g., *Species at Risk Act* [SARA], *Migratory Birds Convention Act*) and to assess potential risk to birds that do not exclusively use wetland habitats.

- Trumpeter Swan (*Cygnus buccinators*; BC List – Yellow) – the model included the same study area as the generalized model and focused on the presence of secluded open-water wetlands (as defined above) with 75% of their margin surrounded by forest. Scoring was based on:
  - Segment crosses a topographical depression or runs parallel to a ridge (score = 1.0);
  - Segment is within 100 m of a suitable wetland (score = 1.0); and
  - Segment is within 100 m to 500 m of a suitable wetland (score = 0.5).
- Horned Grebe (*Podiceps auritus*; BC List – Yellow) – the model included the same study area as the generalized model and focused on the presence of open-water wetlands (as defined above) smaller than 10 ha. Scoring was based on:
  - Segment crosses a topographical depression or runs parallel to a ridge (score = 1.0);
  - Segment is within 100 m of a suitable wetland (score = 1.0); and
  - Segment is within 100 m to 500 m of a suitable wetland (score = 0.5).
- Common Nighthawk (*Chordeiles minor*; Threatened – SARA Schedule 1; BC List – Yellow) – the model included the same study area as the generalized model and focused on the presence of key habitat types: Cultivated Fields (CF), Exposed Soil (ES), Fuzzy-spiked Wildrye-Wolf Willow (WW), Gravel Bar (GB), Gravel Pit (GP), Mine Tailings (RY), Rural (RW), Sedge Wetland (SE), Tamarack-Sedge Ren (TS), Urban (UR), WH, and Willow-Sedge Wetland (WS). Scoring was based on:
  - Segment crosses a topographical depression or runs parallel to a ridge (score = 1.0);
  - Segment is within 100 m of suitable habitat (score = 1.0); and
  - Segment is within 100 m to 500 m of suitable habitat (score = 0.5).
- Olive-sided Flycatcher (*Contopus cooperi*; Threatened – SARA Schedule 1; BC List – Blue) – the model included the same study area as the generalized model and focused on the presence of forest cover: White Spruce series (AM, AS, SC, SH, SO, SW), Black Spruce series (BL, BT), Black Cottonwood (Fm02), Lodgepole Pine (LL), and TS. Scoring was based on:
  - Segment crosses a topographical depression or runs parallel to a ridge (score = 1.0);
  - Segment is within 100 m of suitable habitat (score = 1.0); and
  - Segment is within 100 m to 500 m of suitable habitat (score = 0.5).
- Rusty Blackbird (*Euphagus carolinus*; Special Concern – SARA Schedule 1; BC List – Blue) – the model included the same study area as the generalized model and focused on the presence of key habitat types: BT, SE, TS, WH, and WS. Scoring was based on:
  - Segment crosses a topographical depression or runs parallel to a ridge (score = 1.0);
  - Segment is within 100 m of suitable habitat (score = 1.0); and
  - Segment is within 100 m to 500 m of suitable habitat (score = 0.5).

3.1.2 Model Results

3.1.2.1 Generalized Avian Risk

Two of the 150 segments received a high risk score of 2.5; this represents approximately 1.3% of the total ROW length. These segments are located in the central portion of the ROW and encompass tower locations 44/2, 44/3, 45/1, and 45/2 (Figure 1c). The combination of wetland presence and the crossing of a topographical depression (i.e., Moberly River) contributed to the high ranking.

Fifty-three of the 150 segments received a moderate risk score of 1.5; this represents approximately 35% of the total ROW length (Figures 1a-d). Although segments receiving a score of 1.5 can be found along the entire length of the ROW, there is a notable concentration in the easternmost 20 km, due to the extensive wetland network in this area. One limitation of the binary scoring method (i.e., is there a wetland or not?) is that a given segment will receive a 1.0 or 0.5 score for any wetland, regardless of size or waterfowl supporting capacity, within 100 m or 500 m, respectively.

The remaining 95 segments (approximately 63% of the total ROW length) received low risk scores of 1.0, 0.5, or 0.

3.1.2.2 Species-specific Assessments

Trumpeter Swan – None of the 150 segments received a high risk score of 2.5 for Trumpeter Swan (Figure 2). Forty of the 150 segments received a moderate risk score of 1.5; this represents approximately 27% of the total ROW length. The remaining 110 segments (approximately 73% of the total ROW length) received low risk scores of 1.0, 0.5 or 0.

Horned Grebe – Two of the 150 segments received a high risk score of 2.5 for Horned Grebe; this represents approximately 1.3% of the total ROW length. These segments are located in the central portion of the ROW and encompass tower locations 44/2, 44/3, 45/1, and 45/2 (Figure 3c). The combination of wetland presence and the crossing of a topographical depression (i.e., Moberly River) contributed to the high ranking. Forty-four of the 150 segments received a moderate risk score of 1.5; this represents approximately 29% of the total ROW length. The remaining 104 segments (approximately 69% of the total ROW length) received low risk scores of 1.0, 0.5 or 0.

Common Nighthawk – Seven of the 150 segments received a high risk score of 2.5 for Common Nighthawk; this represents approximately 4.7% of the total ROW length (Figure 4). These segments were concentrated within the central (tower locations: 35/1, 35/2, 44/2, 44/3, 45/1, and 45/2) and western (64/1, 64/2, 65/1, 65/2, 66/1, and 66/2) portions of the ROW where a higher diversity of preferred nighthawk habitats are located. One hundred and eighteen segments received a moderate risk score of 1.5 or 2.0; this represents approximately 77% of the total ROW length; the relatively large proportion of moderate risk segments is indicative of the generalist habitat tendencies of this species, particularly for foraging habitats. The remaining 25 segments (approximately 17% of the total ROW length) received low risk scores of 1.0, 0.5 or 0.

Olive-sided Flycatcher – None of the 150 segments received a high risk score of 2.5 for Olive-sided Flycatcher (Figure 5). Twenty-nine of the 150 segments received a moderate risk score of 1.5; this represents approximately 19% of the total ROW length. The remaining 121 segments (approximately 81% of the total ROW length) received low risk scores of 1.0, 0.5 or 0.

Rusty Blackbird – Five of the 150 segments received a high risk score of 2.5 for Rusty Blackbird; this represents approximately 3.3% of the total ROW length (Figure 6). These segments are located in the central (tower locations: 44/2, 44/3, 45/1, and 45/2) and western (64/1, 64/2, 65/1, 65/2, 66/1, and 66/2) portions of the ROW. The combination of wetland presence and the crossing of a topographical depression (e.g., Moberly River) contributed to the high ranking. Ninety-one of the 150 segments received a moderate risk score of 1.5; this represents approximately 61% of the total ROW length. The remaining 54 segments (approximately 36% of the total ROW length) received low risk scores of 1.0, 0.5 or 0.

3.1.2.3 Summary of Potential High-risk Areas

The following locations were identified as potential high-risk areas for one or more of the modeled scenarios:

- Two ROW segments encompassing towers 35/1 and 35/2: Common Nighthawk;
- Two ROW segments encompassing towers 44/2, 44/3, 45/1, and 45/2: generalized avian risk, Horned Grebe, Common Nighthawk, Rusty Blackbird; and
- Three ROW segments encompassing towers 64/1, 64/2, 65/1, 65/2, 66/1, and 66/2: Common Nighthawk, Rusty Blackbird.

In total, only seven of 150 ROW segments (approximately 9% of total ROW length) are predicted to pose potentially high risk of bird collisions.

3.2 Additional Risk Factors

3.2.1 Biological Features

Data collected by BC Hydro as part of their ongoing monitoring indicates that species known to be susceptible to collisions with transmission lines (e.g., waterfowl) are present in the region and have been observed in wetlands along the ROW. Species detected include Trumpeter Swan, Canada Goose, Common Merganser, and Common Goldeneye.

3.2.2 Structural Features

The current design under consideration for the two 500-kV transmission lines includes features known to minimize the potential for bird collisions (e.g. elimination of shield wires, co-location of lines in a single ROW) and some that may increase the potential for bird collisions (e.g., guy wires, vertical conductor arrangement) (Table 3-1). Elimination of shield wires is considered the best design measure to reduce avian mortalities.

Table 3-1: Presence of Structural Risk Factors for Bird Collisions in Current Proposed Transmission Line Design

Feature	Conductor Design	Tower Type 52A/C	Tower Type 53A/C	Tower Type II A Guyed	Tower Type II A Rigid	Tower Type J MK 8	Tower Type II C Rigid
Shield/ground wires*	No	No	No	No	No	No	No
Conductor spacers	Yes	NA	NA	NA	NA	NA	NA
Horizontal conductor arrangement	NA	No	No	Yes	Yes	Yes	Yes
Tower lighting	NA	No	No	No	No	No	No
Guy wires	NA	Yes	No	Yes	No	No	No
Co-location of lines	Yes	Yes	Yes	Yes	Yes	Yes	Yes

*limited shield wiring (approx. 1.6km) will be required at each end of the ROW as part of substation protection procedures

The selection of guyed versus unguyed towers represents a trade-off between potential effects. Unguyed towers have fewer, small-diameter wires that present collision risk but they provide more opportunities for bird perching (thereby attracting birds to the infrastructure) and they require a large foundation footprint (i.e., more ground disturbance and potential habitat loss). In contrast guyed towers have, by definition, more wires but are generally smaller structures with less lattice and a smaller ground-based footprint.

4.0 CLOSURE

We trust this report meets your present requirements. If you have any questions or comments, please contact the undersigned.

Respectfully submitted,
Tetra Tech EBA Inc.

Prepared by:
Jason Jones, Ph.D., R.P.Bio., P.Biol.
Manager – Pacific and Yukon Region
Environment Practice
Direct Line: 778.945.5840
Jason.Jones@tetratech.com

Reviewed by:
Jeff Matheson, M.Sc., R.P.Bio., P.Biol.
Senior Biologist
Environment Practice
Direct Line: 604.608.8908
Jeff.Matheson@tetratech.com

/sy

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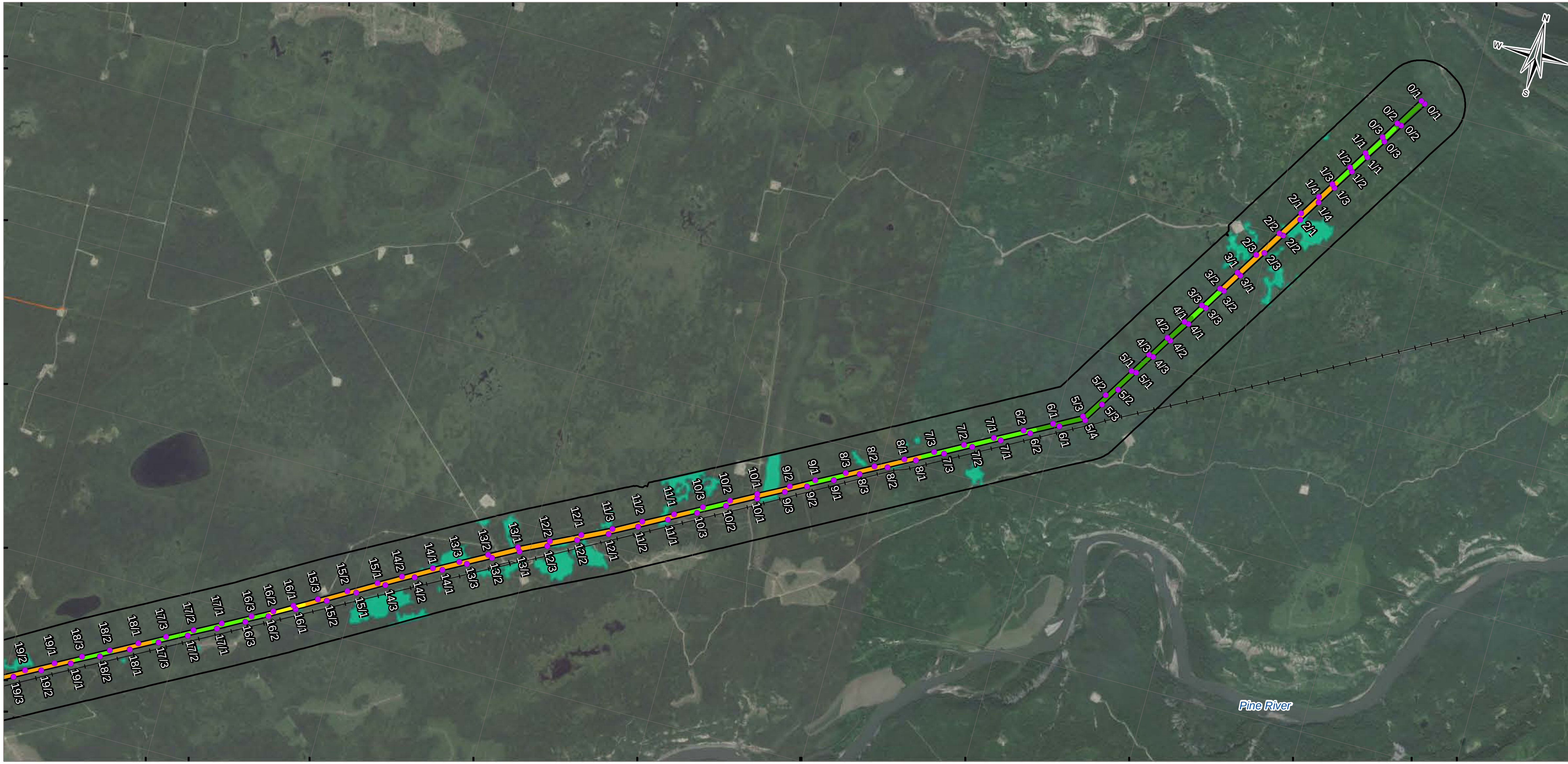
FIGURES

Figure 1a to 1d	Potential Bird Strike Risk Ranking
Figure 2a to 2d	Potential Trumpeter Swan Strike Risk Ranking
Figure 3a to 3d	Potential Horned Grebe Strike Risk Ranking
Figure 4a to 4d	Potential Common Nighthawk Strike Risk Ranking
Figure 5a to 5d	Potential Olive-sided Flycatcher Strike Risk Ranking
Figure 6a to 6d	Potential Rusty Blackbird Strike Risk Ranking

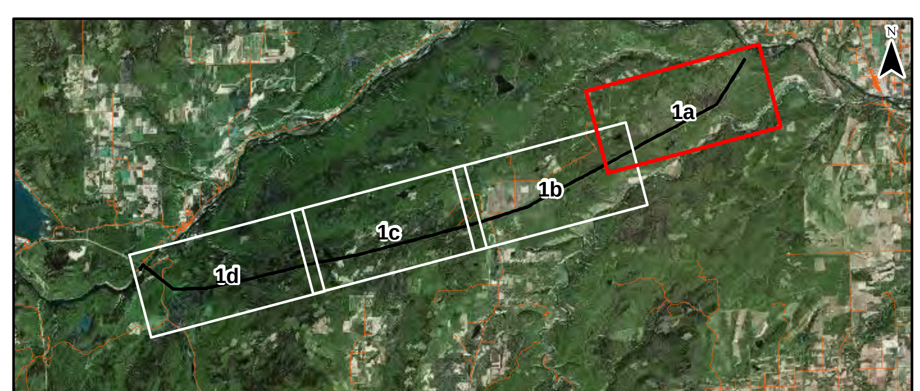


LEGEND

- Tower Location
- Proposed Alignment Corridor
- Study Area (500 m Buffer)
- Open Water Wetland within Study Area
- Existing Road
- Railway

Segment Risk Score

- 0
- 0.5
- 1
- 1.5
- 2.5



NOTES
Base data source:
Proposed Infrastucutre, TEM Mapping and TRIM base data provided by BC Hydro (October 2015)
Imagery from BING Imagery Service for ArcGIS
CanVec 1:50,000

STATUS
ISSUED FOR USE

SITE C CLEAN ENERGY PROJECT WILDLIFE MITIGATION AND MONITORING

Potential Bird Strike Risk Ranking

PROJECTION	DATUM	CLIENT
UTM Zone 10	NAD83	BC hydro

Scale: 1:50,000
1 0.5 0 1
Kilometres

FILE NO.
VENV03003-01_Figure01_OpenWetland.mxd

PROJECT NO.	DWN	CKD	APVD	REV
ENV.VENV03003-01	MEZ	SL	JJ	0

OFFICE	DATE
Tt EBA-VANC	November 18, 2015

TETRA TECH EBA

Figure 1a

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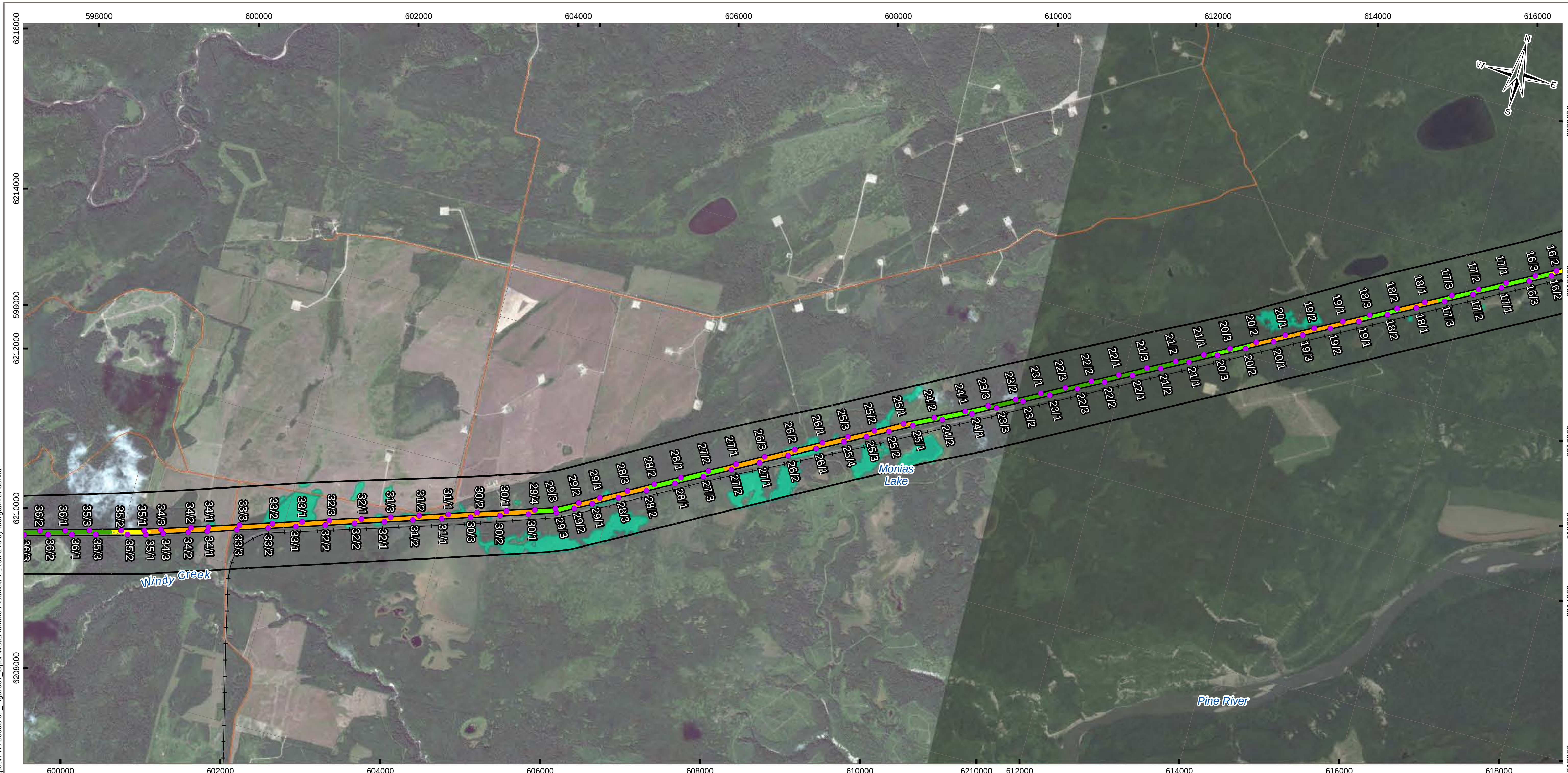
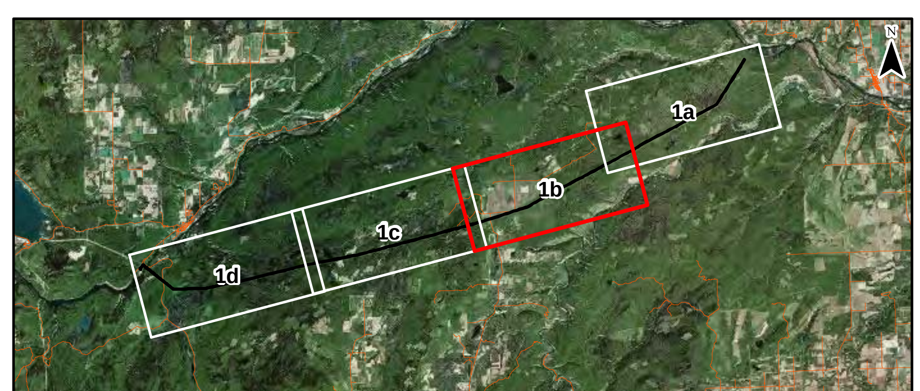


LEGEND

- Tower Location
- Proposed Alignment Corridor
- Study Area (500 m Buffer)
- Open Water Wetland within Study Area
- Existing Road
- Railway

Segment Risk Score

- 0
- 0.5
- 1
- 1.5
- 2.5



NOTES

Base data source:
Proposed Infrastructure, TEM Mapping and TRIM base data provided by BC Hydro (October 2015)
Imagery from BING Imagery Service for ArcGIS
CanVec 1:50,000

STATUS
ISSUED FOR USE

SITE C CLEAN ENERGY PROJECT WILDLIFE MITIGATION AND MONITORING

Potential Bird Strike Risk Ranking

PROJECTION	DATUM	CLIENT
UTM Zone 10	NAD83	BC hydro

Scale: 1:50,000

1 0.5 0 1

Kilometres

FILE NO.
VENV03003-01_Figure01_OpenWetland.mxd

TETRA TECH EBA

PROJECT NO.	DWN	CKD	APVD	REV
ENV.VENV03003-01	MEZ	SL	JJ	0

OFFICE	DATE
Tt EBA-VANC	November 18, 2015

Figure 1b

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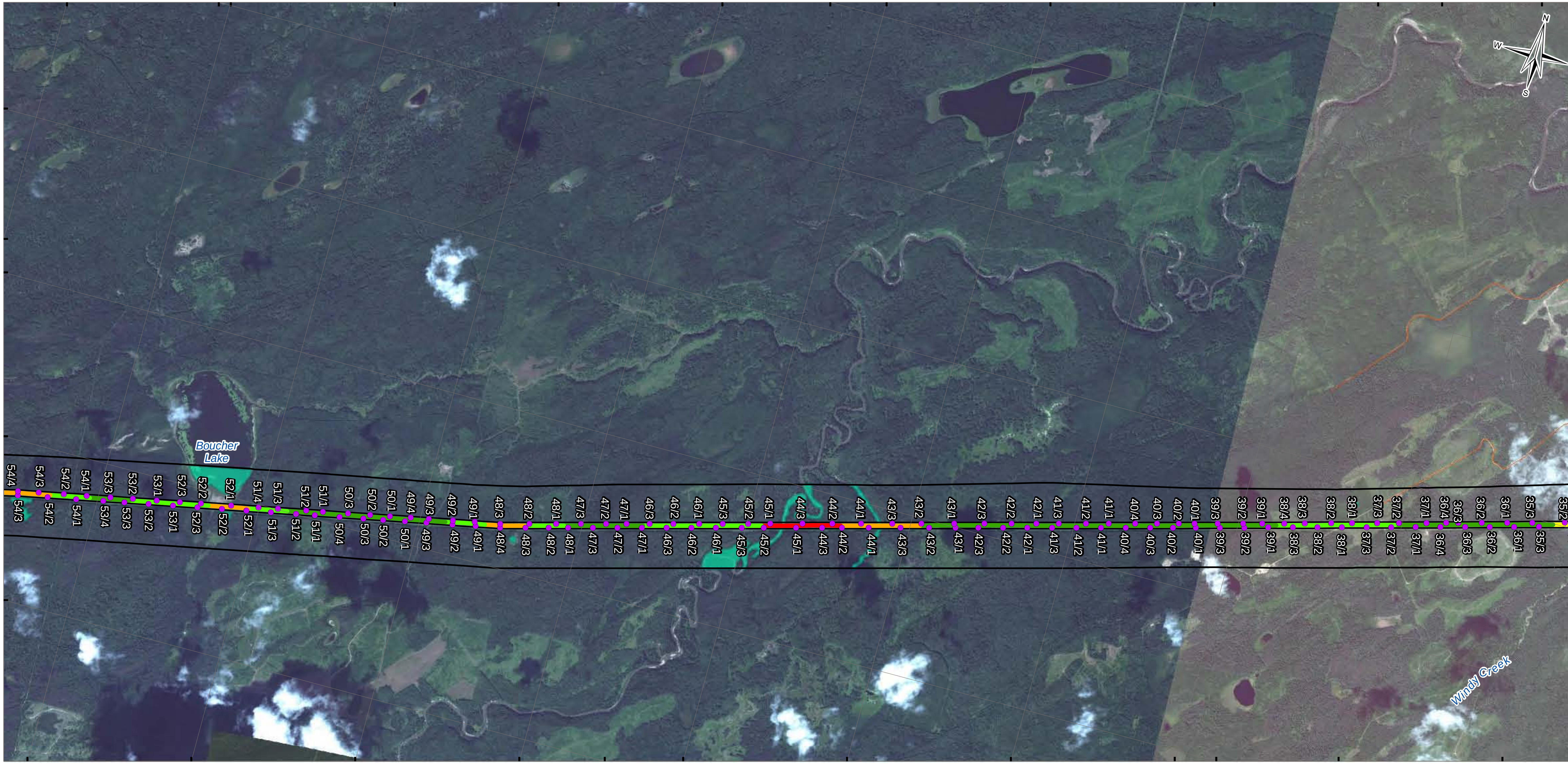
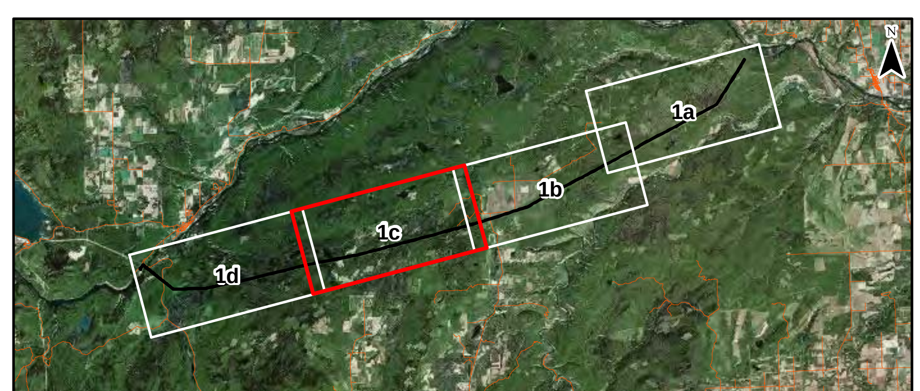


LEGEND

- Tower Location
- Proposed Alignment Corridor
- Study Area (500 m Buffer)
- Open Water Wetland within Study Area
- Existing Road
- Railway

Segment Risk Score

- 0
- 0.5
- 1
- 1.5
- 2.5



NOTES
Base data source:
Proposed Infrastucutre, TEM Mapping and TRIM base data provided by BC Hydro (October 2015)
Imagery from BING Imagery Service for ArcGIS
CanVec 1:50,000

STATUS
ISSUED FOR USE

SITE C CLEAN ENERGY PROJECT WILDLIFE MITIGATION AND MONITORING

Potential Bird Strike Risk Ranking

PROJECTION	DATUM	CLIENT
UTM Zone 10	NAD83	BC hydro

Scale: 1:50,000
1 0.5 0 1
Kilometres

FILE NO.
VENV03003-01_Figure01_OpenWetland.mxd

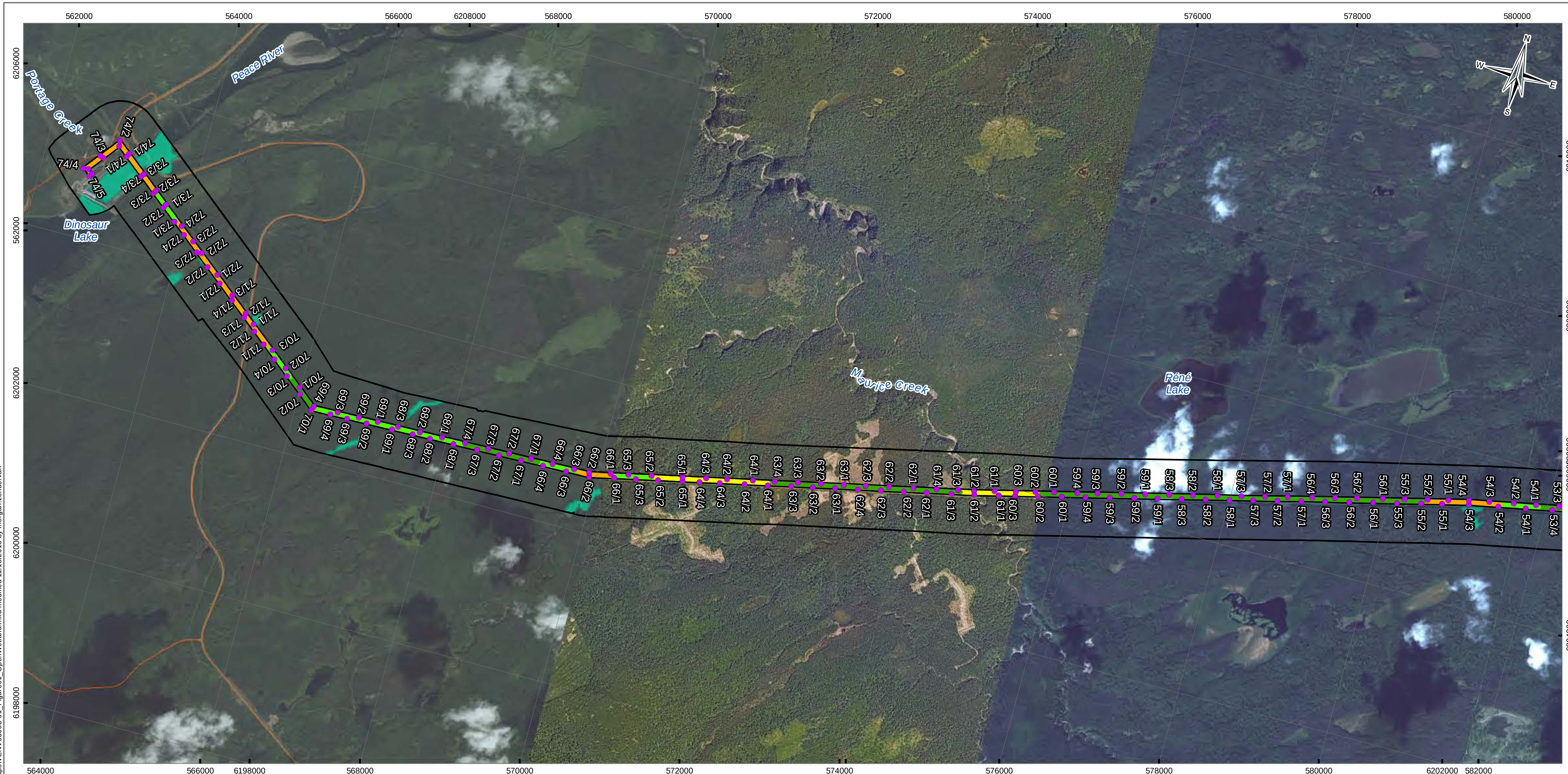
PROJECT NO.	DWN	CKD	APVD	REV
ENV.VENV03003-01	MEZ	SL	JJ	0

OFFICE	DATE
Tt EBA-VANC	November 18, 2015

TETRA TECH EBA

Figure 1c

Q:\Vancouver\GIS\ENVIRONMENTAL\VENV\VENV03003-01_BCHydro\Maps\VENV03003-01_Figure01_OpenWetland.mxd modified 11/18/2015 by morgan.zondervan

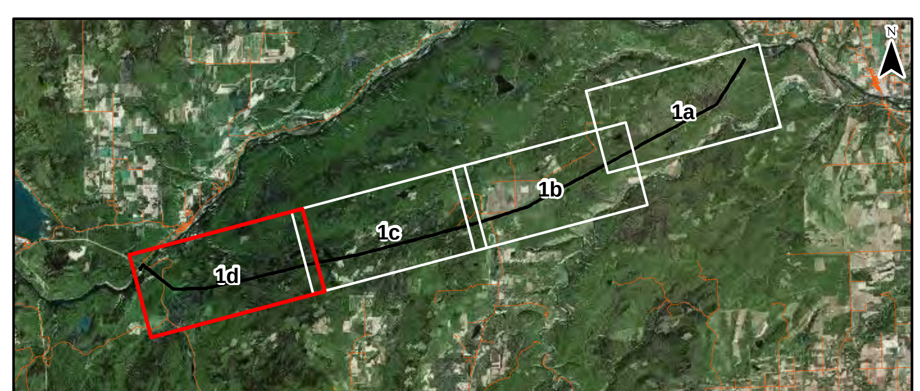


LEGEND

- Tower Location
- Proposed Alignment Corridor
- Study Area (500 m Buffer)
- Open Water Wetland within Study Area
- Existing Road
- Railway

Segment Risk Score

- 0
- 0.5
- 1
- 1.5
- 2.5



NOTES
Base data source:
Proposed Infrastructure, TEM Mapping and TRIM base data provided by BC Hydro (October 2015)
Imagery from BING Imagery Service for ArcGIS
CanVec 1:50,000

STATUS
ISSUED FOR USE

SITE C CLEAN ENERGY PROJECT WILDLIFE MITIGATION AND MONITORING

Potential Bird Strike Risk Ranking

PROJECTION	DATUM	CLIENT
UTM Zone 10	NAD83	BC hydro

Scale: 1:50,000
1 0.5 0 1
Kilometres

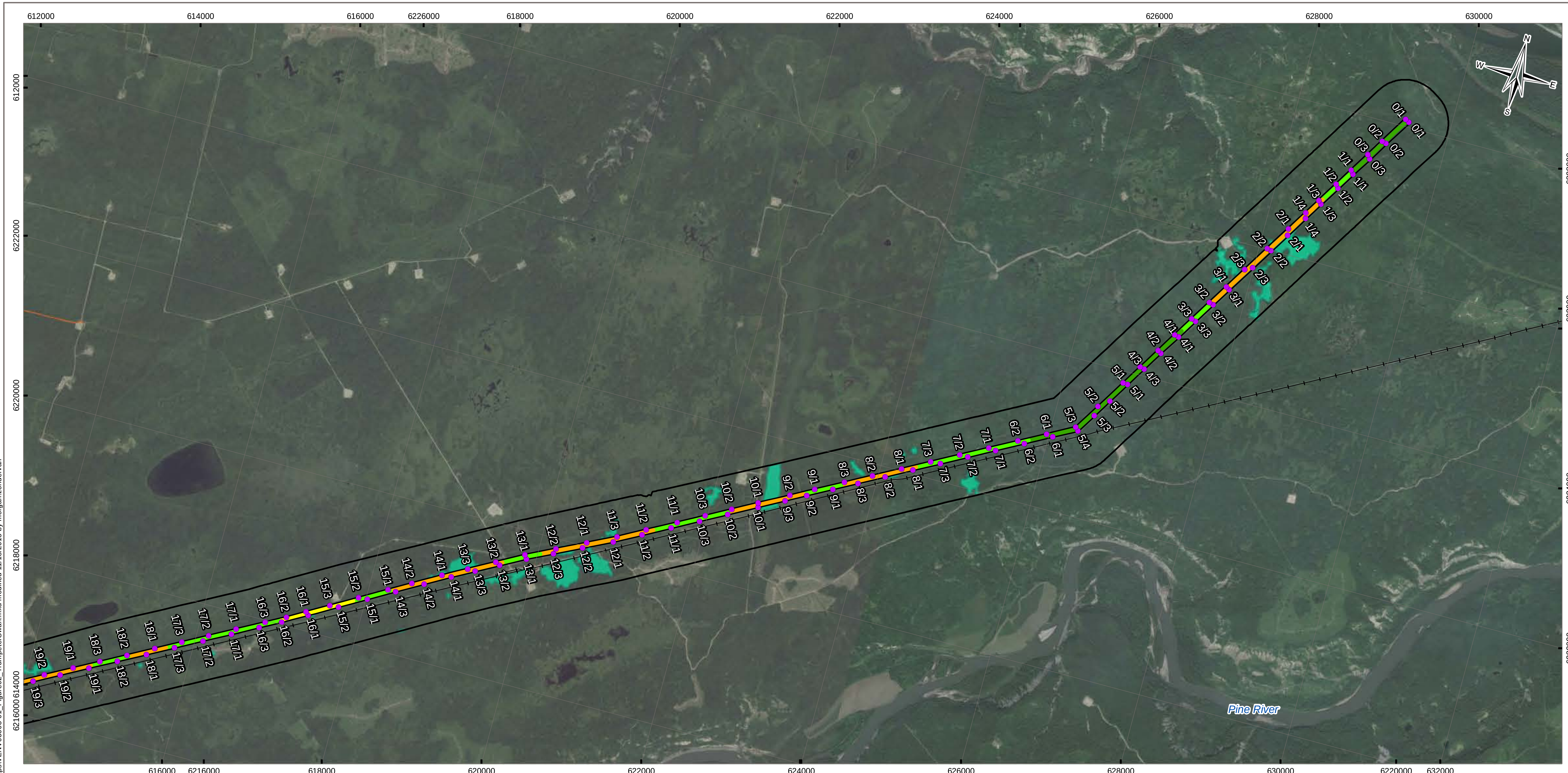
TETRA TECH EBA

FILE NO.
VENV03003-01_Figure01_OpenWetland.mxd

PROJECT NO.	DWN	CKD	APVD	REV
ENV.VENV03003-01	MEZ	SL	JJ	0

OFFICE	DATE
Tt EBA-VANC	November 18, 2015

Figure 1d

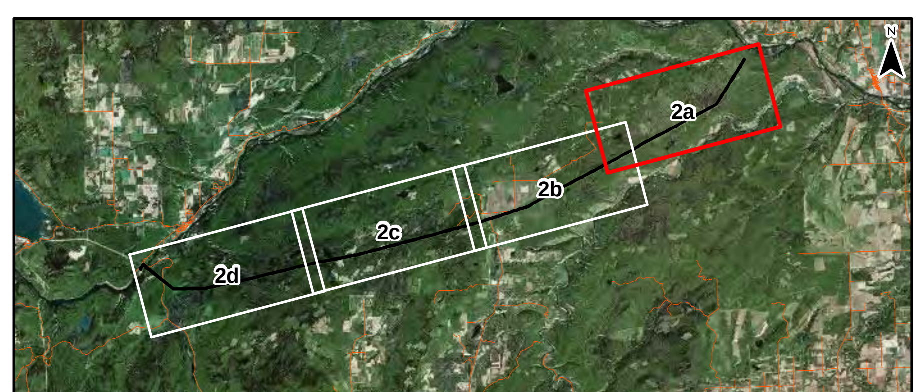


LEGEND

- Tower Location
- Proposed Alignment Corridor
- Study Area (500 m Buffer)
- Trumpeter Swan Habitat within Study Area
- Existing Road
- Railway

Segment Risk Score

- 0
- 0.5
- 1
- 1.5



NOTES
Base data source:
Proposed Infrastrucutre, TEM Mapping and TRIM base data provided by BC Hydro (October 2015)
Imagery from BING Imagery Service for ArcGIS
CanVec 1:50,000

STATUS
ISSUED FOR USE

SITE C CLEAN ENERGY PROJECT WILDLIFE MITIGATION AND MONITORING

Potential Trumpeter Swan Strike Risk Ranking

PROJECTION	DATUM	CLIENT
UTM Zone 10	NAD83	BC hydro

Scale: 1:50,000
1 0.5 0 1
Kilometres

FILE NO.
VENV03003-01_Figure02_TrumpeterSwan.mxd

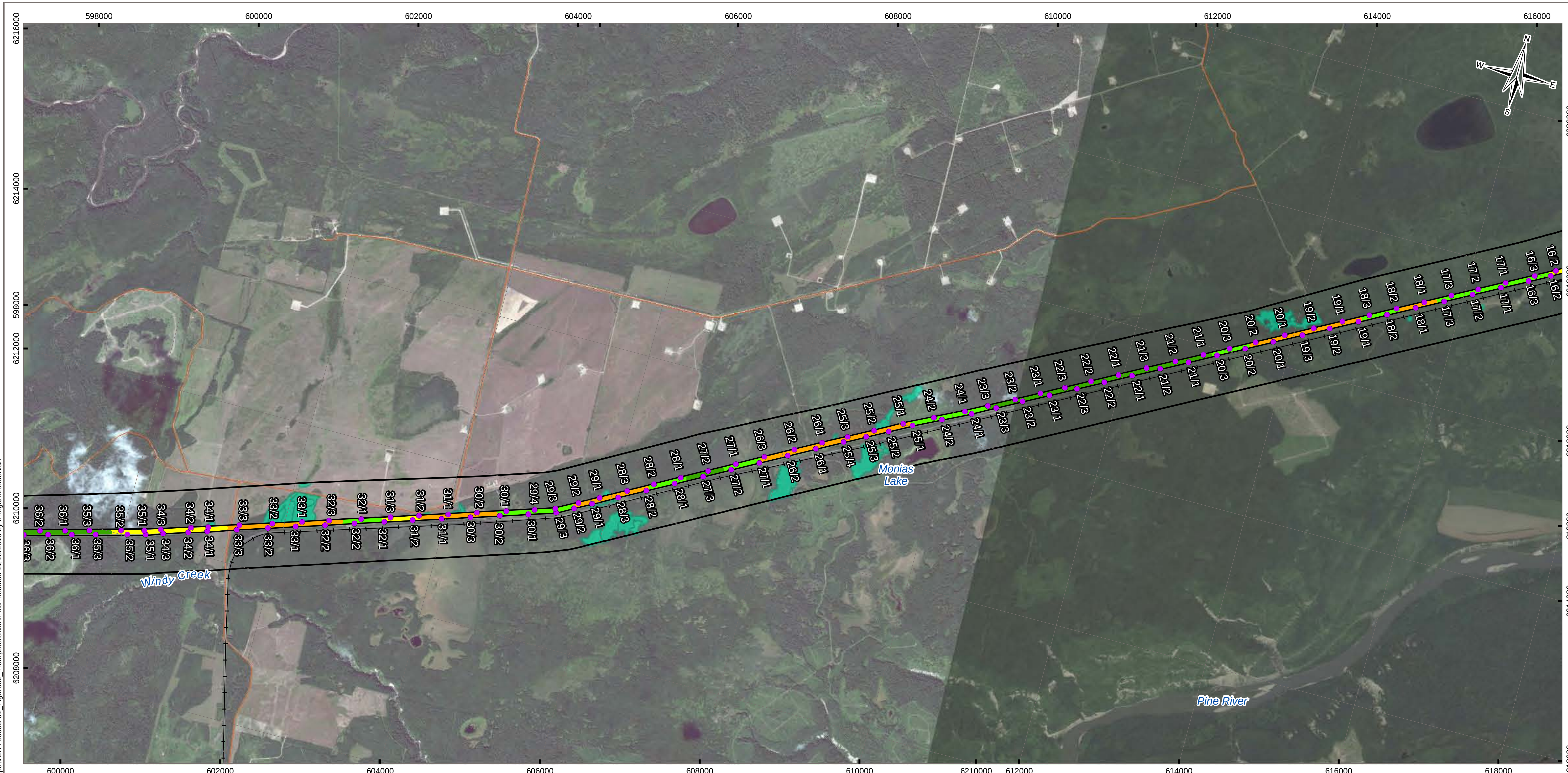
TETRA TECH EBA

PROJECT NO.	DWN	CKD	APVD	REV
ENV.VENV03003-01	MEZ	SL	JJ	0

OFFICE	DATE
Tt EBA-VANC	November 18, 2015

Figure 2a

Q:\Vancouver\GIS\ENVIRONMENTAL\VENV\VENV03003-01_BCHydro\Maps\VENV03003-01_Figure02_TrumpeterSwan.mxd modified 11/18/2015 by morgan.zondervan

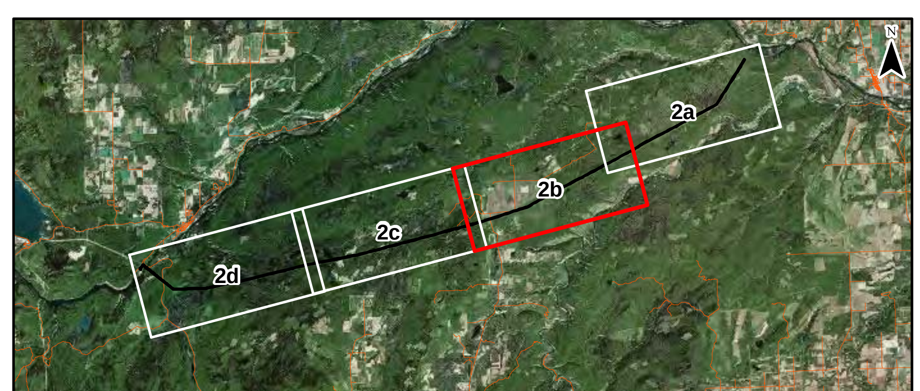


LEGEND

- Tower Location
- Proposed Alignment Corridor
- Study Area (500 m Buffer)
- Trumpeter Swan Habitat within Study Area
- Existing Road
- Railway

Segment Risk Score

- 0
- 0.5
- 1
- 1.5



NOTES
Base data source:
Proposed Infrastrucutre, TEM Mapping and TRIM base data provided by BC Hydro (October 2015)
Imagery from BING Imagery Service for ArcGIS
CanVec 1:50,000

STATUS
ISSUED FOR USE

SITE C CLEAN ENERGY PROJECT WILDLIFE MITIGATION AND MONITORING

Potential Trumpeter Swan Strike Risk Ranking

PROJECTION	DATUM	CLIENT
UTM Zone 10	NAD83	BC hydro

Scale: 1:50,000
1 0.5 0 1
Kilometres

TETRA TECH EBA

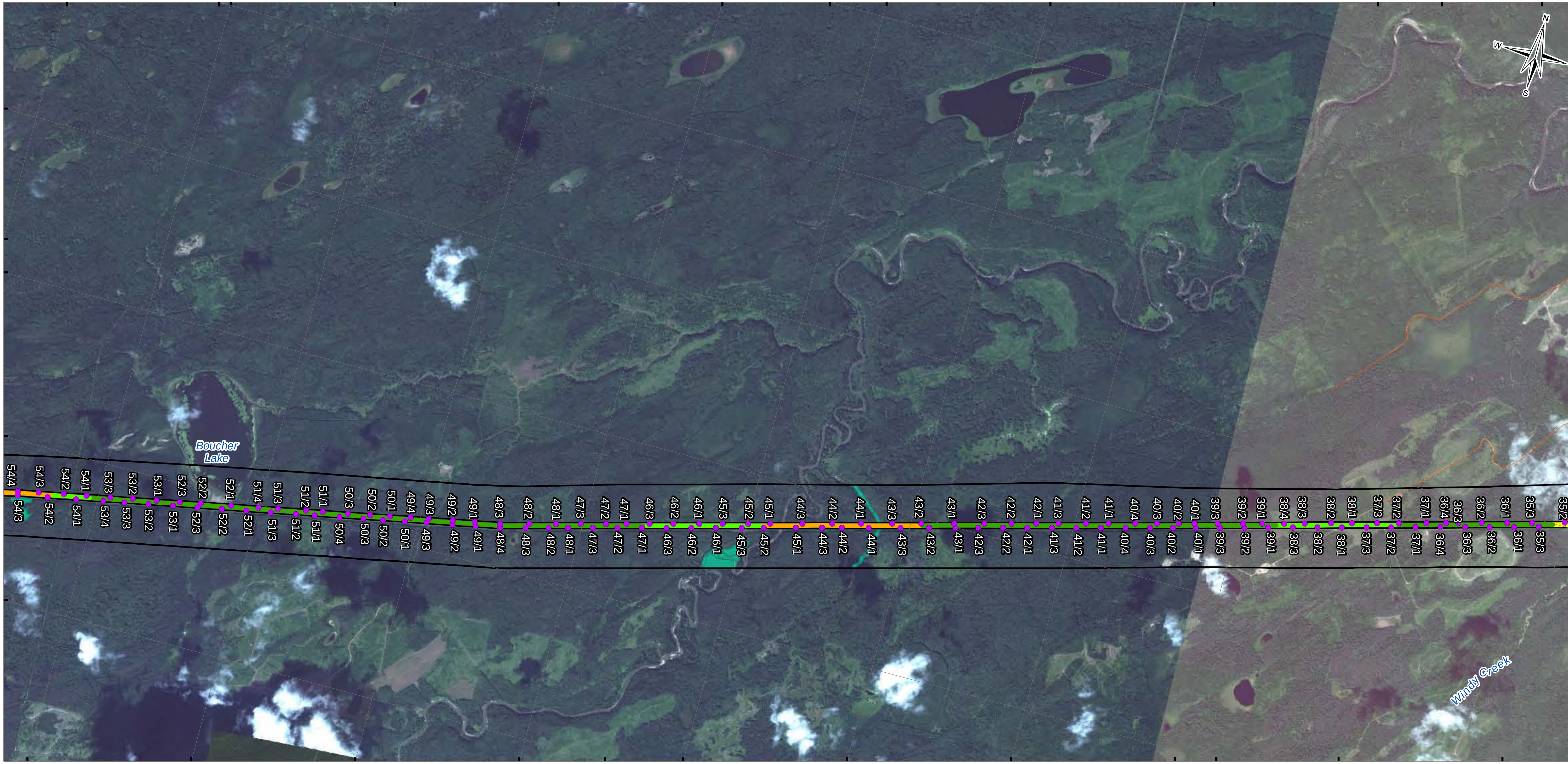
FILE NO.
VENV03003-01_Figure02_TrumpeterSwan.mxd

PROJECT NO.	DWN	CKD	APVD	REV
ENV.VENV03003-01	MEZ	SL	JJ	0

OFFICE	DATE
Tt EBA-VANC	November 18, 2015

Figure 2b

Q:\Vancouver\GIS\ENVIRONMENTAL\VENV\VENV03003-01_BCHydro\Maps\VENV03003-01_Figure02_TrumpeterSwan.mxd modified 11/18/2015 by morgan.zondervan

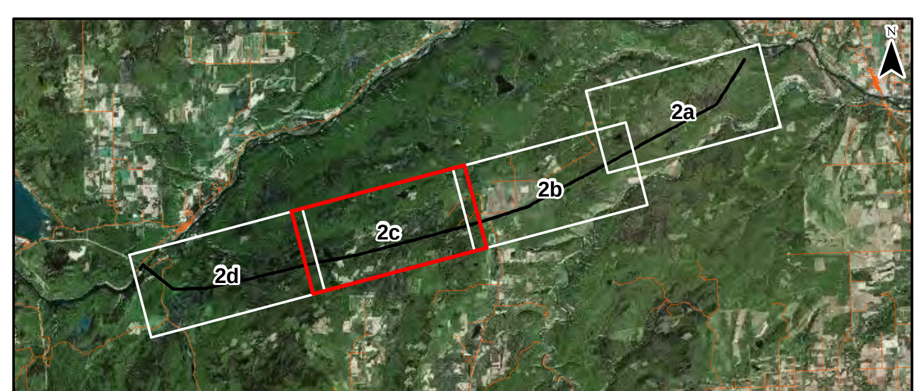


LEGEND

- Tower Location
- Proposed Alignment Corridor
- Study Area (500 m Buffer)
- Trumpeter Swan Habitat within Study Area
- Existing Road
- Railway

Segment Risk Score

- 0
- 0.5
- 1
- 1.5



NOTES
Base data source:
Proposed Infrastucutre, TEM Mapping and TRIM base data provided by BC Hydro (October 2015)
Imagery from BING Imagery Service for ArcGIS
CanVec 1:50,000

STATUS
ISSUED FOR USE

SITE C CLEAN ENERGY PROJECT WILDLIFE MITIGATION AND MONITORING

Potential Trumpeter Swan Strike Risk Ranking

PROJECTION	DATUM	CLIENT
UTM Zone 10	NAD83	BC hydro

Scale: 1:50,000
1 0.5 0 1
Kilometres

FILE NO.
VENV03003-01_Figure02_TrumpeterSwan.mxd

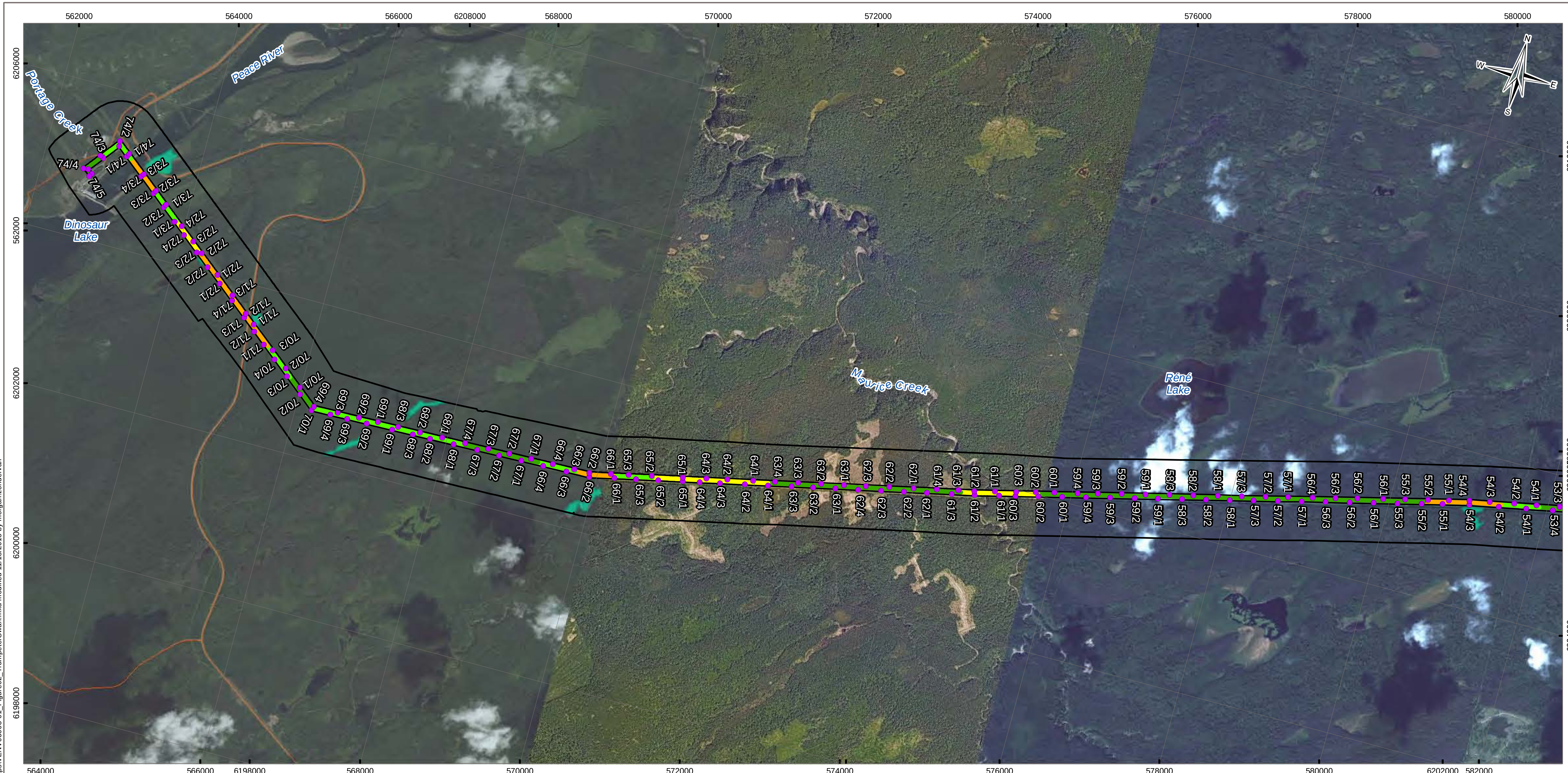
PROJECT NO.	DWN	CKD	APVD	REV
ENV.VENV03003-01	MEZ	SL	JJ	0

TETRA TECH EBA

OFFICE	DATE
Tt EBA-VANC	November 18, 2015

Figure 2c

Q:\Vancouver\GIS\ENVIRONMENTAL\VENV\VENV03003-01_BCHydro\Maps\VENV03003-01_Figure02_TrumpeterSwan.mxd modified 11/18/2015 by morgan.zondervan



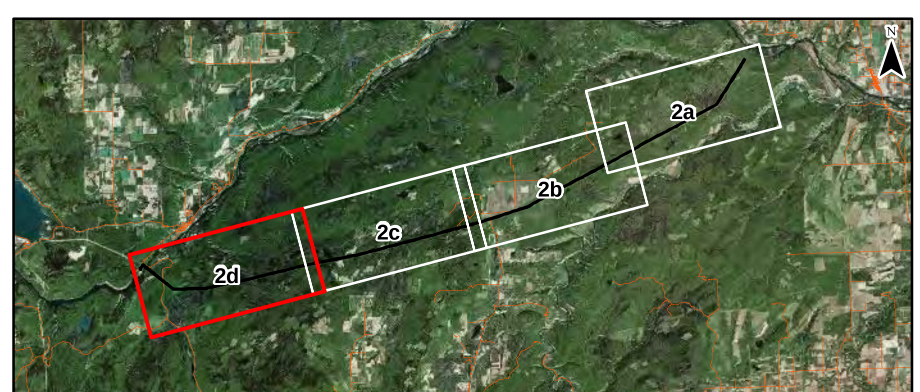
Q:\Vancouver\GIS\ENVIRONMENTAL\VENV\VENV03003-01_BCHydro\Maps\VENV03003-01_Figure02_TrumpeterSwan.mxd modified 11/18/2015 by morgan.zondervan

LEGEND

- Tower Location
- Proposed Alignment Corridor
- Study Area (500 m Buffer)
- Trumpeter Swan Habitat within Study Area
- Existing Road
- Railway

Segment Risk Score

- 0
- 0.5
- 1
- 1.5



NOTES

Base data source:
Proposed Infrastrucutre, TEM Mapping and TRIM base data provided by BC Hydro (October 2015)
Imagery from BING Imagery Service for ArcGIS
CanVec 1:50,000

STATUS
ISSUED FOR USE

SITE C CLEAN ENERGY PROJECT WILDLIFE MITIGATION AND MONITORING

Potential Trumpeter Swan Strike Risk Ranking

PROJECTION	DATUM	CLIENT
UTM Zone 10	NAD83	BC hydro

Scale: 1:50,000
1 0.5 0 1
Kilometres

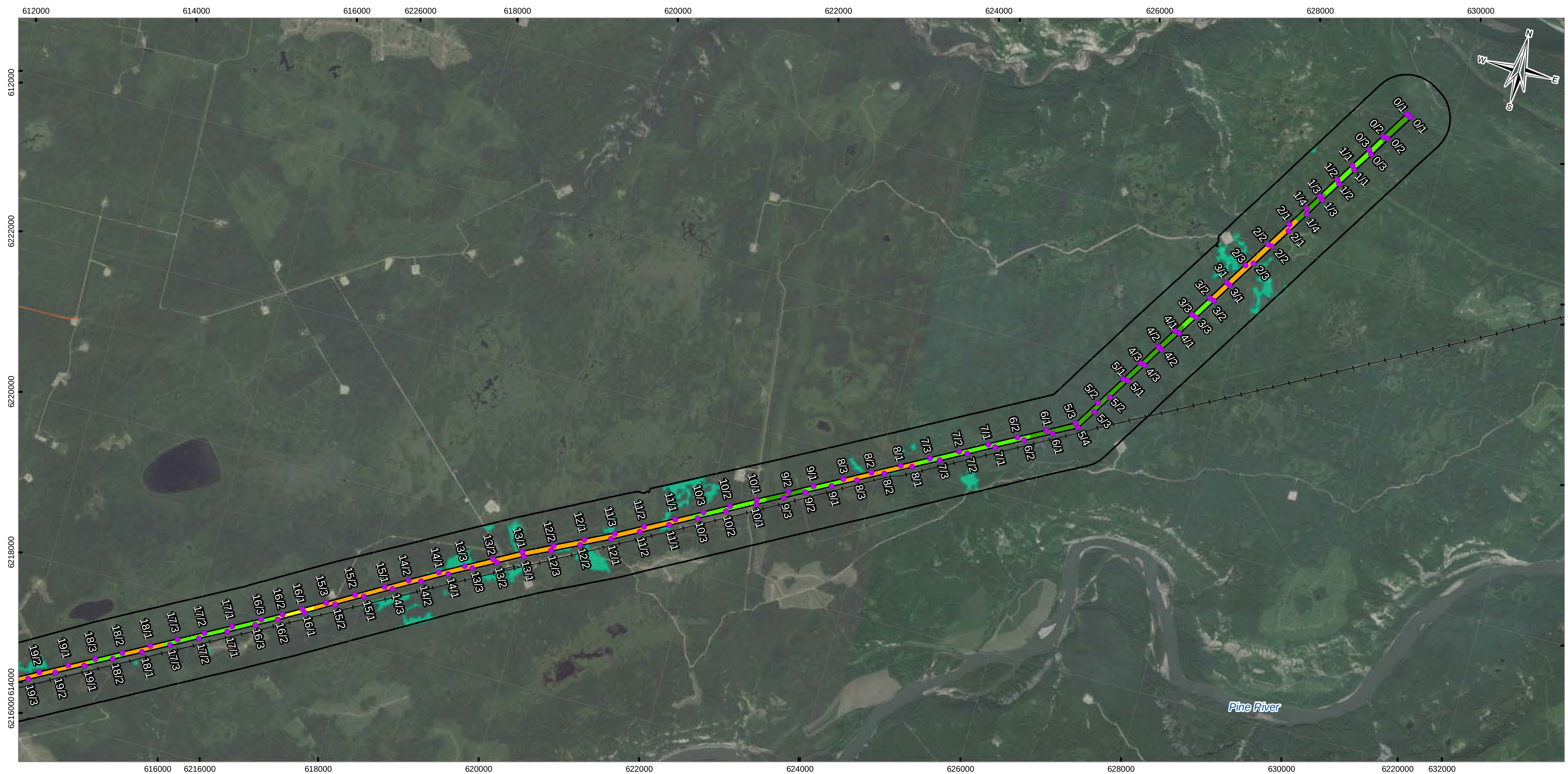
FILE NO.
VENV03003-01_Figure02_TrumpeterSwan.mxd

TETRA TECH EBA

PROJECT NO.	DWN	CKD	APVD	REV
ENV.VENV03003-01	MEZ	SL	JJ	0

OFFICE	DATE
Tt EBA-VANC	November 18, 2015

Figure 2d

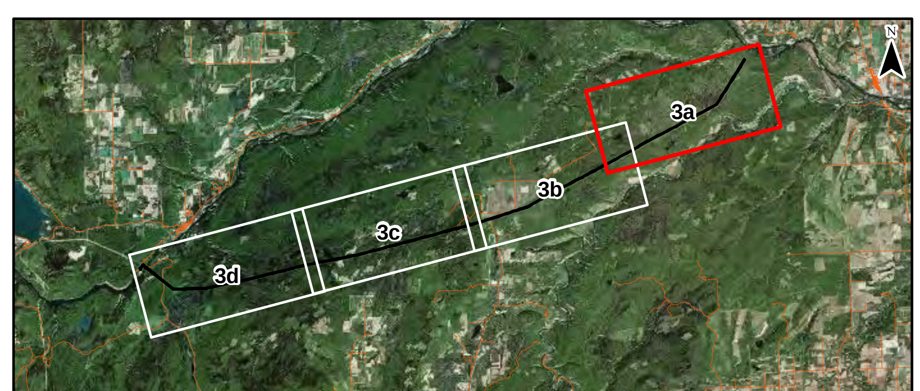


LEGEND

- Tower Location
- Proposed Alignment Corridor
- Study Area (500 m Buffer)
- Horned Grebe Habitat within Study Area
- Existing Road
- Railway

Segment Risk Score

- 0
- 0.5
- 1
- 1.5
- 2.5



NOTES

Base data source:
Proposed Infrastrucutre, TEM Mapping and TRIM base data provided by BC Hydro (October 2015)
Imagery from BING Imagery Service for ArcGIS
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STATUS
ISSUED FOR USE

SITE C CLEAN ENERGY PROJECT
WILDLIFE MITIGATION AND MONITORING

Potential Horned Grebe Strike Risk Ranking

PROJECTION	DATUM	CLIENT
UTM Zone 10	NAD83	BC hydro

Scale: 1:50,000

1 0.5 0 1
Kilometres

TETRA TECH EBA

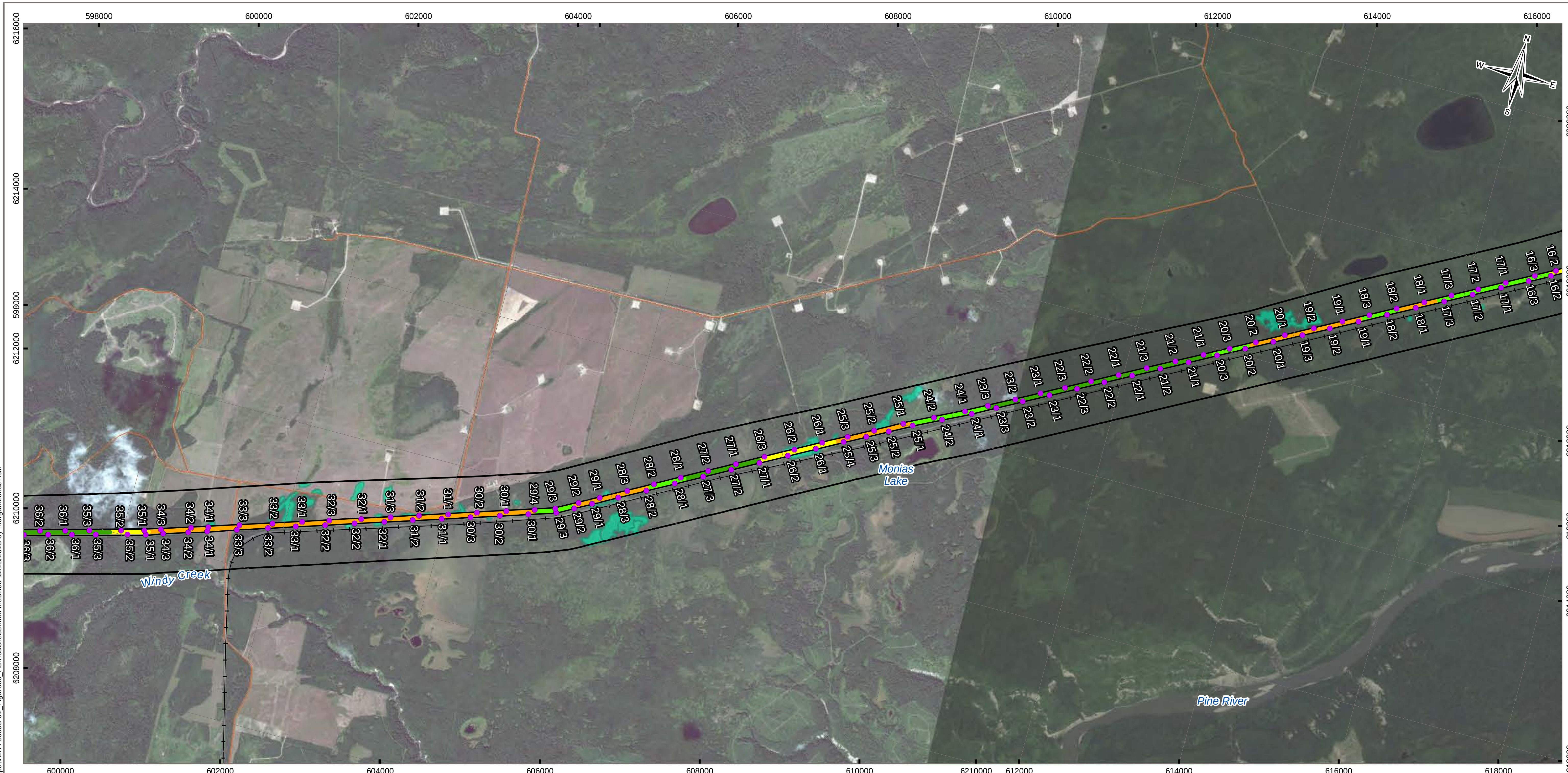
FILE NO.
VENV03003-01_Figure03_HornedGrebe.mxd

PROJECT NO.	DWN	CKD	APVD	REV
ENV.VENV03003-01	MEZ	SL	JJ	0

OFFICE	DATE
Tt EBA-VANC	November 18, 2015

Figure 3a

Q:\Vancouver\GIS\ENVIRONMENTAL\VENV\VENV03003-01_BCHydro\Maps\VENV03003-01_Figure03_HornedGrebe.mxd modified 11/18/2015 by morgan.zondervan

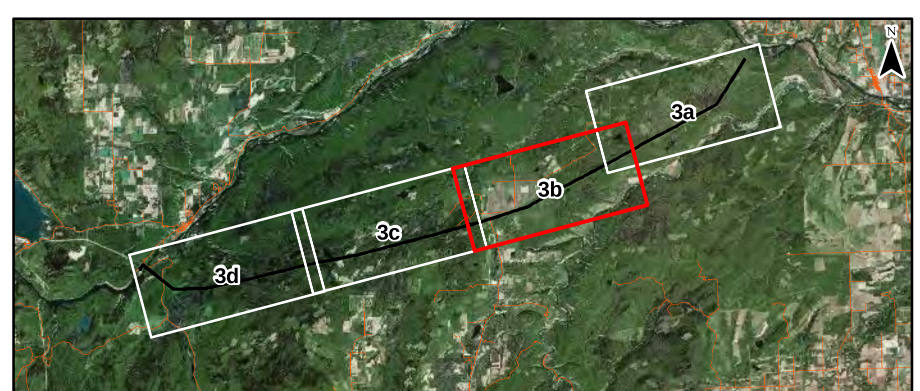


LEGEND

- Tower Location
- Proposed Alignment Corridor
- Study Area (500 m Buffer)
- Horned Grebe Habitat within Study Area
- Existing Road
- Railway

Segment Risk Score

- 0
- 0.5
- 1
- 1.5
- 2.5



NOTES
Base data source:
Proposed Infrastucutre, TEM Mapping and TRIM base data provided by BC Hydro (October 2015)
Imagery from BING Imagery Service for ArcGIS
CanVec 1:50,000

STATUS
ISSUED FOR USE

SITE C CLEAN ENERGY PROJECT WILDLIFE MITIGATION AND MONITORING

Potential Horned Grebe Strike Risk Ranking

PROJECTION	DATUM	CLIENT
UTM Zone 10	NAD83	BC hydro

Scale: 1:50,000
1 0.5 0 1
Kilometres

TETRA TECH EBA

FILE NO.
VENV03003-01_Figure03_HornedGrebe.mxd

PROJECT NO.	DWN	CKD	APVD	REV
ENV.VENV03003-01	MEZ	SL	JJ	0

OFFICE	DATE
Tt EBA-VANC	November 18, 2015

Figure 3b

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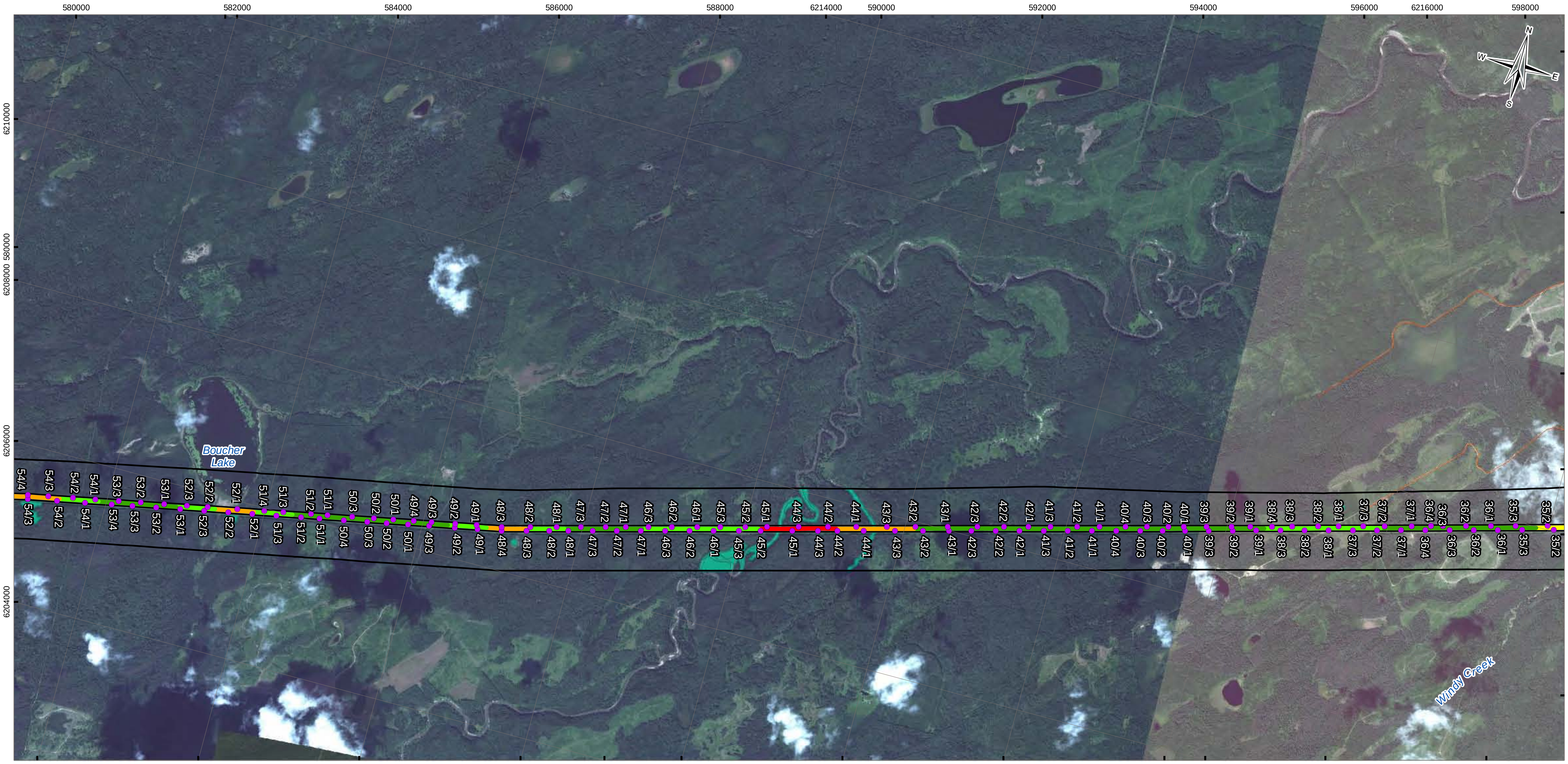
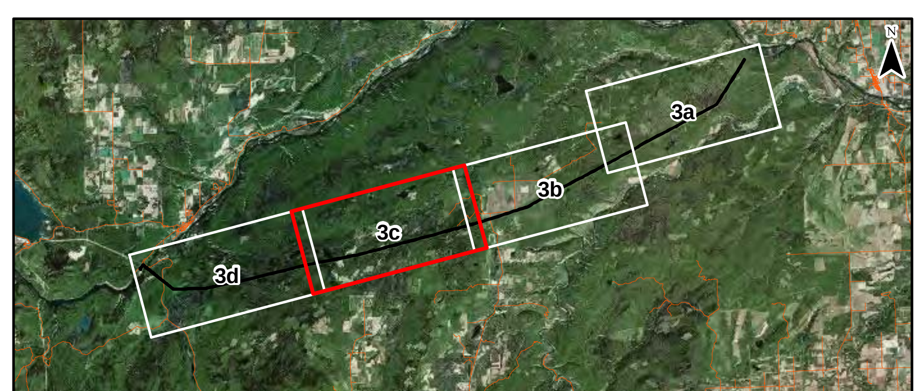


LEGEND

- Tower Location
- Proposed Alignment Corridor
- Study Area (500 m Buffer)
- Horned Grebe Habitat within Study Area
- Existing Road
- Railway

Segment Risk Score

- 0
- 0.5
- 1
- 1.5
- 2.5



NOTES
Base data source:
Proposed Infrastucutre, TEM Mapping and TRIM base data provided by BC Hydro (October 2015)
Imagery from BING Imagery Service for ArcGIS
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STATUS
ISSUED FOR USE

SITE C CLEAN ENERGY PROJECT WILDLIFE MITIGATION AND MONITORING

Potential Horned Grebe Strike Risk Ranking

PROJECTION	DATUM	CLIENT
UTM Zone 10	NAD83	BC hydro

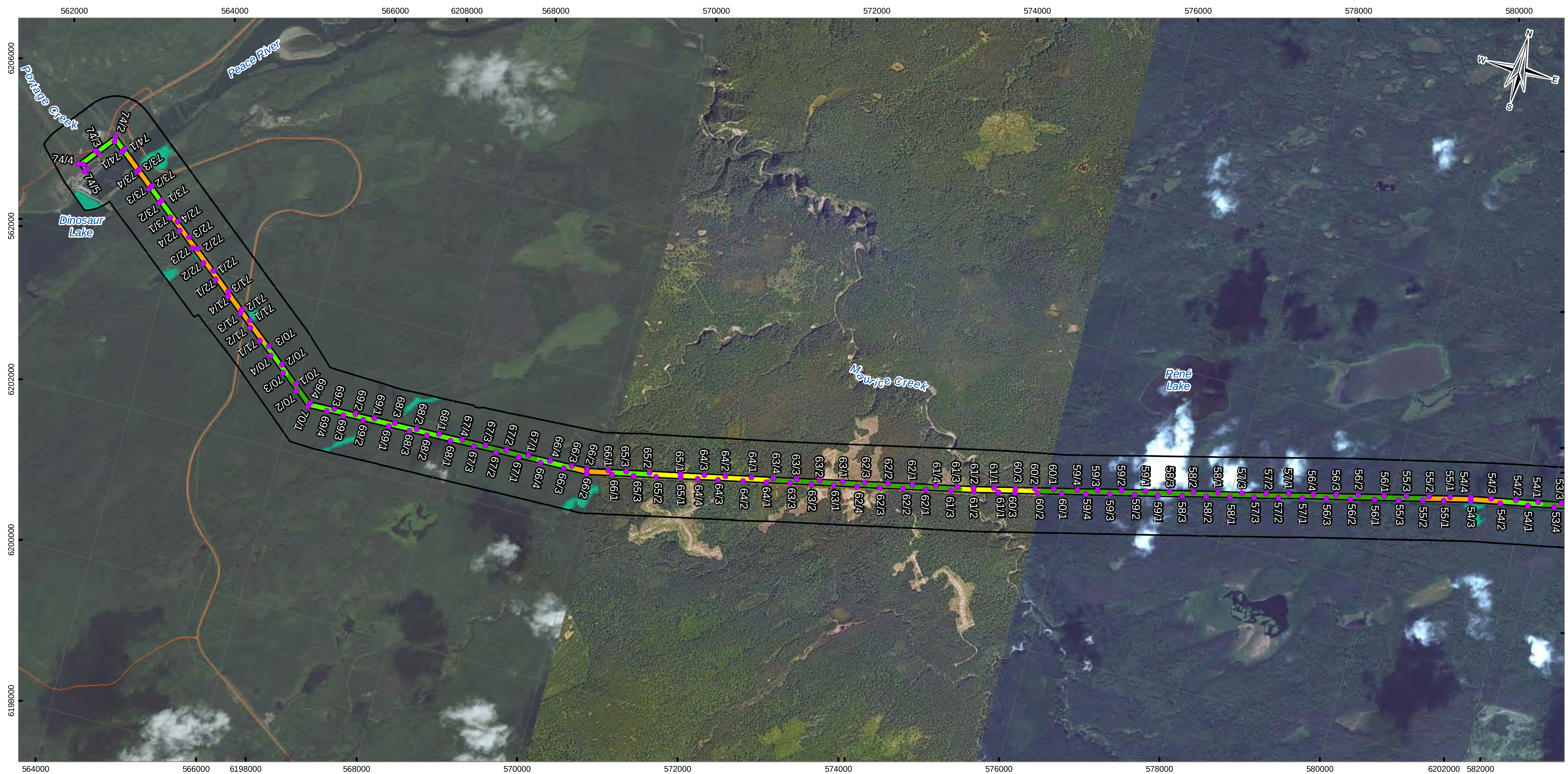
Scale: 1:50,000
1 0.5 0 1
Kilometres

TETRA TECH EBA

FILE NO.				
VENV03003-01_Figure03_HornedGrebe.mxd				
PROJECT NO.	**DWN**	**CKD**	**APVD**	**REV**
ENV.VENV03003-01	MEZ	SL	JJ	0
OFFICE	**DATE**			
Tt EBA-VANC	November 18, 2015			

Figure 3c

Q:\Vancouver\GIS\ENVIRONMENTAL\VENV\VENV03003-01_BCHydro\Maps\VENV03003-01_Figure03_HornedGrebe.mxd modified 11/18/2015 by morgan.zondervan

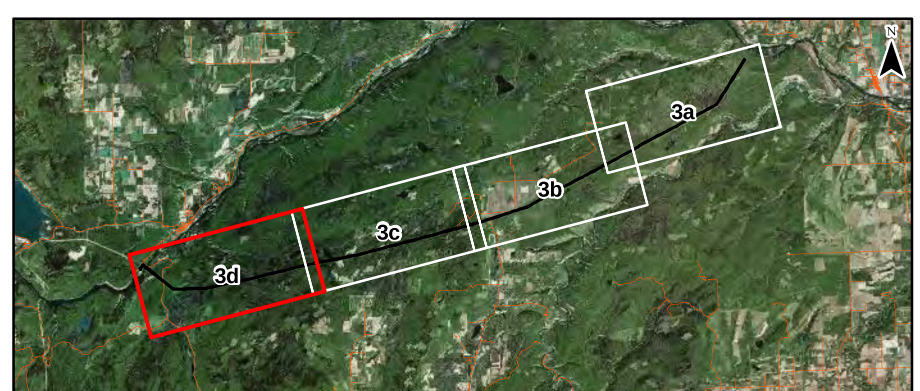


LEGEND

- Tower Location
- Proposed Alignment Corridor
- Study Area (500 m Buffer)
- Horned Grebe Habitat within Study Area
- Existing Road
- Railway

Segment Risk Score

- 0
- 0.5
- 1
- 1.5
- 2.5



NOTES

Base data source:
Proposed Infrastrucutre, TEM Mapping and TRIM base data provided by BC Hydro (October 2015)
Imagery from BING Imagery Service for ArcGIS
CanVec 1:50,000

STATUS
ISSUED FOR USE

SITE C CLEAN ENERGY PROJECT WILDLIFE MITIGATION AND MONITORING

Potential Horned Grebe Strike Risk Ranking

PROJECTION	DATUM	CLIENT
UTM Zone 10	NAD83	BC hydro

Scale: 1:50,000
1 0.5 0 1
Kilometres

TETRA TECH EBA

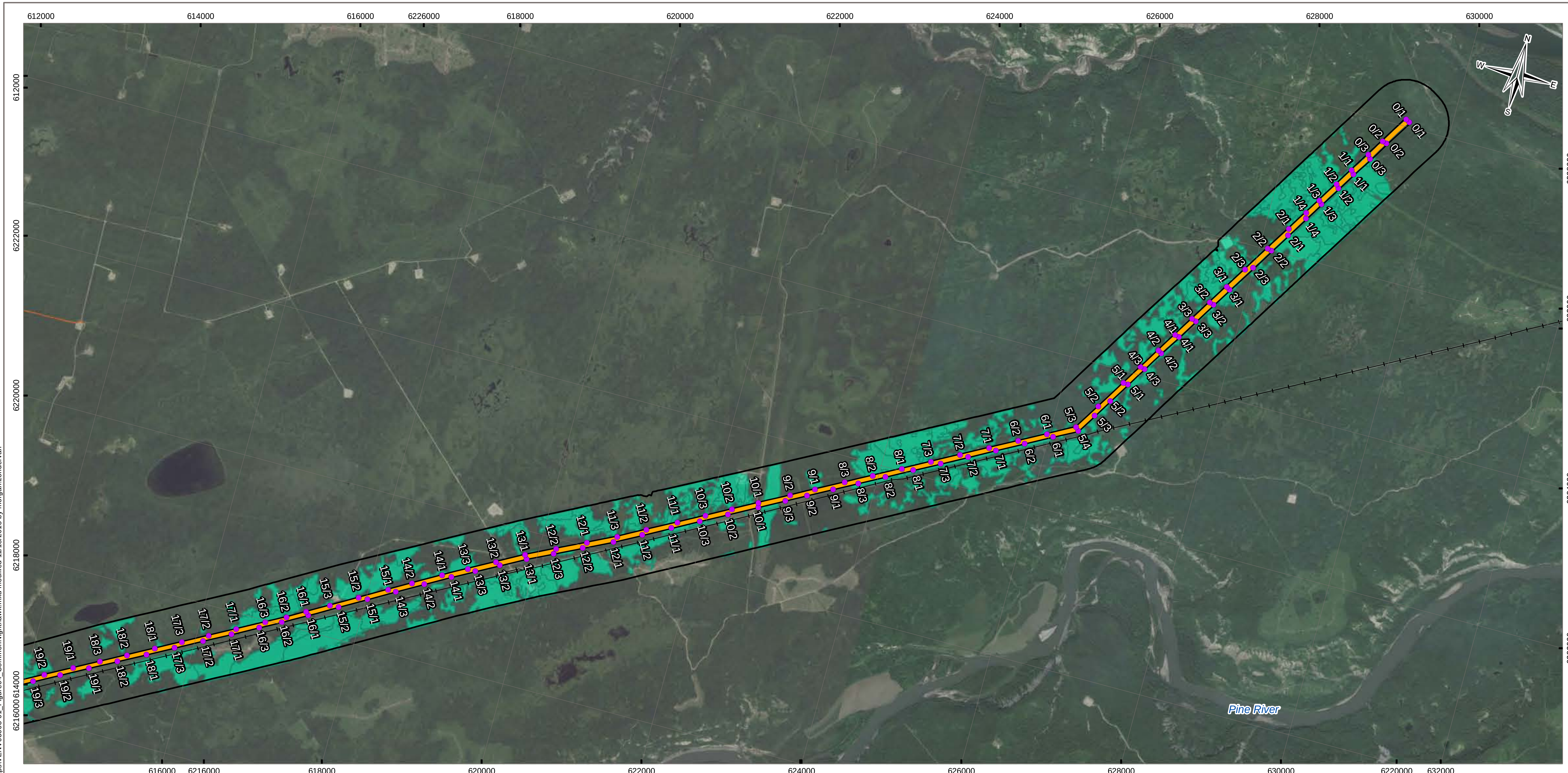
FILE NO.
VENV03003-01_Figure03_HornedGrebe.mxd

PROJECT NO.	DWN	CKD	APVD	REV
ENV.VENV03003-01	MEZ	SL	JJ	0

OFFICE	DATE
Tt EBA-VANC	November 18, 2015

Figure 3d

Q:\Vancouver\GIS\ENVIRONMENTAL\VENV\VENV03003-01_BCHydro\Maps\VENV03003-01_Figure03_HornedGrebe.mxd modified 11/18/2015 by morgan.zondervan



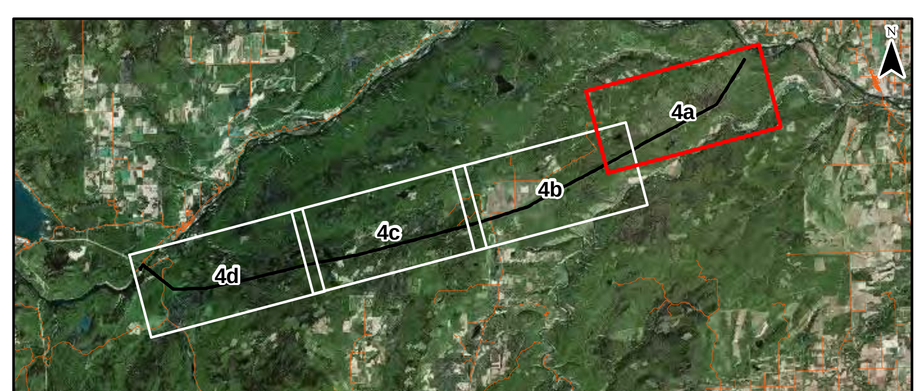
Q:\Vancouver\GIS\ENVIRONMENTAL\VENV\VENV03003-01_BCHydro\Maps\VENV03003-01_Figure04_CommonNighthawk.mxd modified 11/18/2015 by morgan.zondervan

LEGEND

- Tower Location
- Proposed Alignment Corridor
- Study Area (500 m Buffer)
- Common Nighthawk Habitat within Study Area
- Existing Road
- Railway

Segment Risk Score

- 0
- 0.5
- 1
- 1.5
- 2
- 2.5



NOTES

Base data source:
Proposed Infrastucutre, TEM Mapping and TRIM base data provided by BC Hydro (October 2015)
Imagery from BING Imagery Service for ArcGIS
CanVec 1:50,000

STATUS
ISSUED FOR USE

SITE C CLEAN ENERGY PROJECT
WILDLIFE MITIGATION AND MONITORING

Potential Common Nighthawk Strike Risk Ranking

PROJECTION	DATUM	CLIENT
UTM Zone 10	NAD83	BC hydro

Scale: 1:50,000
1 0.5 0 1
Kilometres

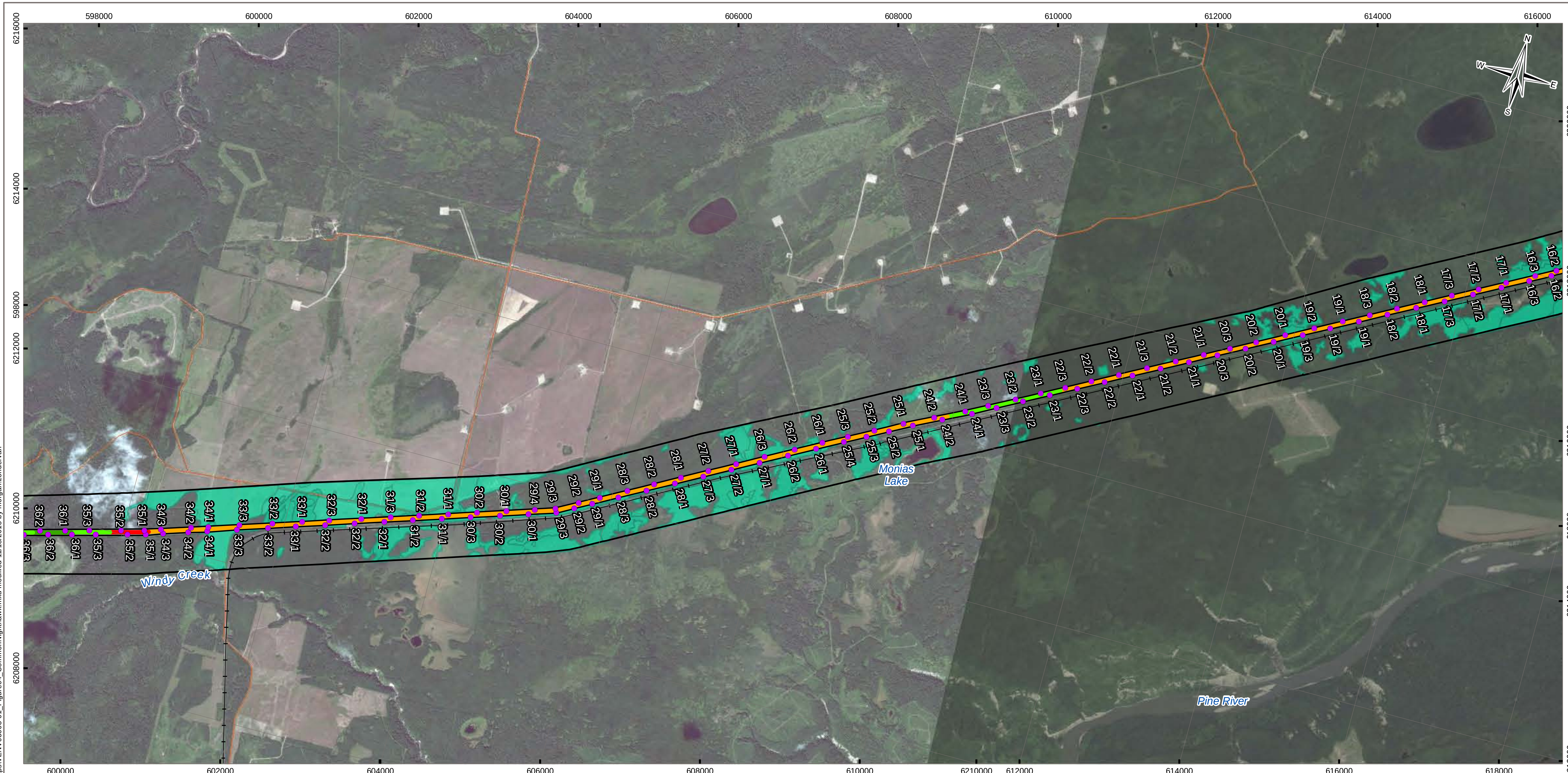
TETRA TECH EBA

FILE NO.
VENV03003-01_Figure04_CommonNighthawk.mxd

PROJECT NO.	DWN	CKD	APVD	REV
ENV.VENV03003-01	MEZ	SL	JJ	0

OFFICE	DATE
Tt EBA-VANC	November 18, 2015

Figure 4a

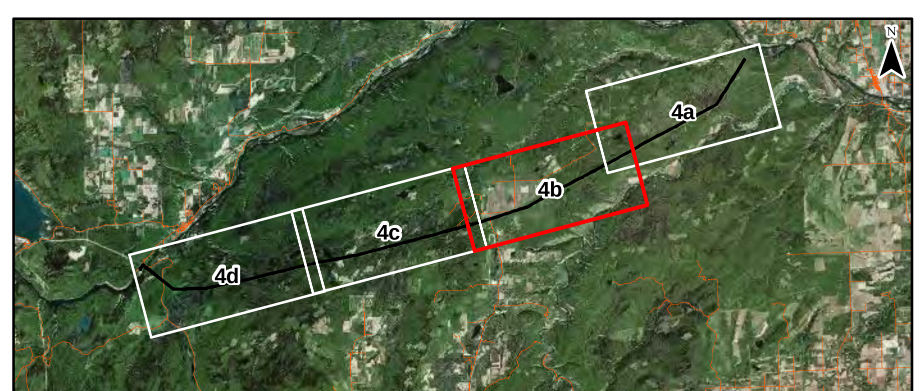


LEGEND

- Tower Location
- Proposed Alignment Corridor
- Study Area (500 m Buffer)
- Common Nighthawk Habitat within Study Area
- Existing Road
- Railway

Segment Risk Score

- 0
- 0.5
- 1
- 1.5
- 2
- 2.5



NOTES
Base data source:
Proposed Infrastucutre, TEM Mapping and TRIM base data provided by BC Hydro (October 2015)
Imagery from BING Imagery Service for ArcGIS
CanVec 1:50,000

STATUS
ISSUED FOR USE

SITE C CLEAN ENERGY PROJECT WILDLIFE MITIGATION AND MONITORING

Potential Common Nighthawk Strike Risk Ranking

PROJECTION: UTM Zone 10
DATUM: NAD83
CLIENT: BC hydro

Scale: 1:50,000
1 0.5 0 1
Kilometres

TETRA TECH EBA

FILE NO.
VENV03003-01_Figure04_CommonNighthawk.mxd

PROJECT NO.	DWN	CKD	APVD	REV
ENV.VENV03003-01	MEZ	SL	JJ	0

OFFICE: Tt EBA-VANC
DATE: November 18, 2015

Figure 4b

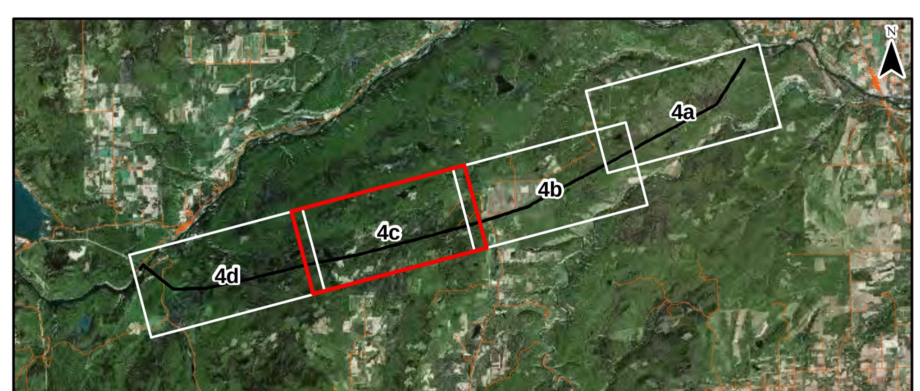
Q:\Vancouver\GIS\ENVIRONMENTAL\VENV\VENV03003-01_BCHydro\Maps\VENV03003-01_Figure04_CommonNighthawk.mxd modified 11/18/2015 by morgan.zondervan

LEGEND

- Tower Location
- Proposed Alignment Corridor
- Study Area (500 m Buffer)
- Common Nighthawk Habitat within Study Area
- Existing Road
- Railway

Segment Risk Score

- 0
- 0.5
- 1
- 1.5
- 2
- 2.5



NOTES
Base data source:
Proposed Infrastrucutre, TEM Mapping and TRIM base data provided by BC Hydro (October 2015)
Imagery from BING Imagery Service for ArcGIS
CanVec 1:50,000

STATUS
ISSUED FOR USE

SITE C CLEAN ENERGY PROJECT WILDLIFE MITIGATION AND MONITORING

Potential Common Nighthawk Strike Risk Ranking

PROJECTION	DATUM	CLIENT
UTM Zone 10	NAD83	BC hydro

Scale: 1:50,000
1 0.5 0 1
Kilometres

TETRA TECH EBA

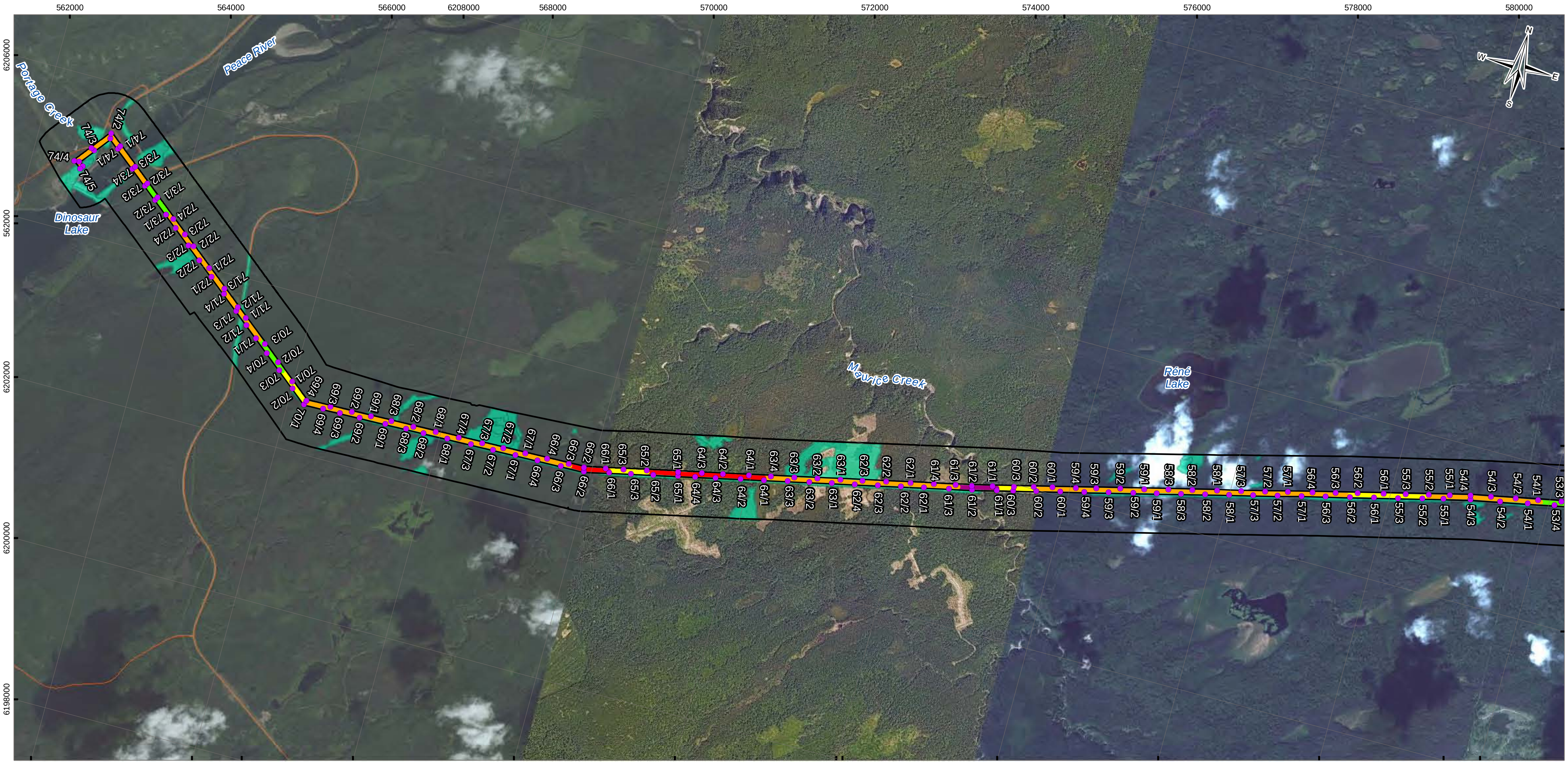
FILE NO.
VENV03003-01_Figure04_CommonNighthawk.mxd

PROJECT NO.	DWN	CKD	APVD	REV
ENV.VENV03003-01	MEZ	SL	JJ	0

OFFICE	DATE
Tt EBA-VANC	November 18, 2015

Figure 4c

Q:\Vancouver\GIS\ENVIRONMENTAL\VENV\VENV03003-01_BCHydro\Maps\VENV03003-01_Figure04_CommonNighthawk.mxd modified 11/18/2015 by morgan.zondervan

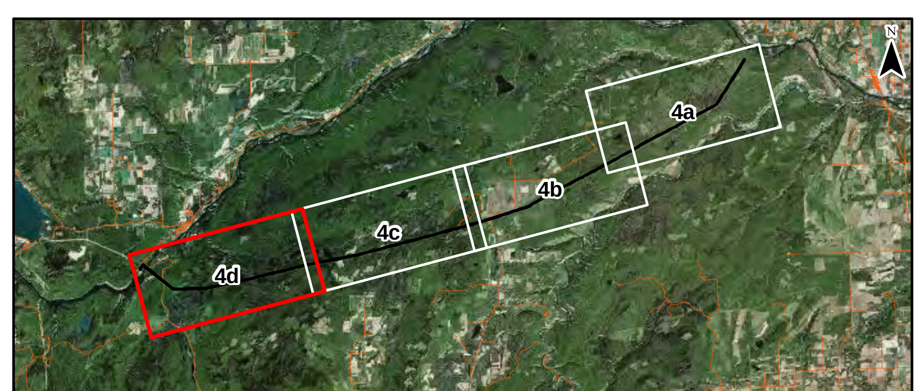


LEGEND

- Tower Location
- Proposed Alignment Corridor
- Study Area (500 m Buffer)
- Common Nighthawk Habitat within Study Area
- Existing Road
- Railway

Segment Risk Score

- 0
- 0.5
- 1
- 1.5
- 2
- 2.5



NOTES
Base data source:
Proposed Infrastucutre, TEM Mapping and TRIM base data provided by BC Hydro (October 2015)
Imagery from BING Imagery Service for ArcGIS
CanVec 1:50,000

STATUS
ISSUED FOR USE

SITE C CLEAN ENERGY PROJECT WILDLIFE MITIGATION AND MONITORING

Potential Common Nighthawk Strike Risk Ranking

PROJECTION	DATUM	CLIENT
UTM Zone 10	NAD83	BC hydro

Scale: 1:50,000
1 0.5 0 1
Kilometres

FILE NO.
VENV03003-01_Figure04_CommonNighthawk.mxd

TETRA TECH EBA

PROJECT NO.	DWN	CKD	APVD	REV
ENV.VENV03003-01	MEZ	SL	JJ	0

OFFICE	DATE
Tt EBA-VANC	November 18, 2015

Figure 4d

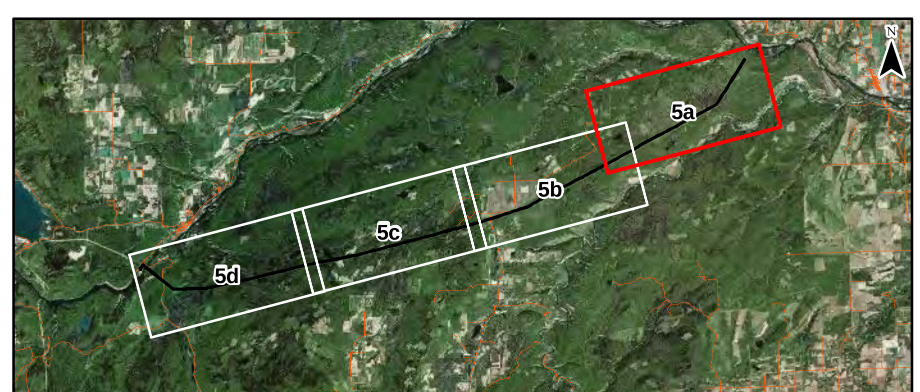
Q:\Vancouver\GIS\ENVIRONMENTAL\VENV\VENV03003-01_BCHydro\Maps\VENV03003-01_Figure04_CommonNighthawk.mxd modified 11/18/2015 by morgan.zondervan

LEGEND

- Tower Location
- Proposed Alignment Corridor
- Study Area (500 m Buffer)
- Olive-sided Flycatcher Habitat within Study Area
- Existing Road
- Railway

Segment Risk Score

- 1.5
- 2.5



NOTES

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STATUS
ISSUED FOR USE

SITE C CLEAN ENERGY PROJECT WILDLIFE MITIGATION AND MONITORING

Potential Olive-sided Flycatcher Strike Risk Ranking

PROJECTION	DATUM	CLIENT
UTM Zone 10	NAD83	BC hydro

Scale: 1:50,000
1 0.5 0 1
Kilometres

TETRA TECH EBA

FILE NO.				
VENV03003-01_Figure05_OlivesidedFlycatcher.mxd				
PROJECT NO.	DWN	CKD	APVD	REV
ENV.VENV03003-01	MEZ	SL	JJ	0
OFFICE	DATE			
Tt EBA-VANC	November 18, 2015			

Figure 5a

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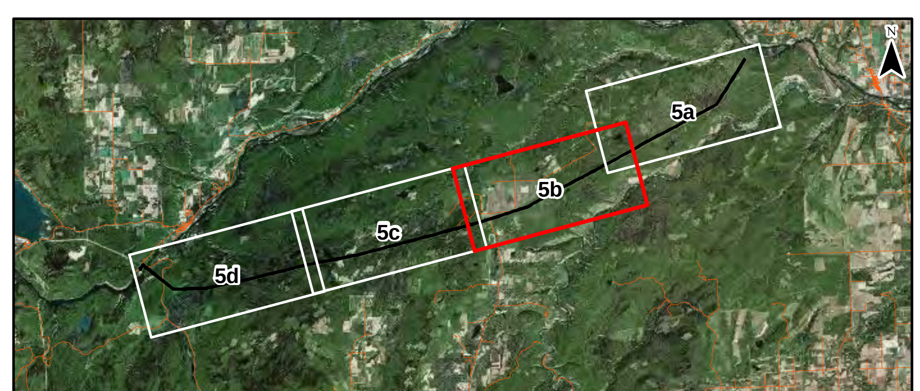
LEGEND

- Tower Location
- Proposed Alignment Corridor
- Study Area (500 m Buffer)
- Olive-sided Flycatcher Habitat within Study Area
- Existing Road
- Railway

Segment Risk Score

- 1.5
- 2.5



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STATUS
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Potential Olive-sided Flycatcher Strike Risk Ranking

PROJECTION	DATUM	CLIENT
UTM Zone 10	NAD83	BC hydro

Scale: 1:50,000
1 0.5 0 1
Kilometres

TETRA TECH EBA

FILE NO.
VENV03003-01_Figure05_OlivesidedFlycatcher.mxd

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ENV.VENV03003-01	MEZ	SL	JJ	0

OFFICE	DATE
Tt EBA-VANC	November 18, 2015

Figure 5b

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LEGEND

- Tower Location
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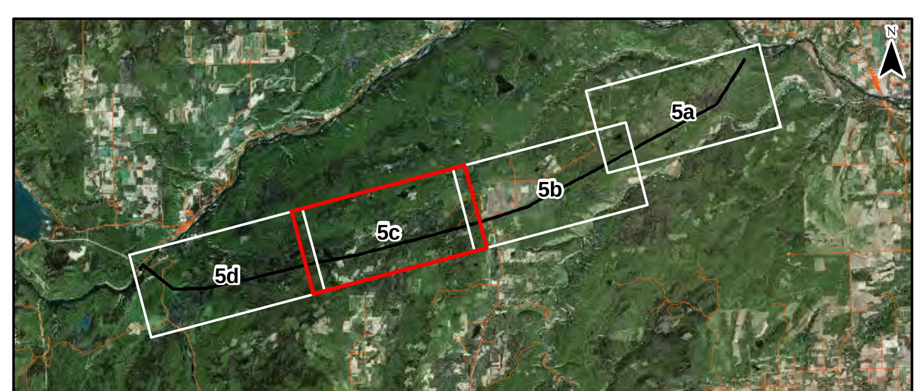
- Existing Road
- Railway

Segment Risk Score

- 1.5
- 2.5



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STATUS
ISSUED FOR USE

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Potential Olive-sided Flycatcher Strike Risk Ranking

PROJECTION UTM Zone 10		DATUM NAD83			CLIENT BC hydro
Scale: 1:50,000 1 0.5 0 1 Kilometres					TETRA TECH EBA
FILE NO. VENV03003-01_Figure05_OlivesidedFlycatcher.mxd					
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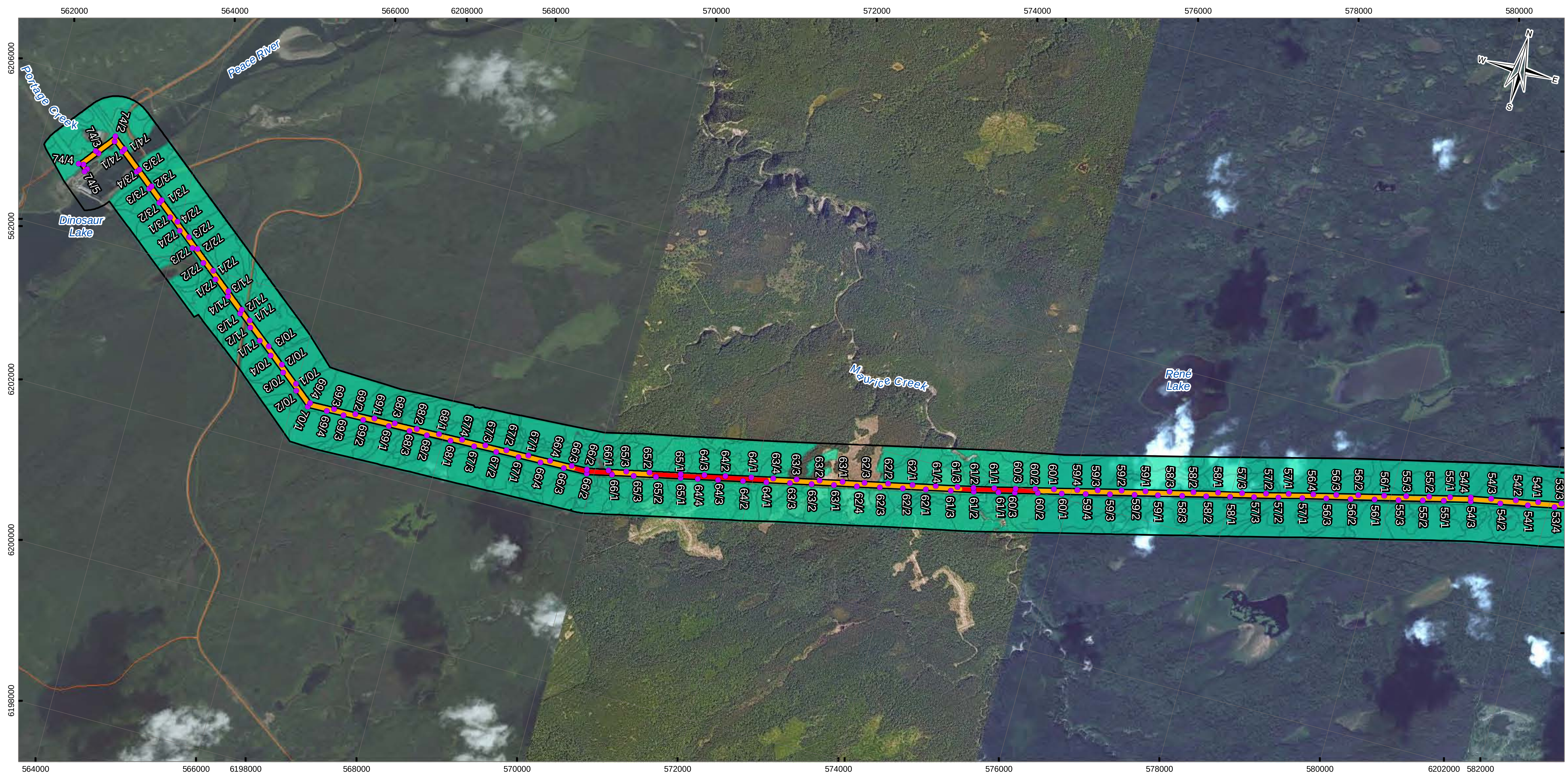
OFFICE Tt EBA-VANC	DATE November 18, 2015				



LEGEND

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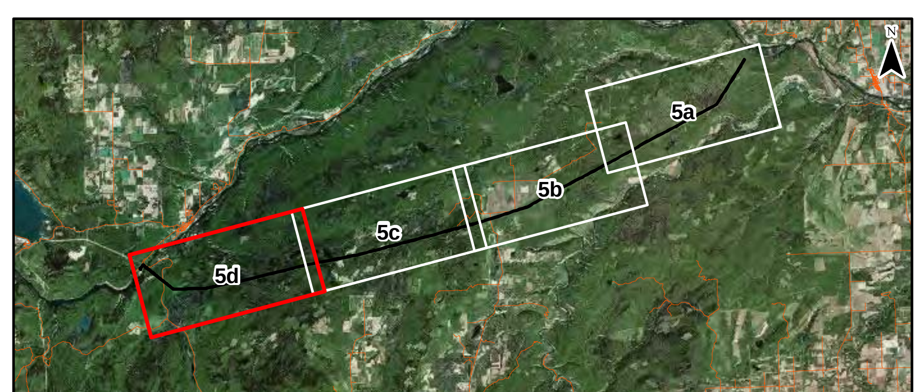
- Existing Road
- Railway

Segment Risk Score

- 1.5
- 2.5



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PROJECTION	DATUM	CLIENT
UTM Zone 10	NAD83	BC hydro

Scale: 1:50,000
1 0.5 0 1
Kilometres

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PROJECT NO.	DWN	CKD	APVD	REV
ENV.VENV03003-01	MEZ	SL	JJ	0

OFFICE	DATE
Tt EBA-VANC	November 18, 2015

Figure 5d

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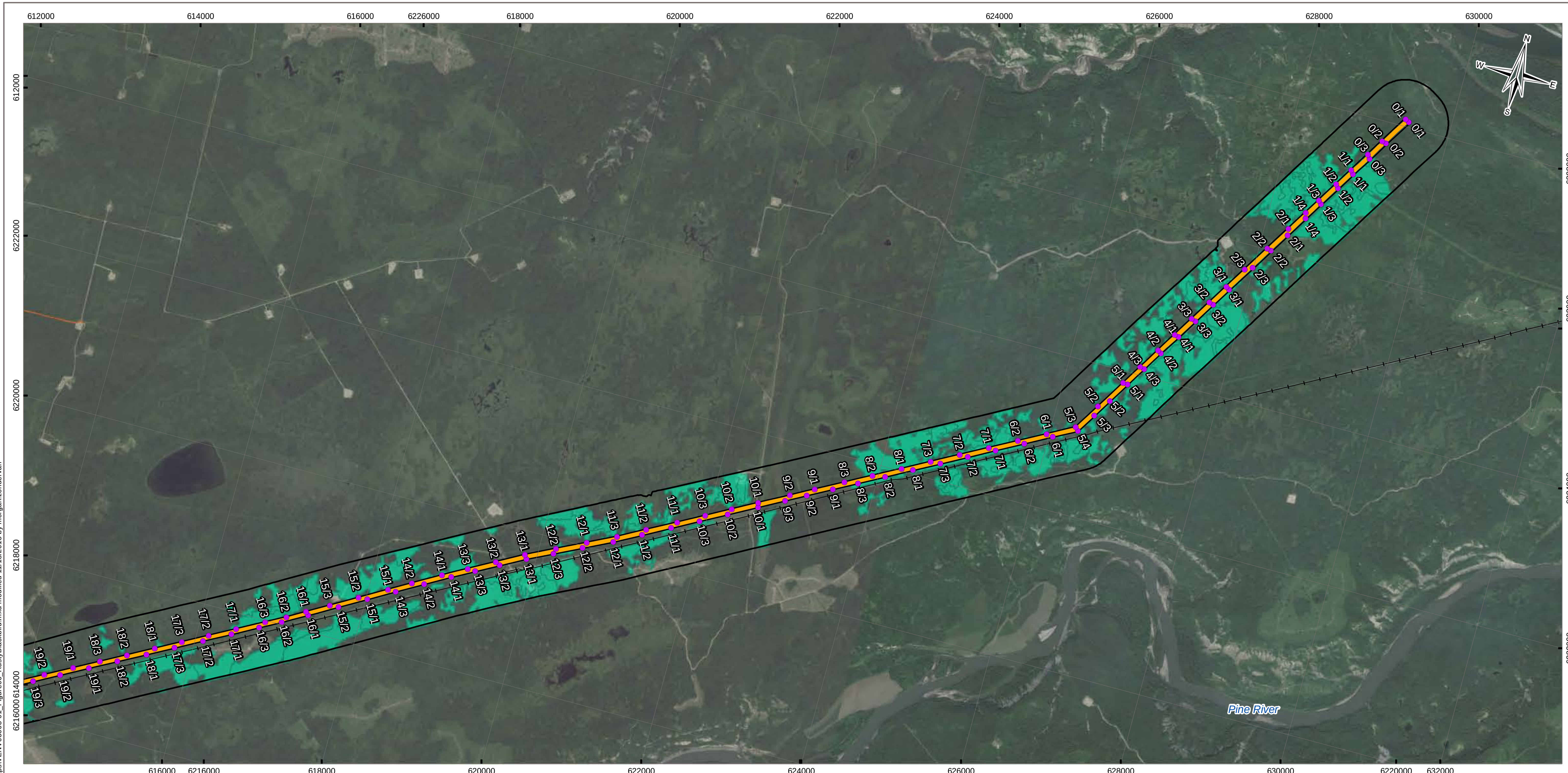

LEGEND

- Tower Location
- Proposed Alignment Corridor
- Study Area (500 m Buffer)
- Rusty Blackbird Habitat within Study Area
- Existing Road
- Railway

Segment Risk Score

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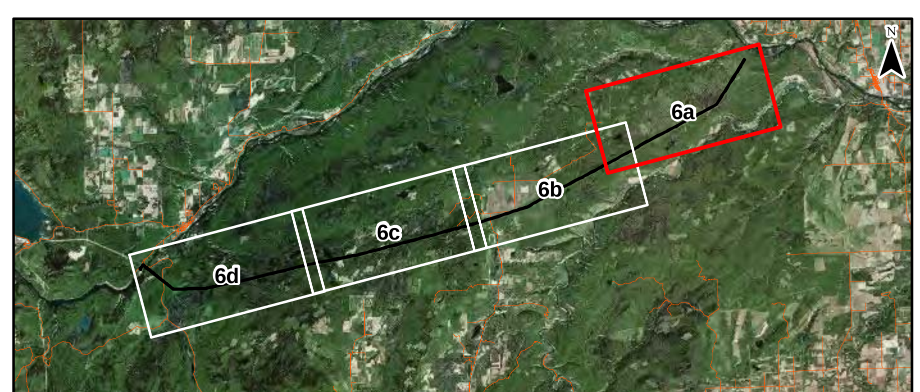
- 0.5
- 1
- 1.5
- 2.5



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Potential Rusty Blackbird Strike Risk Ranking

PROJECTION	DATUM	CLIENT
UTM Zone 10	NAD83	BC hydro

Scale: 1:50,000
1 0.5 0 1
Kilometres

FILE NO.
VENV03003-01_Figure06_RustyBlackbird.mxd

TETRA TECH EBA

PROJECT NO.	DWN	CKD	APVD	REV
ENV.VENV03003-01	MEZ	SL	JJ	0

OFFICE	DATE
Tt EBA-VANC	November 18, 2015

Figure 6a

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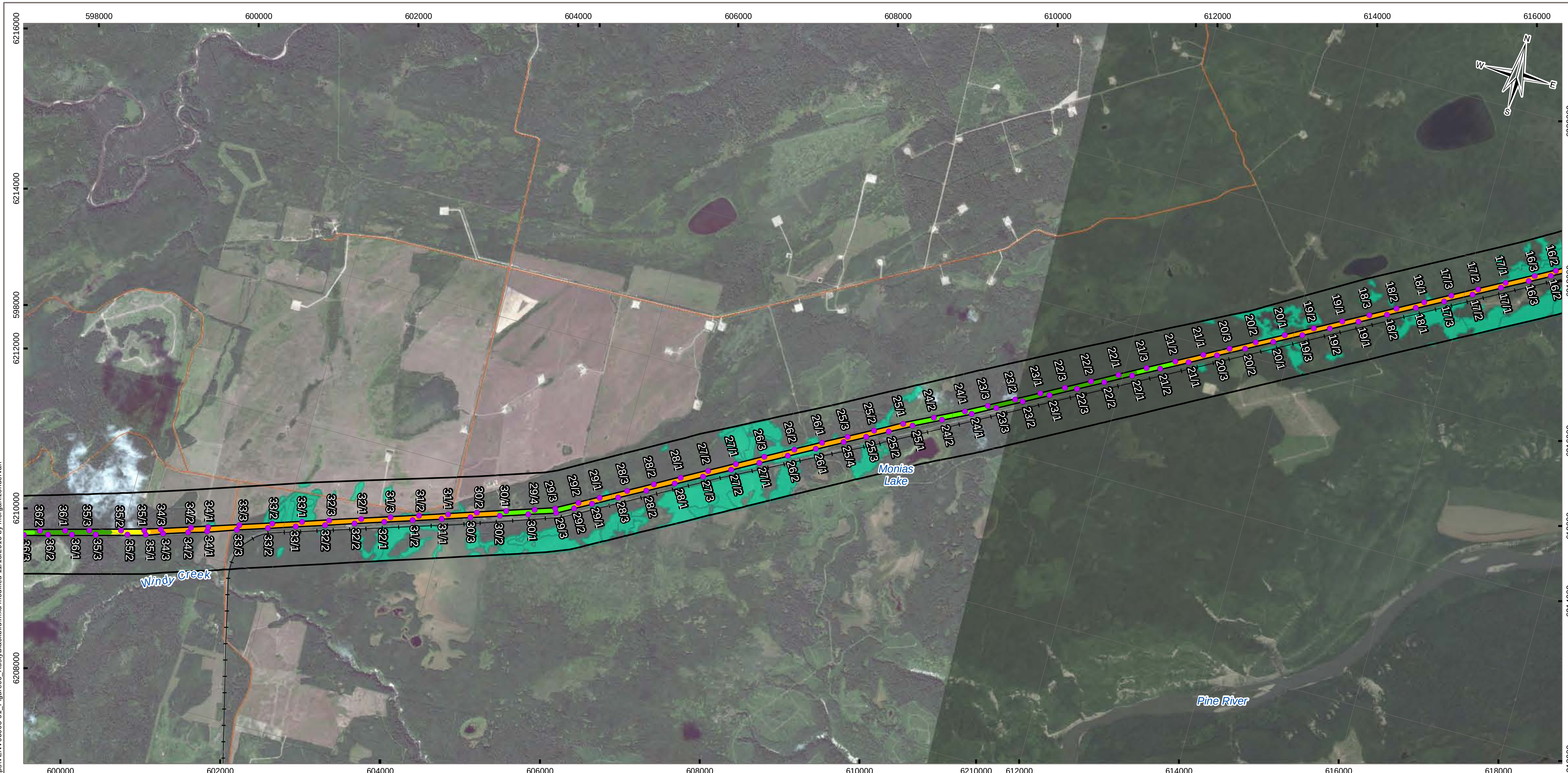

LEGEND

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- Rusty Blackbird Habitat within Study Area
- Existing Road
- Railway

Segment Risk Score

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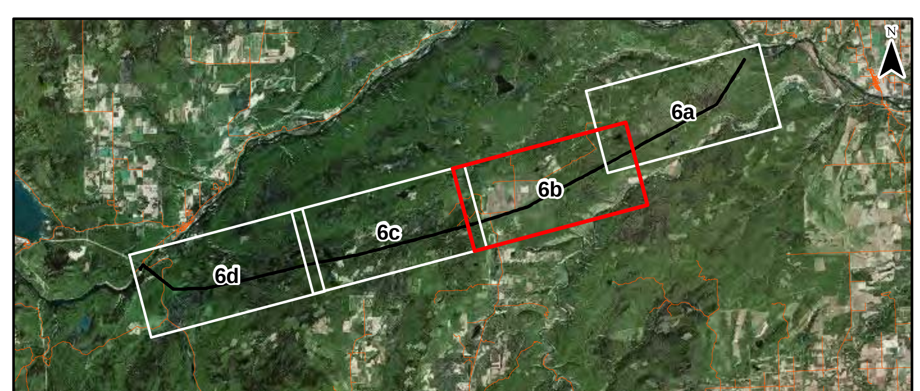
- 0.5
- 1
- 1.5
- 2.5



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UTM Zone 10	NAD83	BC hydro

Scale: 1:50,000
1 0.5 0 1
Kilometres

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ENV.VENV03003-01	MEZ	SL	JJ	0

OFFICE	DATE
Tt EBA-VANC	November 18, 2015

Figure 6b

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Segment Risk Score

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- 1
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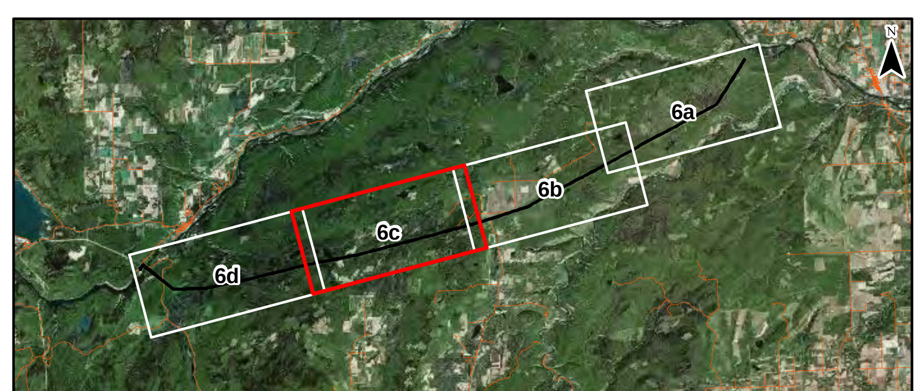
- 2.5



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1 0.5 0 1
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ENV.VENV03003-01	MEZ	SL	JJ	0

OFFICE	DATE
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Figure 6c

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- 0
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- 1
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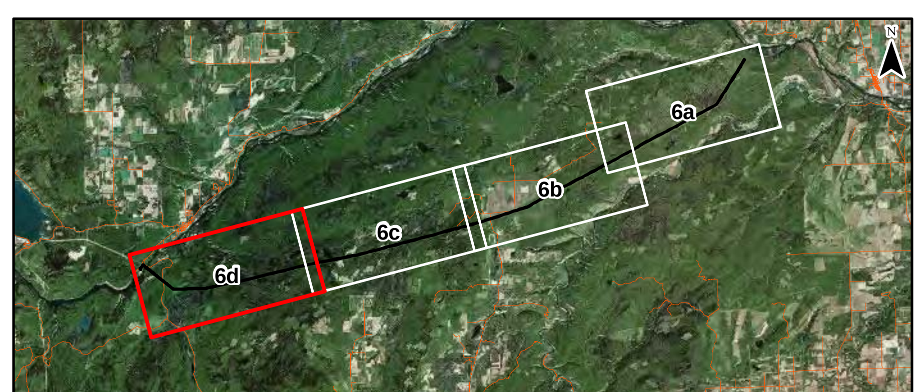

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ENV.VENV03003-01	MEZ	SL	JJ	0
OFFICE	DATE			
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Figure 6d

APPENDIX A
TETRA TECH EBA'S GENERAL CONDITIONS

GENERAL CONDITIONS

GEOENVIRONMENTAL REPORT

This report incorporates and is subject to these "General Conditions".

1.0 USE OF REPORT AND OWNERSHIP

This report pertains to a specific site, a specific development, and a specific scope of work. It is not applicable to any other sites, nor should it be relied upon for types of development other than those to which it refers. Any variation from the site or proposed development would necessitate a supplementary investigation and assessment.

This report and the assessments and recommendations contained in it are intended for the sole use of Tetra Tech EBA's client. Tetra Tech EBA does not accept any responsibility for the accuracy of any of the data, the analysis or the recommendations contained or referenced in the report when the report is used or relied upon by any party other than Tetra Tech EBA's Client unless otherwise authorized in writing by Tetra Tech EBA. Any unauthorized use of the report is at the sole risk of the user.

This report is subject to copyright and shall not be reproduced either wholly or in part without the prior, written permission of Tetra Tech EBA. Additional copies of the report, if required, may be obtained upon request.

2.0 ALTERNATE REPORT FORMAT

Where Tetra Tech EBA submits both electronic file and hard copy versions of reports, drawings and other project-related documents and deliverables (collectively termed Tetra Tech EBA's instruments of professional service), only the signed and/or sealed versions shall be considered final and legally binding. The original signed and/or sealed version archived by Tetra Tech EBA shall be deemed to be the original for the Project.

Both electronic file and hard copy versions of Tetra Tech EBA's instruments of professional service shall not, under any circumstances, no matter who owns or uses them, be altered by any party except Tetra Tech EBA. The Client warrants that Tetra Tech EBA's instruments of professional service will be used only and exactly as submitted by Tetra Tech EBA.

Electronic files submitted by Tetra Tech EBA have been prepared and submitted using specific software and hardware systems. Tetra Tech EBA makes no representation about the compatibility of these files with the Client's current or future software and hardware systems.

3.0 NOTIFICATION OF AUTHORITIES

In certain instances, the discovery of hazardous substances or conditions and materials may require that regulatory agencies and other persons be informed and the client agrees that notification to such bodies or persons as required may be done by Tetra Tech EBA in its reasonably exercised discretion.

4.0 INFORMATION PROVIDED TO TETRA TECH EBA BY OTHERS

During the performance of the work and the preparation of the report, Tetra Tech EBA may rely on information provided by persons other than the Client. While Tetra Tech EBA endeavours to verify the accuracy of such information when instructed to do so by the Client, Tetra Tech EBA accepts no responsibility for the accuracy or the reliability of such information which may affect the report.

Appendix F. Draft management plans for Marl Fen, Rutledge and Wilder Creek Mitigation Lands

SITE C CLEAN ENERGY PROJECT

WILDER CREEK PROPERTY MANAGEMENT PLAN

Prepared by:

P. Christie, P.Ag., RPBio. -Talisman Land Resource Consultants Inc.
and
K. Anré McIntosh, P.Ag., RPBio., PMP - BC Hydro

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Wilder Creek Property Wildlife and Agricultural Management Plan

1.0 INTRODUCTION

BC Hydro owns 7 land Parcels (48, 50, 52, 53, 54, 55, 56 and 57) totalling 423.2 ha, lying between the confluences of Cache Creek and Wilder Creek (Figure 1). Collectively these properties are referred to as the Wilder Creek Properties (the Property). The legal descriptions of the 7 parcels comprising the Property are summarized in Table 1.

The Property, purchased by BC Hydro in 1977, was part of an historic Peace River ranch, encompassing both native rangeland and cultivated lands used for the production of forage, oilseed and grains. The lands are located along the north bank of the Peace River and comprise gently sloping river terraces which back onto steep, warm (south) aspect valley wall slopes. Once the reservoir is filled, 40.4 ha of the lower terrace (Figure 2) will be flooded creating a shallow area of water < 3m deep (Klohn 2009). The cultivated terraces are within the Provincial Agricultural Land Reserve (ALR). The un-cultivated slopes are not in the ALR but have been identified as providing ungulate winter range by the Ministry of Environment although they have not been officially designated as Ungulate Winter Range under the Forest and Range Practices Act.

The Property has been identified as a location where retention and management by BC Hydro will be used to mitigate the loss of vegetation and ecological resources and their associated values as wildlife habitat.

The current and potential value of the Property as wildlife habitat is a reflection of past agricultural management practices. An understanding of this past use is summarized below and will be used to guide the development of the long-term Property management plan.

Table 1. Legal descriptions of Wilder Creek Properties.

Parcel No.	Legal description	Area (ha)
48	Parcel A (25107M) of The North East 1/4 of Section 28 Township 83 Range 20 West of The 6th Meridian Peace River District	61.14
50	That Part of the North West 1/4 of Section 28 Township 83 Range 20 West of the 6th Meridian Peace River District lying North of the Left Bank of the Peace River	39.76
52	The South East 1/4 of Section 33 Township 83 Range 20 West of the 6th Meridian Peace River District	64.86
53	The South West 1/4 of Section 33 Township 83 Range 20 West of The 6th Meridian Peace River District	64.89
54	The Fractional Legal Subdivision 16 of Section 29 Township 83 Range 20 West of the 6th Meridian Peace River District	5.94
55	The North East 1/4 of Section 32 Township 83 Range 20 West of the 6th Meridian Peace River District	64.91
56	The Fractional South East 1/4 of Section 32 Township 83 Range 20 West of the 6th Meridian Peace River District	58.78
57	The Fractional North West 1/4 of Section 32 Township 83 Range 20 West of the 6th Meridian Peace River District	62.91

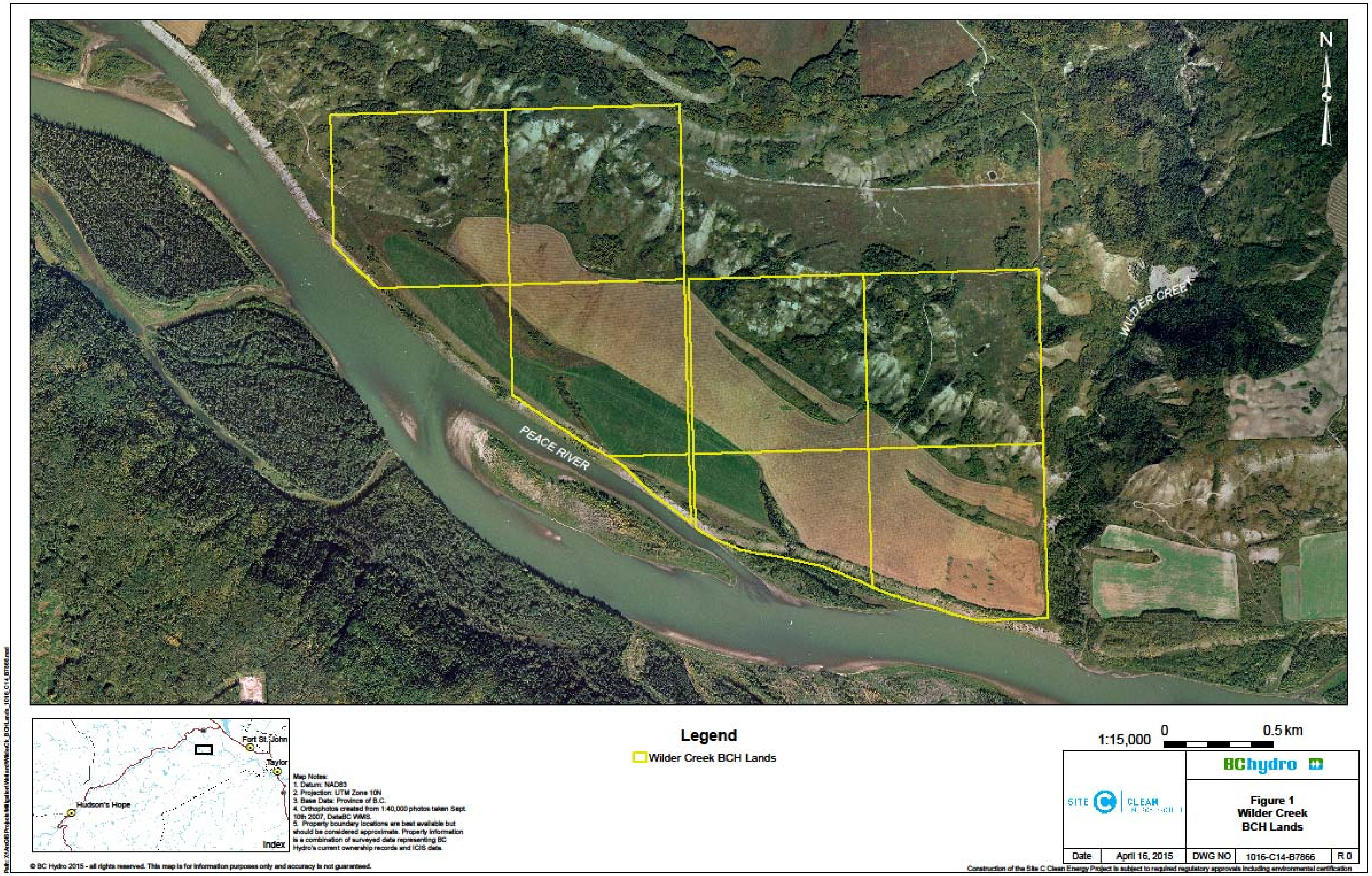


Figure 1. Wilder Creek Lands

This document outlines how the Property will be managed to maintain current agricultural production, protect and enhance sensitive ecosystems, maximize the value of habitats for non-wetland migratory birds and species at risk on the upland and riparian slopes, protect and enhance the shoreline and maximize the habitat value of the shallow, flooded area. This document is intended to be a high-level guidance document that will be amended as needed based on monitoring of the effects of agricultural activities on the Property, further studies on the use of the property by non-wetland migratory birds and species at risk. Management objectives and results will be reviewed annually with the leaseholder and refined as and when needed.

1.1 Plan objectives

This document outlines how the Property will be managed to protect the ungulate winter range on the steep south facing native grassland slopes, maintain and enhance values to non-wetland migratory birds, species at risk and maintain agricultural production on the lower terraces adjacent to the reservoir.

Management of the Property will aid in fulfilling the following conditions attached to the Project's environmental certification:

Federal condition 10.1
The Proponent shall mitigate the potential effects of the Designated Project on non-wetland migratory bird habitat.

Federal condition 10.2
The Proponent shall develop, in consultation with Environment Canada, a plan that addresses potential effects of the Designated Project on non-wetland migratory bird habitat. The plan shall include:

- 10.3.1 non-wetland migratory bird habitat baseline conditions for habitat that would be permanently lost, habitat that would be fragmented and habitat that would remain intact;
- 10.3.2 migratory bird abundance, distribution and use of non-wetland habitat;
- 10.3.4 compensation measures to address the unavoidable loss of non-wetland migratory bird habitat.
- 10.3.6 an approach to monitor and evaluate the effectiveness of the mitigation or compensation measures to be implemented and to verify the accuracy of the predictions made during the environmental assessment on non-wetland migratory bird habitat, including migratory bird use of that habitat.

Federal condition 16.1
The Proponent shall ensure that potential effects of the Designated Project on species at risk, at-risk and sensitive ecological communities and rare plants are addressed and monitored.

Federal condition 16.2
The Proponent shall develop, in consultation with Environment Canada, a plan setting out measures to address potential effects of the Designated Project on species at risk, at-risk and sensitive ecological communities and rare plants.

- 16.3.3: The plan shall include measures to mitigate environmental effects on species at-risk and sensitive ecological communities and rare plants.
- 16.3.6 an approach to monitor and evaluate the effectiveness of mitigation measures and to verify the accuracy of the predictions made during the environmental assessment on species at risk, at-risk and sensitive communities and rare plants.

Provincial condition 4
Plant a 15 m wide riparian area along the reservoir shoreline adjacent to BC Hydro-owned farmland where necessary to provide riparian habitat and bank stabilization except as approved by the onsite environmental monitor.

Provincial condition 16
If loss of sensitive wildlife habitat or important wildlife areas cannot be avoided through Project design or otherwise mitigated, the EAC Holder must implement the following measures, which must be described in the Vegetation and Wildlife Mitigation and Monitoring Plan. The Vegetation and Wildlife Mitigation and Monitoring Plan must include the following compensation measures:

- Management of EAC Holder-owned lands adjacent to the Peace River suitable as breeding habitat for Northern Harrier and Short-eared Owl.
- Establishment of nest boxes for cavity-nesting waterfowl developed as part of wetland mitigation and compensation plan, and established within riparian vegetation zones established along the reservoir on BC Hydro-owned properties.

Provincial condition 24
The EAC Holder must identify suitable lands for ungulate winter range by the end of the first year of construction, on BC Hydro-owned lands, or Crown lands, in the vicinity of the Project in consultation with FLNR (Ministry of Forests, Lands and Natural Resource Operations). If FLNR determines that identified winter range is required, the EAC Holder must identify and maintain suitable BC Hydro-owned lands for ungulate winter range to the satisfaction of FLNR and for the length of time determined by FLNR.

2.0 PROPERTY BACKGROUND

2.1 Agriculture

2.1.1 Soils

The Wilder Creek property lies between the confluences of Cache Creek and Wilder Creek with the Peace River, southeast of Bear Flat, at an elevation between 419-785m asl.

Attachie (AH) soils occupy the northerly portion of the Property along the steep, actively eroding, south-facing valley slopes, above the floodplain of the Peace River (BC Soil Survey 1986). Attachie soils have developed on undifferentiated colluvial materials, including loamy tills mixed with shale and sandstone, and may also have a thin covering of glaciofluvial gravels, sands and silts, as well as loess. Attachie soils are classified as Regosols (young, poorly developed soils) and lithic (shallow to bedrock) Chernozemic soils developed under native grass and shrub vegetation. Due to instability and steep irregular topography, agricultural and forestry uses are severely limited on the AH unit. In some areas, the open slopes have the capacity to support limited domestic grazing.

Taylor (TY) soils occur over the southerly portion of the Property, along the gently to moderately sloping terraces of the north bank of the Peace River at elevations between 400 and 500 m. Taylor soils are classified as Rego Black Chernozems developed on clay textured colluvial (fan) deposits, underlain by variable glaciofluvial deposits. Taylor soils are moderately well to well drained, slowly pervious, and have a subhumid moisture regime. In their native condition, the soils generally have a well developed Ah horizon that overlies clay loam C horizons and usually one or more buried A(h) horizon(s). Taylor soils are often associated with Branham soils, classified as Orthic Eutric Brunisols developed on sandy and silty, calcareous, colluvial fan and glaciofluvial terrace materials. Inclusions of Regosols and Rego Dark Gray Chernozems commonly occur with Taylor and Branham map units.

A detailed soil survey has not been carried out as part of the current work on the Property and the following notes are based on limited field observations to date (refer to Figure 2):

- The soils of the south westerly field (Field 1) have a shallow (15-20 cm) cultivated (Ap) layer of dark brown loam overlying very gravelly and stony, rounded glaciofluvial deposits. This unit is rapidly drained, with low moisture holding capacity. Several large rock piles occur along the inner margin of the field.

- The soils of the middle fields (Fields 2a and 2b) have a clay loam Ap (surface plough layer), generally without gravel but likely sparse rocks in the top 50 cm. There are several large rock piles in the southeast corner that presumably came from rock-picking this field

2.1.2 Climate Capability for Agriculture

The lower terraces of the Property, including all of Fields 1, 2a and 2b, are mapped within unimproved (non-irrigated) Climate Capability for Agriculture Class 3A, with the “A” limitation denoting a climatic moisture deficit of about 132 mm/year (BC Hydro 2012a and 2013). May to September precipitation is about 230 mm. With irrigation the climatic capability rating improves to Class 2G, with the “G” limitation denoting growing degree-days (GDD) of about 1,241., The freeze free period (FFP) averages 91 days.

2.1.3 Land Capability for Agriculture

The Attachie map units, occupying the escarpment slopes, have very low agricultural capability (Class 6 and 7) due to steep irregular slopes and instability, which limit agricultural use to non-intensive grazing (BC Hydro 2011).

The Taylor soil map units, occupying the river terraces where Fields 1, 2a and 2b are located, have high capability for agriculture and are capable of supporting a fairly wide range of crops. The detailed Land Capability for Agriculture mapping compiled by BC Hydro (2012b) rates Field 1 as 60% Class 3 with topography and/or stoniness limitations, and 40% Class 2 with stoniness limitations. The Class 3 areas improve with irrigation to Class 2, with ongoing stoniness limitations while the Class 2 areas would not improve with irrigation due to the on-going GDD climatic limitation (Figure 3). Fields 2a and 2b are rated as dominantly Class 2, with soil structure (D) or aridity (A) limitations and would not improve to Class 1with irrigation due to the on-going GDD climatic limitation (BC Hydro 2012). The agricultural capability maps prepared for the EIS show these fields as improved Class 1. This classification is not supported by the updated climatic data and capability classification which reflects improved Class 2 due to growing degree days of 1241 in the bear flat area.

Based on the July 2015 site visit, Field 1 is dominantly Class 4 with on -going stoniness and low moisture holding capacity limitations. This rating would not improve with irrigation due to the shallow depth to excessive gravels and stones, although forage production would benefit from irrigation. Fields 2a and 2b are dominantly Class 2, with soil structure limitations due to the fine (clay) textures.

2.1.4 Crop Suitability

Fields 2a and 2b are suitable for all the hay and grain crops grown in the Peace Region, with the Class 3A climate limiting the range of other crops, such as vegetables, that could be grown commercially without irrigation. The climatic moisture deficit (~132 mm at Bear Flat) limits the amount of forage that could be produced (ie, cut hay would be limited to one or possibly 2 crops per year, with the potential for additional aftermath grazing). The fine textured soils of Fields 2a and 2b mitigate the climatic soil moisture deficit to some extent, and both the range of cropping alternatives and production levels should be better on the fine textured areas of these fields, compared to the coarser textured Field 1 which would require irrigation to achieve higher production levels.

Soil and moisture conditions observed during the July 2015 site visit, indicate that a single cut of hay can be taken from the fields in most years. Fields 2a and 2b may yield a second cut in some years due to inherently higher moisture holding capacity and higher fertility. Actual harvested hay yields are unknown but likely in the 3-4 tonne/ha (1.5 – 2 t/ac) range based on production estimates for Class 2-3 lands in a Class 3A climate area. Forage yields would improve with irrigation and it is possible that 3 cuts of hay could be taken in some years with irrigation.

2.1.5 Summary of past use

The subject lands have historically been used for forage and grain production including cut hay and canola, as well as periodically oats and/or wheat. Alfalfa seed has also been produced on Fields 2a and 2b. Historically, operators have raised cattle and horses, with the hayfields grazed by cattle following forage harvesting. Livestock were placed on the fields and the adjacent hillside from about mid-September to mid-November. In 2014, Field 2 was treated for noxious weeds, cultivated and left fallow in preparation for planning canola in the Spring of 2015.

Field 1 appears to be a relatively recently created field that has been planted to a grass/legume (clover) hay crop.

The upper, rough pasture area was grazed by domestic buffalo in the past.

2.1.6 Noxious Weeds

The leaseholder has been managing noxious weeds in the cultivated portions of the property. Minor infestations of thistle and dandelion were observed in Fields 1, 2a and 2b during the field reconnaissance. In 2008 night flowering catchfly was documented on the property. A noxious weed inventory will be conducted in 2015 and the results will be provided to the leaseholder for incorporation into their weed management program.

2.2 Infrastructure on site

2.2.1 Access

The Property is located about 7 km south east of Bear Flat, on the north bank of the Peace River. Access is via an all-weather gravel road travelling south east from Highway 29, through the Shaman Buffalo Ranch, then a poorly graded bare soil track cutting through an escarpment gully to the metal gate located along the north side of Field 2. The track through the gully has slumped (at 618260 X 6234211) and given the conditions will continue to erode, if no corrective measures are taken. Access around and through Fields 1, 2a and 2b is via poorly graded farm tracks.

2.2.2 Water

There are two water sources for livestock within the property:

- A dugout located in the rough pasture, upland area of Parcel 523 near the easterly Property boundary (See Figure 3).
- A small wetland located mid-escarpment within Parcel 57 near the westerly boundary of the Property.

There are no known dug or drilled wells on the property.

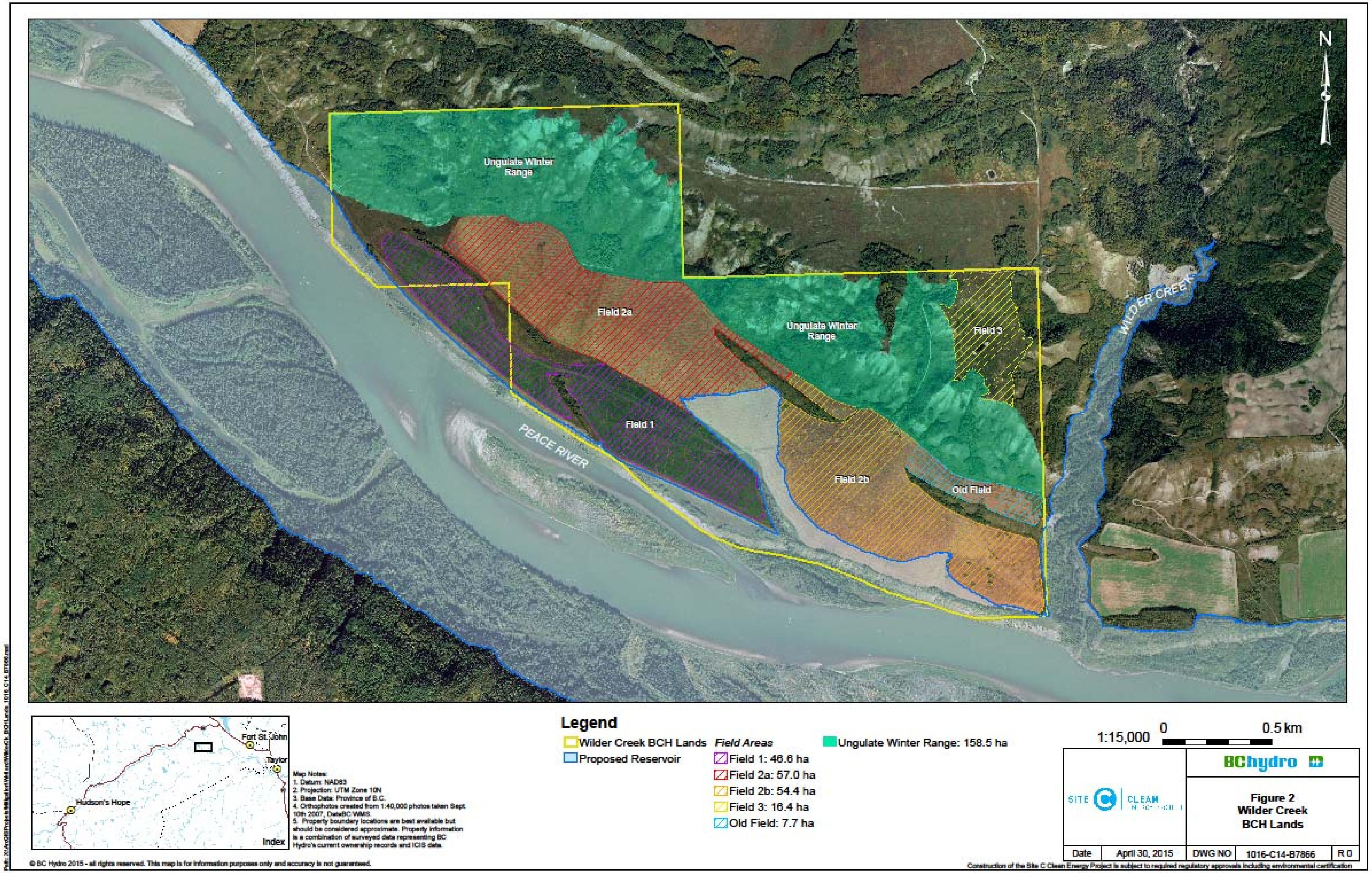


Figure 2. Field numbers and ungulate winter range location: Wilder Creek Lands

2.2.3 Fencing

The Property fields are fenced and cross-fenced with 4-strand barb wire on split fence posts. Much of the fencing is in disrepair and requires replacement. The main access gate along the northern edge of Field 2 is metal and field gates are barbed slip wire.

2.3 Baseline Vegetation Resources on the Property

2.3.1 Ecosystems Present

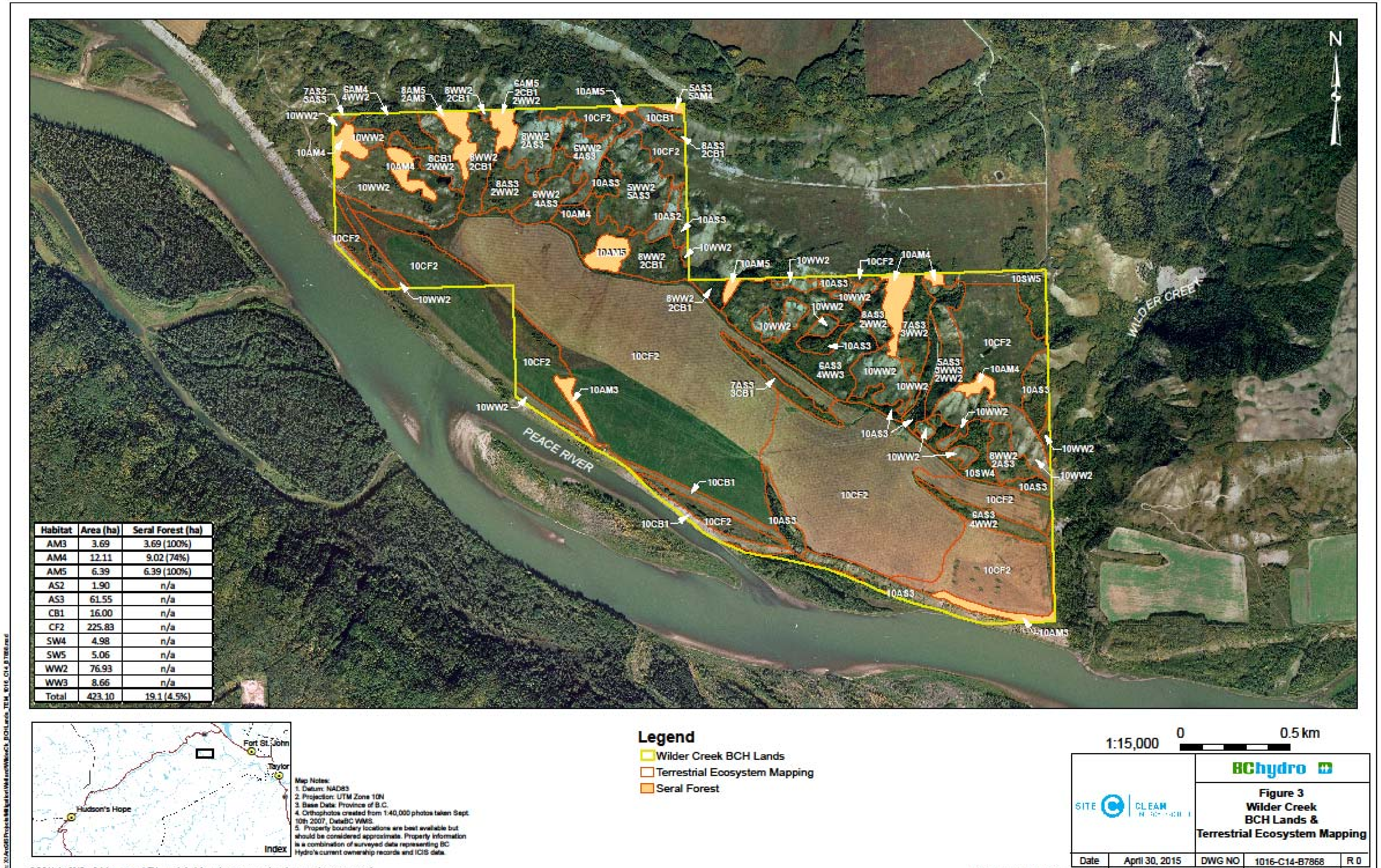
Terrestrial Ecosystem Mapping was completed for the Property as part of the Site C Environmental Assessment (Hilton *et al.* 2013). Seven ecosystems (habitats) were mapped on the Property (Figure 3). Table 2 summarizes the amount of each ecosystem mapped within the Property. The grasslands, mapped as Fuzzy-spiked wildrye-Wolf Willow (WW) are classified as a sensitive ecological community (Hilton *et al.* 2013). None-of the ecosystems on the property are classified as at risk (Hilton *et al.* 2013).

Table 2. Habitats mapped within the Wilder Creek Properties (Hilton et al. 2013).

Habitat	TEM Code	Structural Stage	Area (ha)
Trembling Aspen-Creamy Peavine	AM:ap	3	3.69
Trembling Aspen-Creamy Peavine	AM:ap	4	9.02
Trembling Aspen-Creamy Peavine	AM:ap	5	6.39
White Spruce-Aspen-Step moss	AM	4	3.09
White Spruce-Trembling Aspen Soopolallie	AS	2	1.90
White Spruce-Trembling Aspen Soopolallie	AS	3	61.55
Cut bank	CB	1	16.00
Cultivated Field	CF	2	225.83
White Spruce-Wildrye-Peavine	SW	4	4.98
White Spruce-Wildrye-Peavine	SW	5	5.06
Fuzzy-spiked wildrye-Wolf Willow	WW	2	76.93
Fuzzy-spiked wildrye-Wolf Willow	WW	3	8.66

2.3.2 Rare Plants

Inventories for rare plants were not conducted in this area during baseline surveys. Habitats within the Wilder Creek properties have the potential to support 23 species of rare plants documented during baseline surveys (Table 3). A rare plants survey will be conducted in non-cultivated parts of the property during the Project construction phase to determine which if any rare plants are present within the property.



Habitat	Area (ha)	Seral Forest (ha)
AM3	3.69	3.69 (100%)
AM4	12.11	9.02 (74%)
AM5	6.39	6.39 (100%)
AS2	1.90	n/a
AS3	61.55	n/a
CB1	16.00	n/a
CF2	225.83	n/a
SW4	4.98	n/a
SW5	5.06	n/a
WW2	76.93	n/a
WW3	8.66	n/a
Total	423.10	19.1 (4.5%)

Figure 3. Habitats on the Wilder Creek Property.

Table 3. Rare plants that could occur on the Wilder Creek properties.

Species	Expected habitat
Riverbank anemone (*Anemone virginiana* var. *cylindroidea*)	Upland areas in understory of open aspen forest or in mixed woodlands of aspen, balsam poplar and white spruce and occasionally in full sun with grasses and low shrubs, near fence lines and road shoulders.
Herriot's sage (*Artemisia herriotii*)	River shores, cut banks, slopes; areas of loosely-consolidated soils; moist to dry.
Gardner's saltbrush (*Atriplex gardneri* var. *gardneri*)	Dry grassy slopes; saline clay slopes
Plains reedgrass (*Calamagrostis montanensis*)	Dry grassland slopes, shrub flats, and in open forests
Tawny paintbrush (*Castilleja miniata* var. *fulva*)	Mesic open forests; bluffs
Tender sedge (*Carex tenera*)	Mesic to dry meadows, shorelines, and open forests
Torrey's sedge (*Carex torreyi*)	Grassland; mesic to moist meadows and shrubland; moist woods
Dry-land sedge (*Carex xerantica*)	Dry grasslands and hillsides, open forests, and rock outcrops
Drummond's thistle (*Cirsium drummondii*)	Dry to moist soils of pastures, meadows, forest openings, prairies, and roadsides
Peace daisy (*Erigeron pacalis*)	Grassland opening near low shrubs and mixed woodland.
Old-man's whiskers (*Geum triflorum* var. *triflorum*)	Dry to mesic grasslands, meadows, rocky slopes and open forests
Spike-oat (*Avenula hookeri*)	Mesic to dry open slopes, meadows, and forest clearings
Colorado rush (*Juncus confusus*)	Moist steppe and montane habitats such as open grasslands, meadows, stream banks, and woods
Fennel-leaved desert-parsley (*Lomatium foeniculaceum* var. *foeniculaceum*)	Dry slopes, prairies, and grasslands
Davis' oxytrope (*Oxytropis campestris* var. *davisii*)	River shores, mesic to dry meadows, gravel bars, forest openings
Slender penstemon (*Penstemon gracilis*)	Mesic to dry plains and grasslands
persistent-sepal yellow-cress (*Rorippa calycina*)	River shorelines
Arkansas rose (*Rosa arkansana*)	Prairies and grasslands, thickets, and woodlands
Little bluestem (*Schizachyrium scoparium*)	Mesic to dry grasslands, shrublands, open woods, rocky slopes, and canyons
Rock selaginella (*Selaginella rupestris*)	Rock outcrops and grassy ridges
Drummond's campion (*Silene drummondii* var. *drummondii*)	Dry shrubland, meadows, and woodland openings

Species	Expected habitat
slender wedgegrass (*Sphenopholis intermedia*)	Moist habitats such as shorelines, streambanks, meadows, ponds, etc.
purple-stemmed aster (*Symphyotrichum puniceum* var. *puniceum*)	Various wetlands; shoreline

2.4 Vegetation Management

2.4.1 Protection of south facing grassland and forested slopes

Management of agricultural lands on the lower terrace will retain the suitability and availability of the adjacent steep south facing grassland slopes for ungulate use in winter, late fall and early spring. No livestock grazing will be permitted in grassland or forested habitats. Fences will be installed around the fields to contain any livestock grazing to the cultivated areas.

Prescribed burns are used in the Peace Region to rejuvenate the grasslands and increase their value and suitability for ungulates. BC Hydro will work with the Ministry of Forest Lands and Natural Resources to determine if prescribed burns are a suitable management tool for the south facing grassland slopes on the Property.

2.4.2 Riparian vegetation plantings

A 15 meter riparian vegetation zone will be established along the edge of the reservoir in parcels 57, 54, 50 and 48 though planting of native shrubs and trees outside the five-year beach line. The five-year beach line is the predicted extent of shoreline retreat at the maximum normal reservoir level five years after impoundment (EIS, Volume 2 Appendix B, Part 2).

The objective of establishing the 15m riparian vegetation zone is to replace deciduous and coniferous riparian vegetation lost due to reservoir creation. A mix of live staked Balsam Poplar (60%), willow (30%) and Red-osier Dogwood (10%) will be planted at densities of 2,500 stems/ha. In the long term, the vegetation within this zone is expected provide protection against additional shoreline erosion and provide riparian habitat with the attributes needed to support rare plants, non-wetland migratory birds and species at risk.

3.0 WILDLIFE OBJECTIVES

With the exception of butterfly surveys, baseline wildlife surveys were not conducted at Wilder Creek. Baseline data were consulted to determine which species would be expected to use the property based on the habitats present.

Management of the Property will aid in fulfilling the conditions outlined in Section 1.1 above.

3.1 Target species

Management of the Property will target maintaining, creating and managing habitat (breeding, feeding, migration and winter) for:

- non-wetland migratory birds identified as species of conservation concern for Bird Conservation Region 6 by Environment Canada (2013)
- species at risk documented in similar habitats in the project area
- ungulate winter range

Should additional species of conservation concern for Bird Conservation Region 6 or species at risk be documented on the property during monitoring surveys the management plan will be reviewed and revised as required.

Table 4 below summarizes the species expected to occur on the Wilder Creek lands based on their habitat preferences and occurrences documented in the baseline data (Hilton et al. 2013b, 2013c, 2013d and 2013e).

Table 4. Wildlife species expected to occur on the Wilder Creek lands (M=migrant breeder, R=resident, F=feeding).

Species	BCCF Priority	Habitat										
		AM3	AM4	AM5	AS2	AS3	CB	CF	SW4	SW5	WW2	WW3
Non-wetland migratory birds of Conservation Concern Region 6												
American Kestrel	2							M			M	
American Three-toed Woodpecker	6			R								
Baltimore Oriole	2		M	M								
Bank Swallow	5						M					

Species	BCCF Priority	Habitat										
		AM3	AM4	AM5	AS2	AS3	CB	CF	SW4	SW5	WW2	WW3
Black-billed Magpie	6					R		R			R	R
Blackpoll Warbler	5		M	M								
Bohemian Waxwing	6			R						R		
Boreal Chickadee	5			R								
Boreal Owl				R						R		
Clay-colored sparrow	4				M	M		M			M	M
Eastern Phoebe	4							M			M	M
Great Gray Owl				R						R		
Killdeer	2							M				
Least Flycatcher	6		M	M								
Mourning Warbler	2	M	M						M			
Northern Flicker	6			M						M		
Northern Goshawk	3			M						M		
Northern Harrier	2							M			M	
Northern Shrike	4				R	R		R				
Pileated Woodpecker				R								
Sharp-tailed Grouse	2	R	R	R				R	R	R	R	R
Western Tanager	6			M						M		
Western Wood-Pewee	2			M						M		
White-throated Sparrow	5				M	M		M			M	M
White-winged Crossbill	5			R						R		
Yellow-bellied Sapsucker	6		R	R					R	R		
Other Non-wetland migratory birds												
American Redstart	6		M	M					M	M		
American Robin	6	M	M	M		M		M	M	M		
Black capped Chickadee	6			R		R				R		
Cedar Waxwing	6	M	M	M		M			M	M		
Chipping Sparrow	5	M	M	M		M		M	M	M		M
Common Yellowthroat	5							M				
Dark-eyed Junco	5	R	R	R		R			R	R		R
Golden-crowned Kinglet	5								M	M		
Great Horned Owl				R						R		
Least Flycatcher	6	M	M	M		M			M	M		M
Northern Saw-whet Owl				R						R		
Purple Finch	2			M						M		
Red-breasted Nuthatch	5		M	M					M	M		

Species	BCCF	Habitat										
	Priority	AM3	AM4	AM5	AS2	AS3	CB	CF	SW4	SW5	WW2	WW3
Red-eyed Vireo	2	M	M	M		M			M	M		
Ruby-crowned Kinglet	6			M						M		
Tennessee Warbler	5	M				M			M		M	M
Warbling Vireo	6	M	M	M		M			M	M		
White-throated Sparrow	5	M	M	M		M			M	M		
Yellow-rumped Warbler	5	M	M	M		M			M	M		
Yellow Warbler	2	M	M	M		M		M	M	M		
Species at risk												
Alberta Arctic											M	M
Aphrodite Fritillary		M	M	M		M					M	M
Arctic Blue					M	M					M	M
Arctic Skipper		M	M	M				M	M	M	M	M
Assiniboine Skipper		M	M	M	M	M		M			M	M
Common Ringlet					M	M		M			M	M
Common Woodnymph		M	M	M	M	M		M	M	M	M	M
Coral Hairstreak								M				
Great Spangled Fritillary		M	M	M	M	M					M	M
Old World Swallowtail											M	M
Striped Hairstreak											M	M
Tawny Crescent		M	M	M	M	M			M	M	M	M
Uhler's Arctic					M	M					M	M
Black-throated Green Warbler	1			M								
Broad-winged Hawk	4			M						M		
Canada Warbler	2		M	M					M	M		
Cape-may Warbler*												
Cackling Goose	4							M				
Common Nighthawk	2										M	M
Connecticut Warbler	2			M						M		
Le Conte's Sparrow	4							M			M	M
Olive-sided Flycatcher*												
Rusty Blackbird*												
Short-eared Owl	2							R			R	R
Upland Sandpiper	1							M			M	
Eastern red bat		F	F	F	F	F	F	F	F	F	F	F

Species	BCCF Priority	Habitat										
		AM3	AM4	AM5	AS2	AS3	CB	CF	SW4	SW5	WW2	WW3
Northern long-eared myotis	2	F	F	F	F	F	F	F	F	F	F	F
Ungulates												
Elk	5	R	R	R	R	R	R	R	R	R	R	R
Mule deer	6	R	R	R	R	R	R	R	R	R	R	R

*expected to occur after reservoir inundation/establishment of old forests within property

3.2 Management Activities

Management for non-wetland migratory birds, species at risk and ungulates will be achieved through:

- Installing fencing around the perimeter of Fields 1, 2a and 2b. The objective of the fencing is to contain any livestock grazing to the cultivated field areas.
    - The fence configuration will be 5 wire. The top and bottom wires will be smooth. The middle three wires will be barbed. The lower and top smooth wires will be raised to facilitate ungulate passage (the proposed fencing is described in the BC Agricultural Fencing Handbook (Ministry of Agriculture Food and Fisheries 2002 available at: http://www.agf.gov.bc.ca/resmgmt/publist/300Series/307000-1.pdf).
    - Existing fencing will be removed in conjunction with installation of the new fencing.
- Installing split rail fencing along the northern property boundary of Parcel 52 to demark the beginning of the old field habitat (former rough pasture) area.
- Establishing and maintaining old field habitats on the plateau and lower terrace (Parcel 52 uplands and Old field; Figure 2)
- Establishing large trees along the edge of fields and within current forested areas
- Enhancing values of the steep riparian rive and gully slopes to non-wetland migratory birds by planting native, woody species (trees and shrubs).
- Installing posts and nest boxes suitable for American Kestrel, swallows, waterfowl and other cavity nesting species along fence lines at the edge of cultivated fields and within the 15m riparian vegetation zone

- Conducting prescribed burns of grassland habitats (steep south facing slopes) to rejuvenate native grassland and early seral habitats and maintain and enhance their value as ungulate winter range

4.0 MANAGEMENT OBJECTIVES: AGRICULTURE

The objectives of field management are to maintain agricultural production within the areas of cultivated field habitat on the lower terrace adjacent to the reservoir, create additional wildlife habitat within cultivated fields, and protect and maintain wildlife habitats within the property. This will be achieved through a program of field management that will include:

- Retain and improve existing grain and oilseed production on Fields 2a and 2b;
- Retain and improve existing forage production on Field 1;
- Establish and maintain areas of old field habitat on the plateau (formerly rough pasture) and terrace (old field)
- Allow current level of livestock grazing in cultivated areas until reservoir filling begins;
- After reservoir filling begins and fencing is installed, allowing pasture use and aftermath grazing by livestock only on the actively cultivated areas of Fields 1, 2a and 2b.
- Encourage more intensive agricultural crop production (e.g. alfalfa seed, vegetables) post reservoir filling, particularly if irrigation water becomes available.

4.1 Field Management

Typically, Peace River hayfields and pastures require renovation every 5-8 years in order to maintain optimal forage production levels. Field 1 has been recently cultivated and seeded and should not require renovation for a few years, but would benefit from regular fertilizing, addition of organic matter (manure or green maturing) and perhaps scarification and over-seeding.

Field 2 is being alternately cropped for forage and oil seed production by the current leaseholder. In 2014 it was prepared for planting to a canola crop in 2015.

The proposed cultivation, weed treatment, fertilizing and seeding specifications will be reviewed for each field with the lessee annually.

5.0 DETAILED MANAGEMENT PLAN

5.1 Priority Site Works

5.1.1 Access

The access road entering the property through Field 3 requires improvement. Stabilizing works are required where the track is slumping in the gully. Additional site visits are required develop a strategy to restore the road.

5.1.4 Fencing

Ungulate-friendly fencing will be installed along the perimeter of Field 1, 2a and 2b as described in Section 3.2 to restrict livestock use to the cultivated fields, once reservoir filling commences. Split rail fencing will be installed along the northerly boundary of Parcel 52, at the entrance to the Property.

5.1.5 Cattle Watering

The dugout located in Parcel 52 will no longer be available for livestock watering. If livestock use is to continue on Fields 1, 2a and 2b, options for providing water will need to be developed. Livestock may be able to access the reservoir or new dugouts may be required. Discussions will be held with the lessee to determine the necessity of and possible locations for livestock watering facilities within the Property.

5.2 Field Improvements

5.2.1 Field Management

Field 1 (46.6 ha) adjacent to the Peace River is currently only used for forage crops because the soils are coarse (sandy) textured and shallow, overlying gravels and stones (Figure 2). Field 2 (57 ha) is used to produce forage and oilseed (canola) crops.

Two management regimes will be implemented in these fields:

- Maintain long term forage production in Field 1
- Maintain intensive crop production on Field 2 (and post-flooding, Fields 2a and 2b)
- Margins of Fields 1 and 2, where appropriate, will be managed to provide old field-grassland habitat. Vegetation height within these areas will be 0.3 to 2.1 meters with the objective of providing breeding habitat for Short-eared Owl, Northern Harrier, Sharp-tailed Grouse and Common Nighthawk.

- o Old field habitats will be managed through either a simple rotation of predominantly light, later season grazing (August to mid-October) one year followed by earlier, light spring (mid-May to end of June) grazing the following year or light haying, leaving at least 6 inches of stubble. If management via grazing is employed, the interval with which the fields would be grazed in the spring would be determined based on actual field conditions. The objective will be to allow about 50% of the grasses to go to seed each year of later grazing and 100% of the field to go to seed in each year of early grazing. The determination of the intensity of grazing and the frequency of spring grazing or mowing would be based maintenance of old field characteristics.

5.2.2 Weed management plan

- Minor infestations of thistle and dandelion were recorded during the brief Property visit in 2014;
- A weed survey will be carried out in 2015. Results will be provided to the leaseholder for inclusion in their 2015 weed management plan. BC Hydro will assist the leaseholder in development of the weed management plan through its Agricultural Leaseholder Noxious Weed Treatment Program. Through this program, leaseholders can access expert advice from a noxious weed control specialist in planning and implementing noxious weed control. After an audit by the weed control specialist, of the efficacy of any chemical treatments, BC Hydro reimburses the leaseholder the cost of chemicals used.

6.0 ADDITIONAL REQUIREMENTS AND/OR RECOMMENDATIONS

- No polypropylene twine or wire is to be used for any hay brought on site. Only degradable twine is to be permitted
- Hunting and trapping will not be permitted on the property

7.0 MONITORING AND FOLLOW-UP TO MANAGEMENT OF PROPERTY

7.1 Lessee record keeping requirements

At a minimum the lease holder will keep records of the following:

- Crops grown including: date of planting and harvest

- Weed treatment(s) including: area treated, date of treatment, chemicals applied, rate of application, treatment efficacy and plans for following year's treatment
- Wildlife observations, including any issues with wildlife.

7.2 Monitoring by BCH

BC Hydro will conduct the following surveys and monitoring observations on the Property:

- Breeding bird surveys (see Sections 7.1.1.2-A and 7.2.7 of the *Vegetation and Wildlife Mitigation and Monitoring Plan*)
- Bird nest monitoring plan (see Section 7.1.1.2-B of the *Vegetation and Wildlife Mitigation and Monitoring Plan*)
- Ground nesting raptor surveys (see Section 78.9.5.1 of the *Vegetation and Wildlife Mitigation and Monitoring Plan*)
- Monitoring winter use by ungulates
- Monitoring of general property conditions (TBD).

7.3 Annual meetings to discuss/update management plans

To be determined in consultation with leaseholder.

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SITE C CLEAN ENERGY PROJECT

RUTLEDGE PROPERTY MANAGEMENT PLAN

Prepared by:

P. A. Christie, P.Ag., RPBio. -Talisman Land Resource Consultants Inc.

and

K. Anré McIntosh, P.Ag., RPBio. - BC Hydro

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1.0 INTRODUCTION

BC Hydro has identified 5 land Parcels, totalling approximately 208 ha that will be retained and managed to provide habitat for rare plants and wildlife. Collectively these properties are referred to as the Rutledge property (the Property) and were purchased by BC Hydro on July 23, 2014. The property, is located on either side of Dry Creek, west of Farrell Creek about 12 km north-east of Hudson's Hope adjacent to the Site C reservoir (Figure 1). The legal descriptions of the 5 parcels that will be managed for rare plants and wildlife are summarized in Table 1.

The lands are located along the north bank of the Peace River and comprise gently sloping river terraces which back onto steep, warm (south) aspect valley wall slopes. The cultivated terraces are within the Provincial Agricultural Land Reserve (ALR). The un-cultivated slopes are not in the ALR but have been identified as providing ungulate winter range by the Ministry of Environment although they have not been officially designated as Ungulate Winter Range under the Forest and Range Practices Act.

The Property parcels located south of Highway 29 will be inundated when the reservoir is filled. Hayfields south of Highway 29 will continue to be used for production of forage until just prior to reservoir filling. These lands are not discussed further in this plan.

The current value of the Property as wildlife habitat is a reflection of past agricultural management practices. An understanding of this past use is summarized below and will be used to guide the development of the long-term Property management plan.

Table 1. Legal descriptions of Rutledge property.

Parcel No.	Legal description	Area (ha)
254	The North West 1/4 of Section 19 Township 82 Range 24 West of The 6th Meridian Peace River District	64.56
254.1	Block A Of The North East 1/4 Of Section 24 Township 82 Range 25 West of the 6th Meridian Peace River District	5.27
255	That Part of the South West 1/4 of Section 19 Township 82 Range 24 West of the 6th Meridian Peace River District Lying North of the Left Bank of the Peace River Except Plan 21821	29.07
257	The South East 1/4 of Section 24 Township 82 Range 25 West of the 6th Meridian Peace River District Except Plans 21821	47.73
258	The South West 1/4 of Section 24 Township 82 Range 25 West of the 6th Meridian Peace River District Except Plan 30367 and 21821	57.44

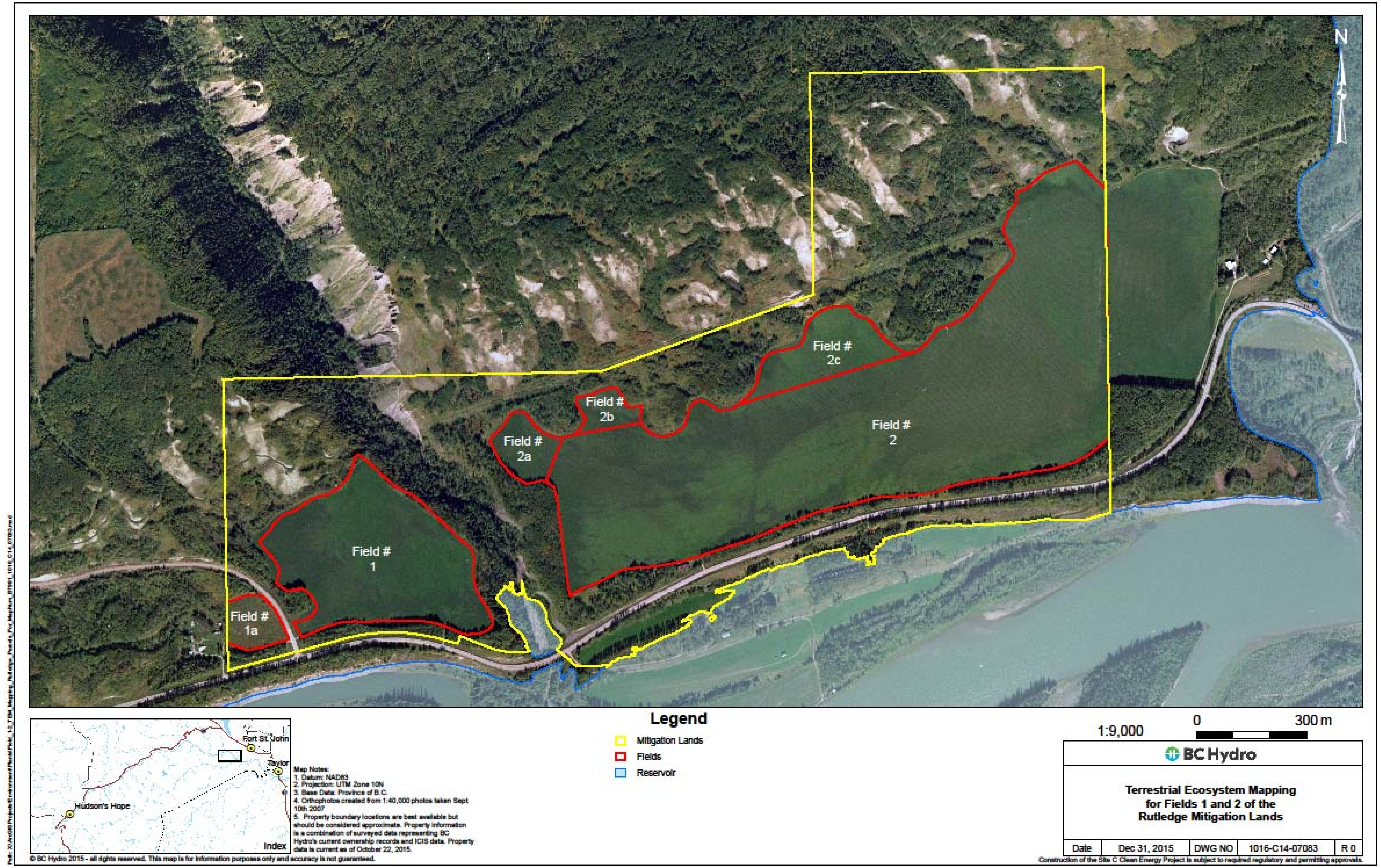


Figure 1. Rutledge property Mitigation Lands

1.1 Plan objectives

This document outlines how the Property will be managed to protect the ungulate winter range on the steep south facing native grassland slopes, maintain and enhance values to non-wetland migratory birds, species at risk and maintain agricultural production on the main forage fields above Hwy 97. This document is intended to be a high-level guidance document that will be amended as needed based on monitoring of the effects of agricultural activities on the Property and further studies on the use of the Property by non-wetland migratory birds and species at risk. Management objectives and results will be reviewed annually with the leaseholder and refined as and when needed.

Management of the Property will aid in fulfilling the following conditions attached to the Project's environmental certification:

- **Federal condition 10.1:** The Proponent shall mitigate the potential effects of the Designated Project on non-wetland migratory bird habitat.
- **Federal condition 10.2:** The Proponent shall develop, in consultation with Environment Canada, a plan that addresses potential effects of the Designated Project on non-wetland migratory bird habitat. The plan shall include:
  - **10.3.1** non-wetland migratory bird habitat baseline conditions for habitat that would be permanently lost, habitat that would be fragmented and habitat that would remain intact;
  - **10.3.2** migratory bird abundance, distribution and use of non-wetland habitat;
  - **10.3.4** compensation measures to address the unavoidable loss of non-wetland migratory bird habitat.
  - **10.3.6** an approach to monitor and evaluate the effectiveness of the mitigation or compensation measures to be implemented and to verify the accuracy of the predictions made during the environmental assessment on non-wetland migratory bird habitat, including migratory bird use of that habitat.
- **Federal condition 16.1:** The Proponent shall ensure that potential effects of the Designated Project on species at risk, at-risk and sensitive ecological communities and rare plants are addressed and monitored.
- **Federal condition 16.2:** The Proponent shall develop, in consultation with Environment Canada, a plan setting out measures to address potential effects of the Designated Project on species at risk, at-risk and sensitive ecological communities and rare plants.
  - **16.3.3**: The plan shall include measures to mitigate environmental effects on species at-risk and sensitive ecological communities and rare plants.
  - **16.3.6** an approach to monitor and evaluate the effectiveness of mitigation measures and to verify the accuracy of the predictions made during the environmental assessment on species at risk, at-risk and sensitive communities and rare plants.
- **Provincial condition 4:** Plant a 15 m wide riparian area along the reservoir shoreline adjacent to BC Hydro-owned farmland where necessary to provide riparian habitat and bank stabilization except as approved by the onsite environmental monitor.

- **Provincial condition 16:** If loss of sensitive wildlife habitat or important wildlife areas cannot be avoided through Project design or otherwise mitigated, the EAC Holder must implement the following measures, which must be described in the Vegetation and Wildlife Mitigation and Monitoring Plan. The Vegetation and Wildlife Mitigation and Monitoring Plan must include the following compensation measures:
  - Management of EAC Holder-owned lands adjacent to the Peace River suitable as breeding habitat for Northern Harrier and Short-eared Owl.
  - Establishment of nest boxes for cavity-nesting waterfowl developed as part of wetland mitigation and compensation plan, and established within riparian vegetation zones established along the reservoir on BC Hydro-owned properties.
- **Provincial condition 24:** The EAC Holder must identify suitable lands for ungulate winter range by the end of the first year of construction, on BC Hydro-owned lands, or Crown lands, in the vicinity of the Project in consultation with FLNR (Forests, Lands and Natural Resource Operations). If FLNR determines that identified winter range is required, the EAC Holder must identify and maintain suitable BC Hydro-owned lands for ungulate winter range to the satisfaction of FLNR and for the length of time determined by FLNR.

2.0 Property Background

2.1 Agriculture

2.1.1 Soils

The Rutledge property is located along the west side of Farrell Creek at the confluence with the Peace River, about 12 km north-east of Hudson's Hope, at an elevation between 440-600m asl. Highway 29 bisects the property and Farrell Creek Road lies along the western boundary. A deep, glacial drainage gully transects the easterly boundary of Lot 258 and south-west boundary of Lot 257 (Figure 1).

The Branham (BR)-Clayhurst (CY) soils unit occupies the upper hayfields of the gently to moderately sloping, south facing terraces dominantly on the north side of Hwy 29 (BC Soil Survey 1986). Branham soils are classified as Orthic Eutric Brunisols. They are well drained and have developed on calcareous, sandy to silty, colluvial fan and glacio-fluvial terrace deposits. Generally, the BR-CY unit contains about 40% Clayhurst soils, which are classified as Eluviated Eutric Brunisols developed on gravelly, sandy glacio-fluvial deposits. Clayhurst soils are well to rapidly drained, and weakly calcareous.

2.1.2 Climate Capability for Agriculture

Fields 1 and 2 (Figure 1) are mapped within unimproved (non-irrigated) climatic capability rating Class 2G, with the "G" limitation denoting growing degree-days (GDD) of about 1,240. The freeze free period (FFP) is generally less than 90 days. May to September precipitation is about 225-230 mm, and the climatic moisture deficit is about 130 mm/year. The climatic capability rating does not improve with irrigation, due to the G limitation, although crop production would be increased with supplemental irrigation in some years when droughty periods occur during the growing season (BC Ministry of Environment, 1983, and BC Hydro 2012 and 2013).

2.1.3 Land Capability for Agriculture

The Branham-Clayhurst soil map units, occupying Fields 1 and 2, have high capability for agriculture and are capable of supporting a fairly wide range of crops.

Based on the July 2014 site visit, Fields 1 and 2 appear to be dominantly Branham soils, with an agricultural capability of Class 2 due to climatic capability restrictions. The British Columbia Land Inventory (BCLI, 1979) rates these fields as Class 2 with a combination of minor limitations (Class 2X). The capability would not improve to Class 1 with irrigation due to the on-going GDD (G) climatic limitation. The BCLI mapping predates the published soils mapping referred to above, and does not reflect the component (~40%) of Clayhurst soils mapped as occurring within these units.

Limited field observations to date, noted that the Branham soils are mixed with patches of gravelly, sandy Clayhurst soils. Gravelly, sandy Clayhurst soils are rated as agricultural capability Class 4 due to low moisture holding capacity and low fertility. The agricultural capability of the Clayhurst component would improve one class (to Class 3) with irrigation and other management improvements (fertilization, increased organic matter). These improvements would also increase forage production levels.

2.1.4 Crop Suitability

Fields 1 and 2 are suitable for all the hay and grain crops grown in the Peace Region, with the Class 2G climate limiting the range of other crops, including vegetables and fruits, which could be grown commercially without irrigation. The climatic moisture deficit (~130 mm) limits the amount of forage that could be produced (ie, cut hay would be limited to one or possibly 2 crops per year, with the potential for additional aftermath grazing). The fine textured (Branham) soils of Fields 1 and 2 may mitigate the climatic soil moisture deficit to some extent, and both the range of cropping alternatives and production levels should be better on the fine textured areas of these fields, compared to the coarser textured (Clayhurst) soil pockets which would require irrigation to achieve higher production levels.

Soil and moisture conditions observed during the July 2014 site visit, indicate that without irrigation a single cut of hay can be taken from the fields in most years. Actual harvested hay yields are unknown but likely in the 3-4 tonne/ha (1.5 – 2 t/ac) range based on production estimates for Class 2-3 lands in a Class 3A climate area. Forage yields would improve with irrigation and it is possible that 2 or even 3 cuts of hay could be taken in some years.

2.1.5 Summary of past use

The subject lands are part of the historic Rutledge Farm and the upper and lower terrace fields have historically been used for forage and grain production, including cut hay and (likely) canola, oats and/or wheat. The property has been leased to a Peace River Valley farm operator for the past several years and the hayfields are in an alfalfa, timothy, tall fescue mix, commonly used in the Peace River Valley. None of the fields have been, or are, irrigated.

2.1.6 Noxious Weeds

An inventory of noxious weed presence on the property was conducted in 2015. Seven noxious weeds were documented within the property: annual sow thistle (S*onchus oleraceus)*, Canada thistle (*Cirsium arvense),*common tansy (*Tanacetum vulgare),* oxeye daisy (*Leucanthemum vulgare),* perennial sow thistle (*Sonchus arvensis),* scentless chamomile (*Matricaria maritime),* wild oats (*Avena fatua).* Control of the noxious weeds will be the responsibility of the leaseholder.

2.2 Infrastructure on site

2.2.1 Access

The Rutledge property is located about 12 km north-east of Hudson's Hope. Highway 29 bisects the property and Farrell Creek Road lies along the eastern boundary. Field 1 is accessed via a short driveway at the intersection of Hwy 29 and Farrell Creek Road; Field 2 is accessed via a gate and short gravel driveway off Hwy 29. There are no buildings on the property south of north of Highway 29.

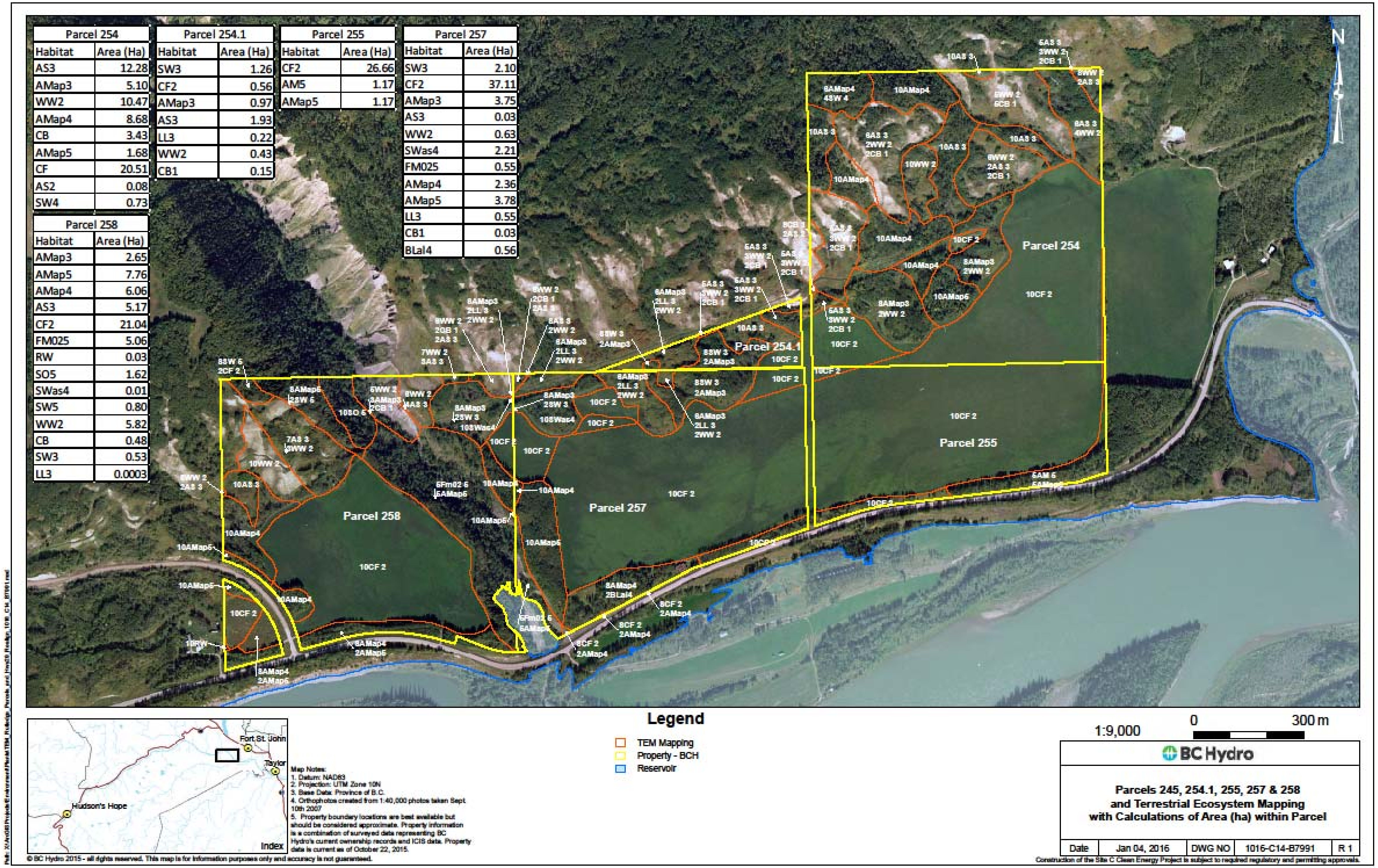
2.2.2 Water and fencing

There are no irrigation improvements on the property north of Hwy 29. The fields north of Highway 29 are not fenced.

2.3 Vegetation Resources on the Property

2.3.1 Ecosystems Present

Terrestrial Ecosystem Mapping was completed for the Property as part of the Site C Environmental Assessment (Hilton *et al.* 2013). Thirteen ecosystems (habitats) were mapped on the Property (Figure 2). Table 2 summarizes the amount of each ecosystem mapped within the Property. The grasslands, mapped as Fuzzy-spiked wildrye-Wolf Willow (WW) are classified as a sensitive ecological community (Hilton *et al.* 2013). None-of the ecosystems on the property are classified as at risk (Hilton *et al.* 2013).



Parcel 254

Habitat	Area (Ha)
AS3	12.28
AMap3	5.10
WW2	10.47
AMap4	8.68
CB	3.43
AMap5	1.68
CF	20.51
AS2	0.08
SW4	0.73

Parcel 254.1

Habitat	Area (Ha)
SW3	1.26
CF2	0.56
AMap3	0.97
AS3	1.93
LL3	0.22
WW2	0.43
CB1	0.15

Parcel 255

Habitat	Area (Ha)
CF2	26.66
AM5	1.17
AMap5	1.17

Parcel 257

Habitat	Area (Ha)
SW3	2.10
CF2	37.11
AMap3	3.75
AS3	0.03
WW2	0.63
SWas4	2.21
FM025	0.55
AMap4	2.36
AMap5	3.78
LL3	0.55
CB1	0.03
BLal4	0.56

Parcel 258

Habitat	Area (Ha)
AMap3	2.65
AMap5	7.76
AMap4	6.06
AS3	5.17
CF2	21.04
FM025	5.06
RW	0.03
SO5	1.62
SWas4	0.01
SW5	0.80
WW2	5.82
CB	0.48
SW3	0.53
LL3	0.0003

Figure 2. Habitats on the Rutledge property.

Table 2. Habitats mapped within the Rutledge property (Hilton et al. 2013).

Habitat	TEM Code	Structural Stage	Area (ha)
White Spruce/Trembling Aspen-Creamy Peavine (seral Association)	AMap	3	12.47
	AMap	4	17.10
	AMap	5	15.13
White Spruce/Trembling Aspen-Step Moss	AM	5	1.17
White Spruce/Trembling Aspen-Soopolallie	AS	2	0.08
	AS	3	19.41
White Spruce-Wildrye-Peavine	SW	3	3.89
	SW	4	0.73
	SW	5	0.8
White Spruce-Soopolallie (seral association)	SWas	4	2.22
Black cottonwood/White Spruce-Red-osier dogwood	FM02	5	6.36
Fuzzy-spiked Wildrye – Wolf-willow	WW	2	17.53
Cutbank	CB	1	4.09
Cultivated field (including pastures)	CF	2	104.27
Rural	RW		0.03
White Spruce-Currant-Oak fern	SO	5	1.62
Lodgepole pine - Lingonberry - Velvet-leaved blueberry	LL	3	0.77
Subalpine Fir/Trembling Aspen-Labrador tea	BLal	4	0.56

2.3.2 Rare Plants

Inventories for rare plants were not conducted in this area during baseline surveys. Rare plant surveys were conducted within the Highway 29 realignment corridor in 2015, during which two rare vascular plant species and two rare lichens were documented (Table 3). An additional 14 rare plants may occur within portions of the property not surveyed based on the habitats present (Table 3). A rare plant survey for the remainder of the property is planned for 2016.

Table 3. Rare plants that could occur on the Rutledge property.

Common Name	Taxon	BC List	Documented on property
VASCULAR PLANTS			
Herriot's sage	*Artemisia herriotii*	Red	
spike-oat	*Avenula hookeri*	Blue	
plains reedgrass	*Calamagrostis montanensis*	Blue	Yes
Torrey's sedge	*Carex torreyi*	Blue	
dry-land sedge	*Carex xerantica*	Blue	
tawny paintbrush	*Castilleja miniata var. fulva*	Red	Yes
Drummond's thistle	*Cirsium drummondii*	Blue	
old man's whiskers	*Geum triflorum var. triflorum*	Red	
Davis' locoweed	*Oxytropis campestris var. davisii*	Blue	
slender penstemon	*Penstemon gracilis*	Red	
Drummond's campion	*Silene drummondii var.*	Blue	

	drummondii		
slender wedgegrass	*Sphenopholis intermedia*	Blue	
LICHENS			
protracted tarpaper	*Collema multipartitum*	Red	
peppered pelt	*Peltigera evansiana*	Red	
immaculate rosette	*Physcia stellaris*	Blue	Yes
threadbare ribbon	*Ramalina sinensis*	Blue	Yes
snow-white dimple	*Squamarina lentigera*	Red	

2.4 Vegetation Management

2.4.1 Protection of south facing grassland and forested slopes

No livestock grazing will be permitted on the Property.

The management regime for Fields 1 and 2 will retain the suitability and availability of the adjacent steep south facing grassland slopes for ungulate use in winter, late fall and early spring and maintain the suitability and availability of the Dry Creek ravine for birds, bats and amphibians.

Prescribed burns are used in the Peace Region to rejuvenate the grasslands and increase their value and suitability for ungulates. BC Hydro will work with Forest Lands and Natural Resources to determine if prescribed burns are a suitable management tool for the south facing grassland slopes above Field 2.

2.4.2 Creation of Old field habitats

Fields 1a, 2a, 2b and 2c (Figure 1), will be fenced off from Fields 1 and 2 managed to provide old field-grassland habitat. Vegetation height within these areas will be 0.3 to 2.1 meters with the objective of providing breeding habitat for Short-eared Owl, Northern Harrier, Sharp-tailed Grouse and Common Nighthawk. Vegetation within the old field areas will be maintained through periodic mowing on a rotational basis such that at least one area is maintained in old field status within the property at all times (i.e. one old field is mowed every four (4) years).

2.4.3 Riparian vegetation plantings

A 15 meter riparian vegetation zone will be established along the edge of the reservoir in parcels 256, 257 and 259 through planting of native shrubs and trees outside the five-year beach line (Figure 2). The five-year beach line is the predicted extent of shoreline retreat at the maximum normal reservoir level five years after impoundment (EIS, Volume 2 Appendix B, Part 2).

The objective of establishing the 15m riparian vegetation zone is to replace deciduous and coniferous riparian vegetation lost due to reservoir creation. A mix of live staked Balsam Poplar (60%), willow (30%) and Red-osier Dogwood (10%) will be planted at densities of 4,500 stems/ha. In the long term, the vegetation within this zone is expected provide protection against additional shoreline erosion and provide riparian habitat with the attributes needed to support rare plants, non-wetland migratory birds and species at risk.

3.0 WILDLIFE MANAGEMENT OBJECTIVES

Management of the Property will aid in fulfilling the conditions outlined in Section 1.1 above.

3.1 Target species

Management of the Property will target maintaining, creating and managing habitat (breeding, feeding, migration and winter) for:

- non-wetland migratory birds identified as species of conservation concern for Bird Conservation Region 6 by Environment Canada (2013)
- species at risk documented in similar habitats in the project area
- ground nesting raptors (Northern Harrier, Short-eared Owl)
- ungulate winter range

Should additional species of conservation concern for Bird Conservation Region 6 or species at risk be documented on the property, the management plan will be reviewed and revised as required. Table 4 summarizes the species expected to occur on the Rutledge property lands based on their habitat preferences and occurrences documented in the baseline data (Keystone 2013).

Table 4. Avian species expected to occur on the Rutledge property lands by habitat.

Species	Status in Area	Distribution of each species within habitats occurring on the Rutledge Property													
		AM	AM:ap	AS	BL:al	CB	CF	Fm02	LL	RO	RW	SO	SW	SW:as	WW
Non-wetland migratory bird species of conservation concern for BCR 6															
Alder Flycatcher	mb														
American Kestrel	mb						X								X
American Three-toed Woodpecker	mb	X	X		X			X				X			
Baltimore Oriole	mb	X			X			X			X				
Bank Swallow	mb					X									
Barn Swallow	mb										X				
Bay-breasted Warbler	mb	X						X				X			
Black-billed Magpie	y			X			X				X				X
Blackpoll Warbler	mb	X										X			
Black-throated Green Warbler	mb	X	X		X			X				X			
Bohemian Waxwing	y	X	X					X				X	X	X	
Boreal Chickadee	y	X	X		X			X				X			
Brown Creeper	mb	X										X			
Canada Warbler	mb	X	X									X	X		
Cape May Warbler	mb	X						X				X	X		
Clay-colored Sparrow	mb			X			X								X
Common Nighthawk	mb						X				X				X

Species	Status in Area	Distribution of each species within habitats occurring on the Rutledge Property													
		AM	**AM:ap**	**AS**	**BL:al**	**CB**	**CF**	**Fm02**	**LL**	**RO**	**RW**	**SO**	**SW**	**SW:as**	**WW**
Common Yellowthroat	mb														
Connecticut Warbler	mb	X							X				X		
Eastern Phoebe	mb						X				X				X
Le Conte's Sparrow	mb						X								X
Least Flycatcher	mb	X	X		X			X			X	X			
Mourning Warbler	mb		X		X			X	X			X	X	X	
Nelson's Sparrow	mb														
Northern Flicker	mb	X	X	X	X			X	X			X	X	X	
Northern Shrike	mb			X			X				X				X
Olive-sided Flycatcher	mb							X							
Pileated Woodpecker	y	X	X					X				X			
Sharp-tailed Grouse	y	X	X	X	X		X	X	X			X	X	X	X
Western Tanager	mb	X							X				X		
Western Wood-Pewee	mb	X						X	X			X	X		
White-throated Sparrow	mb			X			X				X				X
White-winged Crossbill	y	X							X			X	X		
Yellow-bellied Sapsucker	mb	X	X									X	X	X	
Greater Yellowlegs	mb														
Killdeer	mb						X				X				
Upland Sandpiper	mb						X				X				X
Other non-wetland migratory birds present within the Project Area															
American Pipit	mb	X					X			X					
American Redstart	mb	X	X		X		X	X	X			X	X	X	X
American Robin	mb	X	X	X	X		X	X	X		X	X	X	X	X

Species	Status in Area	Distribution of each species within habitats occurring on the Rutledge Property													
		AM	AM:ap	AS	BL:al	CB	CF	Fm02	LL	RO	RW	SO	SW	SW:as	WW
Black and White Warbler	mb	X	X		X		X	X	X			X	X	X	
Black-capped Chickadee	y	X		X			X	X	X		X	X	X		
Blue-headed Vireo	mb	X					X	X	X			X	X		
Calliope hummingbird	mb														
Cassin's vireo	mb											X			
Cedar Waxwing	mb	X		X			X	X	X		X	X	X		
Chipping Sparrow	mb	X	X		X		X	X	X		X	X	X	X	X
Cliff Swallow	mb					b				X					
Common Grackle	y	X	X	X	X		X	X	X			X	X	X	X
Dark-eyed Junco	y	X	X	X	X				X			X	X	X	
Dusky Flycatcher	mb	X	X		X				X			X	X		
Eastern Kingbird	mb	X	X	X								X			
Evening Grosbeak	y	X	X					X				X	X	X	
Fox sparrow	mb	X	X	X	X		X	X	X		X		X	X	X
Golden-crowned Kinglet	mb	X					X	X	X			X	X		
Grey Catbird	mb	X													X
Grey Crowned Rosy Finch	mb					X				X	X				
Hairy Woodpecker	mb	X					X	X	X			X	X		
Hammond's Flycatcher	mb	X	X					X				X	X	X	
Hermit Thrush	mb	X		X		X	X	X	X			X	X		X
House Sparrow	y						X				X				
House Wren	mb	X	X	X			X		X		X		X	X	X
Lincoln’s Sparrow	mb	X	X	X	X		X	X	X		X	X	X	X	X
Magnolia Warbler	mb	X	X	X	X			X	X			X	X		

Species	Status in Area	Distribution of each species within habitats occurring on the Rutledge Property													
		AM	AM:ap	AS	BL:al	CB	CF	Fm02	LL	RO	RW	SO	SW	SW:as	WW
Northern Rough-winged Swallow	mb					X	X								X
Orange-crowned Warbler	mb	X	X	X	X	X	X	X	X		X	X	X	X	X
Ovenbird	mb	X	X		X		X	X	X			X	X	X	X
Pacific Wren	mb														
Pacific Slope Flycatcher	mb	X		X				X	X			X	X		
Pine Siskin	mb	X		X		X	X	X	X		X	X	X		X
Purple Finch	mb	X		X		X	X	X	X		X	X	X		X
Red Crossbill	mb	X										X	X		
Red-breasted Nuthatch	y	X		X	X				X			X	X		
Red-eyed Vireo	mb		X	X	X	X	X	X			X	X		X	X
Rose-breasted Grosbeak	mb	X	X	X	X	X	X	X	X			X	X	X	X
Ruby-crowned Kinglet	mb	X					X	X	X			X	X		
Ruby-throated Hummingbird	mb	X	X												
Savannah Sparrow	mb	X	X	X	X		X	X			X	X	X	X	
Says Phoebe	mb	X	X												
Song Sparrow	mb	X	X	X		X	X	X				X	X	X	X
Swainson's Thush	mb	X	X	X	X	X	X	X	X		X	X	X	X	X
Tennessee Warbler	mb	X	X	X	X		X	X	X		X	X	X	X	
Townsend's Solitaire	mb	X	X					X	X	X			X	X	X
Varied Thrush	mb	X	X		X		X	X				X	X	X	
Vesper Sparrow	mb		X	X			X				X			X	X
Violet-green Swallow	mb	X	X	X		X	X						X	X	
Warbling Vireo	mb	X	X	X	X	X	X	X	X			X	X		X

Species	Status in Area	Distribution of each species within habitats occurring on the Rutledge Property													
		AM	AM:ap	AS	BL:al	CB	CF	Fm02	LL	RO	RW	SO	SW	SW:as	WW
White-breasted Nuthatch	y		X					X						X	
White-crowned Sparrow	mb	X	X	X			X		X				X	X	
Yellow-rumped Warbler	mb	X	X	X	X	X	X	X	X		X	X	X	X	
mb=migrant, breeds in Project areas; y=year round resident breeds in Project areas; X=habitats used for breeding and/or migration															

3.2 Wildlife Management Activities

Management for non-wetland migratory birds, species at risk and ungulates will be achieved through:

- Establishing and maintaining old field habitats within Fields 1a, 2a, 2b and 2c (Figure 1) to provide nesting habitat for Short-eared Owl and Northern Harrier as described in Section 2.4.2 above.
- Protecting the forested habitat along and adjacent to Dry Creek from additional disturbance
    - fencing will be used to divide the area of cultivated field from the forested habitat
    - this part of the property will not be included in the lease and the leaseholder will not be allowed to access or use this area
- Protecting native grassland and early seral habitats from additional disturbance
    - this part of the property will not be included in the lease and the leaseholder will not be allowed to access or use this area
    - conducting, as required, prescribed burns of grassland habitats (steep south facing slopes) to rejuvenate native grassland and early seral habitats and maintain and enhance their value as ungulate winter range

4.0 AGRICULTURAL MANAGEMENT OBJECTIVES

The overall agricultural management objective is to maintain and enhance forage production within Fields 1 and 2 on the upper terrace above realigned Hwy 29.

No livestock grazing is proposed as the fields are not fenced.

Typically, Peace River hayfields and pastures are operated on an 8-10 year rotation designed to maintain optimal forage production levels – a greenfeed crop (such as oats) for up to 2 years, hay for up to 6 years, and pasture for up to 2 years.

Field 1 and 2 have a good alfalfa, timothy, tall fescue stand and should not require renovation for a few years, but would benefit from regular fertilizing, addition of organic matter (manure or green maturing) and perhaps scarification and over-seeding.

The proposed cultivation, weed treatment, fertilizing and seeding specifications for Fields 1 and 2 will be reviewed annually with the lessee.

Field 1a, 2a, 2b and 2c will be managed to provide old field-grassland habitat as discussed in Section 2.4.2 above.

4.2 Weed Management Plan

Results of the 2015 noxious weed inventory will be provided to the leaseholder for inclusion in their 2016 weed management plan. BC Hydro will assist the leaseholder in development of the weed management plan through its Agricultural Leaseholder Noxious Weed Treatment Program. Through this program, leaseholders can access expert advice from a noxious weed control specialist in planning and implementing noxious weed control. After an audit by the weed control specialist of the efficacy of any chemical treatments, BC Hydro reimburses the leaseholder the cost of chemicals used.

5.0 ADDITIONAL REQUIREMENTS AND/OR RECOMMENDATIONS

- No polypropylene twine or wire is to be used for bailing hay on site. Only degradable twine is to be permitted
- Hunting and trapping will not be permitted on the property
- Honey bees will be allowed

6.0 MONITORING AND FOLLOW-UP TO MANAGEMENT OF PROPERTY

6.1 Lessee record keeping requirements

At a minimum the lease holder will keep records of the following:

- Crops grown including: date of planting and harvest
- Weed treatment(s) including: area treated, date of treatment, chemicals applied, rate of application, treatment efficacy and plans for following year's treatment
- Wildlife observations, including any issues with wildlife.

6.2 Monitoring by BCH

BC Hydro will conduct the following surveys and monitoring observations on the Property:

- Breeding bird surveys
- Surveys of migrating birds (e.g. March-April and September);
- Monitoring of general property conditions (TBD).

6.3 Annual meetings to discuss/update management plans

To be determined in consultation with leaseholder.

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SITE C CLEAN ENERGY PROJECT

MARL FEN WETLAND PROPERTY MANAGEMENT PLAN

Prepared by:

P. Christie-Talisman Resource Consultants
Darryl Kroeker Ducks Unlimited Canada
and
K. Anré McIntosh-BC Hydro

May 2015

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1.0 INTRODUCTION

In January, 2014, BC Hydro acquired a 637 ha (1574 acre) property (the Property) consisting of three (3) parcels about 2 km west of Hudson's Hope, just north of the airport (**Figure 1**). The legal descriptions of the parcels comprising the Property are:

- PID: 013-335-553 Legal: Parcel A (T41614) of District Lot 1200 Peace River District
- PID: 014-789-736 Legal: District Lot 1211 Peace River District, Except the West 80 Feet
- PID: 024-828-203 Legal: Block A District Lot 1210 Peace River District

The Property lies within the Provincial Agricultural Land Reserve (ALR).

The Property was purchased for the purposes of wetland and wildlife mitigation for the Site C Clean Energy Project ("the Project") because it contains 104 ha (256 acres) of wetland (**Figure 1)** surrounded by 422 ha (1042 acres) of hay fields and pasture (of which 386 ha (849 ac) are cultivated) and 112 ha (276 acres) of forest. Vegetation and wildlife surveys conducted in 2012 prior to the purchase of the Property confirmed habitats on the Property were being used by a range of wildlife including species at risk and bird species of conservation concern for Bird Conservation Region 6 (Environment Canada 2013) that were identified as potentially being adversely affected by Project construction and operations (BC Hydro 2013).

The current values of the Property as wildlife habitats are a reflection of past management practices. An understanding of this past use is summarized below and will be used in developing the long-term management plan.

1.1 Plan objectives

This document outlines how the Property will be managed to protect the wetland, maintain and enhance wildlife habitat values and maintain agricultural production.

Management of these lands will assist BC Hydro in fulfilling the following conditions of the Environmental Certificate:

- **Federal condition 10**: Mitigation of non-wetland migratory bird habitat
- **Federal condition 11**: Mitigation for wetland habitat use by migratory birds and species at risk and compensation to address the loss of wetland area and functions supporting migratory birds and species at risk
- **Federal condition 16**: Address and monitor effects of the Project on species at risk, at-risk and sensitive ecological communities and rare plants.

This dynamic plan will be amended from time-to-time based on Property monitoring, further studies and refinement of management objectives.

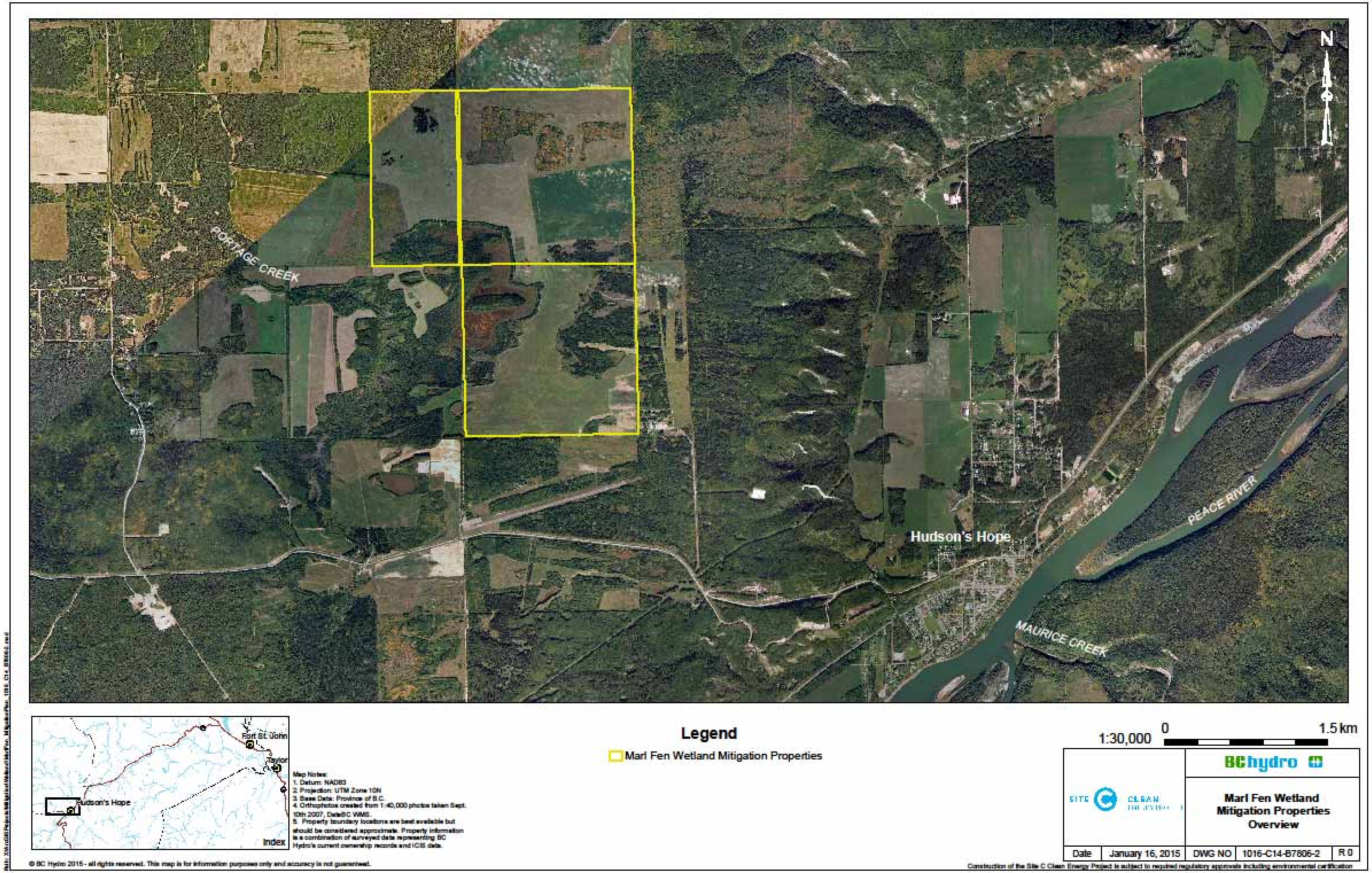

Figure 1. Location of Marl Fen Property

1.2 Condition of the property

In 2014 the Property was visited in June and September. The objective of the June visit was to discuss previous use of the property with individuals who had recently farmed the Property and to conduct a site visit to inform development of this plan. During the site visit notes were taken regarding the conditions of fields, condition of the wetland, fencing type, location and status of on-site infrastructure. A second site visit was conducted at the end of September. The objective of the second visit was to tour the property with the leaseholder and discuss the condition of the cattle water sources and identify improvements that could be made to these sources.

The June site visit confirmed the fields and fencing were generally in good condition, although several fields will require renovation over the next few years and some fencing and gate repairs are also required. The wetland showed little sign of having been used by cattle and it was determined that fencing the perimeter of the wetland, to exclude cattle, was not required for the 2014 grazing season provided stocking levels remained in line with historic levels.

In the first week of August, 2014, 225 head of cattle were put on site. At the end of August the lease holder informed BC Hydro that the dugouts were drying up as a result of the drought conditions. A site visit was conducted at the end of September to assess the condition of the dugouts and to identify measures to improve the dugouts and water sources along the edge of the wetland.

During the September site visit it became evident that the cattle were using three locations at the edge of the wetland as their primary water source and travelling fairly deep into the wetland to access water and forage. The edge of the wetland around the watering sites was heavily impacted by cattle. It was also noted that the grazing of the fields was uneven with higher grazing intensity near the wetland water sources and decreasing as distance from water increased.

The following recommendations were developed as a result of the September site visit:

- The wetland would be fenced off to exclude cattle
- Extracting water from the wetland is required to provide cattle with water, particularly in dry years
- Infrastructure improvements would need to be made at the water channel at the edge of the wetland
- A second water source would be developed at the edge of the wetland
- Dugouts in the fields would be refurbished through removal of accumulated organic matter
- All but one of the dugouts would be fenced to prevent direct access by cattle
- External troughs would be used to provide water to cattle at dugouts
- Cattle would access water at the largest dugout via a fenced ramp running into the dugout
- Additional water sources in the fields may need to be developed in the future to support cattle grazing.

2.0 BASELINE AGRICULTURAL CONDITIONS

2.1 Soils

The level to gently sloping upland fields, lying at elevations between 680-700 m[1], are mapped as dominantly (70%) Beryl (BY) soils classified as Brunisolic Gray Luvisols developed on a thin layer of sandy to loamy alluvium that generally overlies calcareous clay tills (BC Soil Survey 1986). The texture of the generally thin (10 to 20 cm) upper horizon ranges from fine sand to silt.

Beryl soils are moderately well drained, slowly pervious, and have a humid water regime. The typical soil profile has a thin upper (Ae) horizon, a yellowish brown, loamy (Bm) horizon, and a second Ae horizon that overlies a more finely textured (Bt) horizon. The C horizon is generally fine textured (clayey) and moderately calcareous.

About 30% of the upland area is mapped as Lynx (LY) soils, also classified as Brunisolic Gray Luvisols developed on fine sandy to loamy, strongly calcareous glaciofluvial deposits. These soils occur intermittently at elevations below 750 m along the upper terraces adjacent to the Peace River Valley and its main tributaries. The macro topography is level to gently sloping overall, with intermittent ridges of cross-bedded fine sandy surface sediments that have characteristics consistent with soils reworked by wind action (aeolian materials).

Lynx soils are well drained, moderately pervious, and have a humid water regime. The typical soil profile comprises brown sandy loam Bm and Ae horizons, and a thin loamy Bt horizon, overlying a calcareous Ck horizon at about 30 cm depth.

The published soils mapping (BC Soil Survey 1986) states that Beryl soils are often associated with Eaglesham organic soils which occur in poorly drained, shallow depressions interspersed throughout the upland areas adjacent to the Peace River Valley. These fen soils are classified as poorly drained Terric Mesisols developed on sedge peats. A brief field reconnaissance suggests that shallow organic soils, with dominantly sedge cover, occur in the depressional channels interspersed throughout the fields, particularly in the northeast portion of the site. Field tests confirmed that the shallow relief ridges along some of the channels exhibit soil textures typical of Aeolian deposits.

The wetland, covering the depressional southwesterly portion of the property, is mapped as Kenzie (KZ) organic soils classified as Terric Mesisols developed from sphagnum moss peats (BC Soil Survey 1986). The strongly acid peat is generally between 1 to 2 m deep and is saturated most of the year by acidic water. The surface horizons (Of) are fibric and the lower horizons are partially (mesic) decomposed (Om). The peats overlie mineral sub-soils. Field observations along the excavated wetland reservoir at Dugout Site #1 indicate the sub-soils at the edge of the wetland are fine sandy loams, with low silt and clay content.

[1] LiDAR data. Acquired 2006

2.2 Climate Capability for Agriculture

The subject lands, including the large wetland and upland fields, are mapped within climate capability for agriculture Class 3G, with the major limitation of insufficient heat units (G). Growing degree-days (GDD) range from 1030 to 1169, May to September precipitation is about 250 mm, and the freeze free period (FFP) is 60-74 days (BC Ministry of Environment, 1983). The climatic moisture deficit is about 148 mm/year (based on the 40 year mean).

2.3 Land Capability for Agriculture

The available land capability for agriculture mapping (BCLI, 1979) pre-dates the 1983 soil mapping, and does not reflect the most current soils information (BC Ministry of Environment and Ministry of Agriculture and Food 1983). The forage fields in the upland areas are mapped as 70% Class 4 with topography and low moisture holding capacity limitations, and 30% Class O5 with wetness limitations. The Class O5 areas could potentially be improved to Class O4 with onsite drainage works. This class is assigned without consideration of the economic feasibility of these improvements. The more recent soils mapping shows the upland fields as 30% Lynx (mineral) soils, which are not organic, and would likely be rated as Class 3 (the base climate capability rating) as they are finer textured than the Beryl soils so do not have the low moisture holding capacity limitation and are depressional to gently sloping. Based on limited field observations to date, the shallow, depressional channels interspersed throughout the upland fields are poorly drained, shallow sedge peat soils that would be Class O5 in their unimproved (not drained) state.

The wetland, mapped as Kenzie soils, is rated as unimproved Class O4 improving to O3 with local drainage works. This class is assigned without consideration of the economic feasibility of these improvements. The more recent soils mapping indicates that the depressional areas in which Kenzie soils occur are subject to local frost pooling and that these soils have little potential for agriculture (BC Ministry of Environment and Ministry of Agriculture and Food 1983)

2.4 Crop Suitability

The upland field areas are suitable for most hay and grain crops grown in the Peace Region, with the Class 3 climate severely limiting the range of other crops, such as vegetables, that could be grown commercially. The climatic moisture deficit (~148 mm) and the lack of suitable irrigation water sources further limit the amount of forage that could be produced: cut hay would be limited to one crop per year, with a limited amount of after-math grazing potential.

3.0 PAST USE CONDITIONS AND RECENT USE

The total cultivated area within the property is 386ha. Table 1 outlines the cultivated area by field (see Figure 3 below for field numbers).

Table 1. Cultivated areas within fields

Field Number	Cultivated area (ha)
1	97
2	30
3	44
4	30
5	50
6	73
7	62
Total cultivated area	**386**

The subject lands have historically been used for forage production including cut hay and pasture, and have provided seasonal grazing for 300 to 400 head of cattle. Horses have also been pastured on the site in the past. The fields would have been grazed on a seasonal rotation, with light after-math grazing of cut hayfields.

Former operators have stated that an annual, single cut of hay was taken from most fields. Actual harvested hay yields are unknown but based on production estimates for Class 3-4 lands in a Class 3 climate area, yields are estimated to be in the 2 tonne/ha (0.8 t/ac) range. Since 2007 fields have been used as pasture, primarily for cattle, although there appears to have been limited horse (e.g. <10 head) grazing. Traditionally, cattle have been placed onsite between May 24 and June 10, and taken off between mid-August and mid-November, depending on moisture and grass conditions. The wetter the year, the better the vegetation growth and the longer the fields can support cattle.

Based on field observations and interviews with past operators, the fields were periodically replanted. The primary grass species that have been planted include mixes of Timothy, creeping red fescue, orchard grass, meadow bromegrass and alfalfa.

With the exception of the more recently renovated fields (shown on **Figure 3**), most fields appear to be over-mature in terms of forage yields and would benefit from cultivation and reseeding (renovating). The fields along the northerly Property boundary appear to be the oldest in terms of cultivation and seeding history and have reverted to “old field habitat”.

3.1 Weed issues

3.1.1 2014 Inventory and Control

A weed inventory of the Property was completed June 6-9, 2014. Canada thistle (*Cirsium arvense)*, perennial sow thistle (*Sonchus arvensis)* and yellow hawkweed (*Hieracium pratense*) were documented. The only significant infestation identified was in the northeast recently cultivated field. **Figure 2** outlines the location of the infestations within the property.

3.1.2 2014 Treatment

The infestations were treated four times in 2014 with aminopyralid, 2,4-D amine (**Table 2**). On October 3rd a post-treatment audit was conducted. During the audit, all noxious weed infestations treated were surveyed to assess the efficacy of the treatments. The audit confirmed that the chemicals had effectively treated the plants: no live Canada thistles (all were dead or dying) and no perennial sow thistles were observed during the final audit.

Table 2. Summary of 2015 noxious weed treatments

Baseline Survey / Walkthrough	Herbicide Application	Post treatment Inspection	Final Weed Audit
June 4 - 9	-	N/A	-
-	July 26 aminopyralid – 0.5 L/ha, 7.0 ha	Aug. 8	-
-	July 27 aminopyralid – 0.5 L/ha, 2.0 ha	Aug. 10	-
-	Aug. 8 2,4-D Amine 600 – 1.48 L/ha, 0.135 ha	Aug. 25	-
-	Aug. 10 2,4-D Amine 600 – 1.5 L/ha, 0.70 ha	Aug. 25	-
Sep. 5	-	-	-
-	-	-	Oct. 3

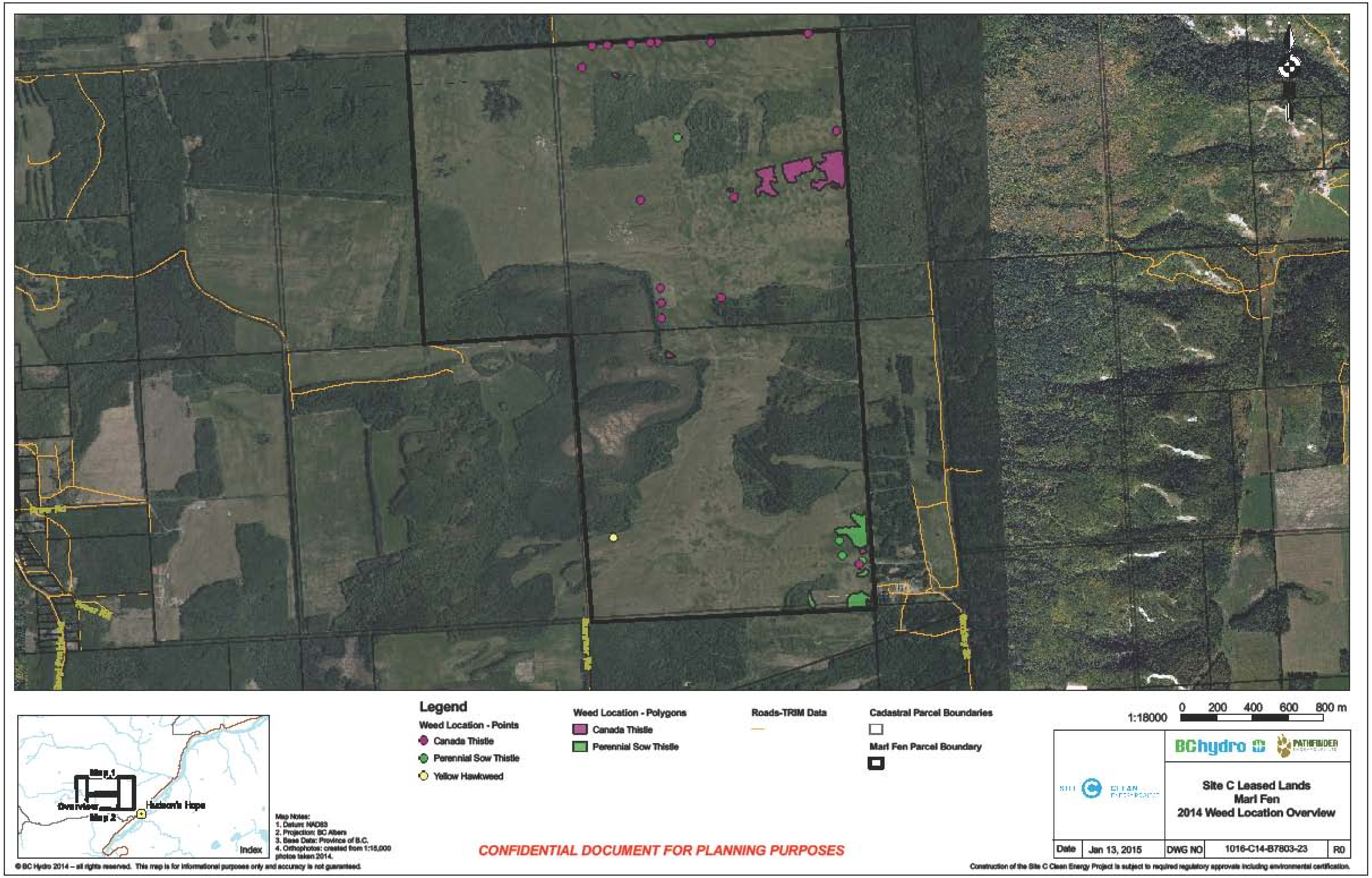

Figure 2. Location of noxious weed infestations.

Source: Pathfinder Endeavours 2015

4.0 INFRASTRUCTURE ON SITE

4.1 Access

The Property is located just north of the Hudson's Hope Airport, and can be accessed from either the north or west. Access from the north is via Beryl Prairie, Wegen, Boring and Stove Roads. Access from the south is via Canyon Drive and the gravel road at the west end of the airport. A relatively well graded bare soil track runs between the wetland and upland forage fields, to the vicinity of the old corrals in the mid-Property. Poorly graded internal tracks are used to access the fields, including the north fields and northerly Property boundary.

4.2 Buildings

There are no residences on the property. There is one small dilapidated shed (**Appendix 1: Photo 1**) on the Property, near the three steel silos used for grain and seed storage (**Appendix 1: Photo 2**). These are located near the south west entrance to the site. Apparently, orchard grass seed is stored in at least one of the silos.

4.3 Water

A shallow reservoir has been excavated along the mid-western boundary of the wetland, Dugout #1 (**Appendix 1: Photo 3, Figure 3**). The reservoir was constructed several years ago[2] to provide water for cattle. Water is extracted from this channel via a seasonal (portable) pump system into troughs located along the edge of the field.

Additional livestock water is provided at 6 shallow dugouts located throughout the Property, including 2 more along the westerly margin of the wetland, as shown on **Figure 3**.

[2] The date of construction was not provided by the previous property owner.

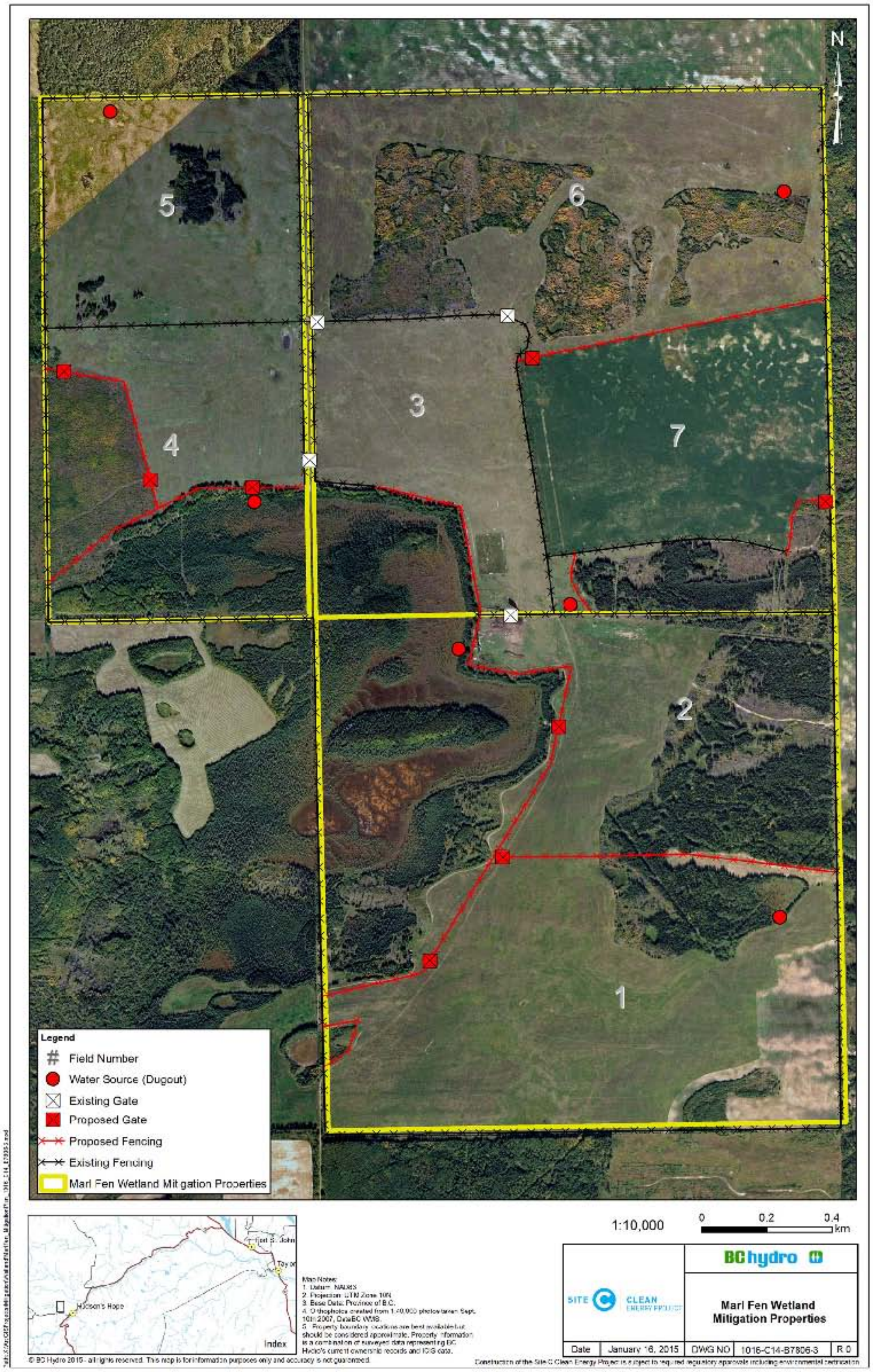

Figure 3. Location of cattle watering sites

There are no known dug or drilled wells on the property.

4.4 Fencing and Corrals

The entire periphery of the Property is fenced along the property lines and internal field fencing is also in place, as shown on **Figure 3**. Fencing is primarily 4 strand barb wire, generally in good repair (**Appendix 1: Photo 4**), with sections that are either down from wear and tear or trespass vandalism (**Appendix 1: Photo 5**). Existing gate locations are also shown on **Figure 3**. The main access gates are metal and field gates are barbed slip wire. Some gates have been damaged or removed (**Appendix 1: Photo 6**).

Old timber plank corrals, a loading ramp, and a high page wire fenced hay storage site, generally in disrepair, are located in the vicinity of dugout #1 (**Appendix 1: Photo 7**).

5.0 BASELINE VEGETATION RESOURCES ON THE PROPERTY

Vegetation data presented in this management plan were collected during surveys of the property in 2012 and 2014. Detailed descriptions of the methods and results can be found in Simpson *et al.* 2014 which is appended to this management plan.

5.1.1 Ecosystems present

Terrestrial Ecosystem Mapping was completed for the Property in 2014. Fifteen ecosystems (habitats) were mapped (**Figure 4-1 and Figure 4-2**). **Table 2** summarizes the amount of each ecosystem mapped within the Property.

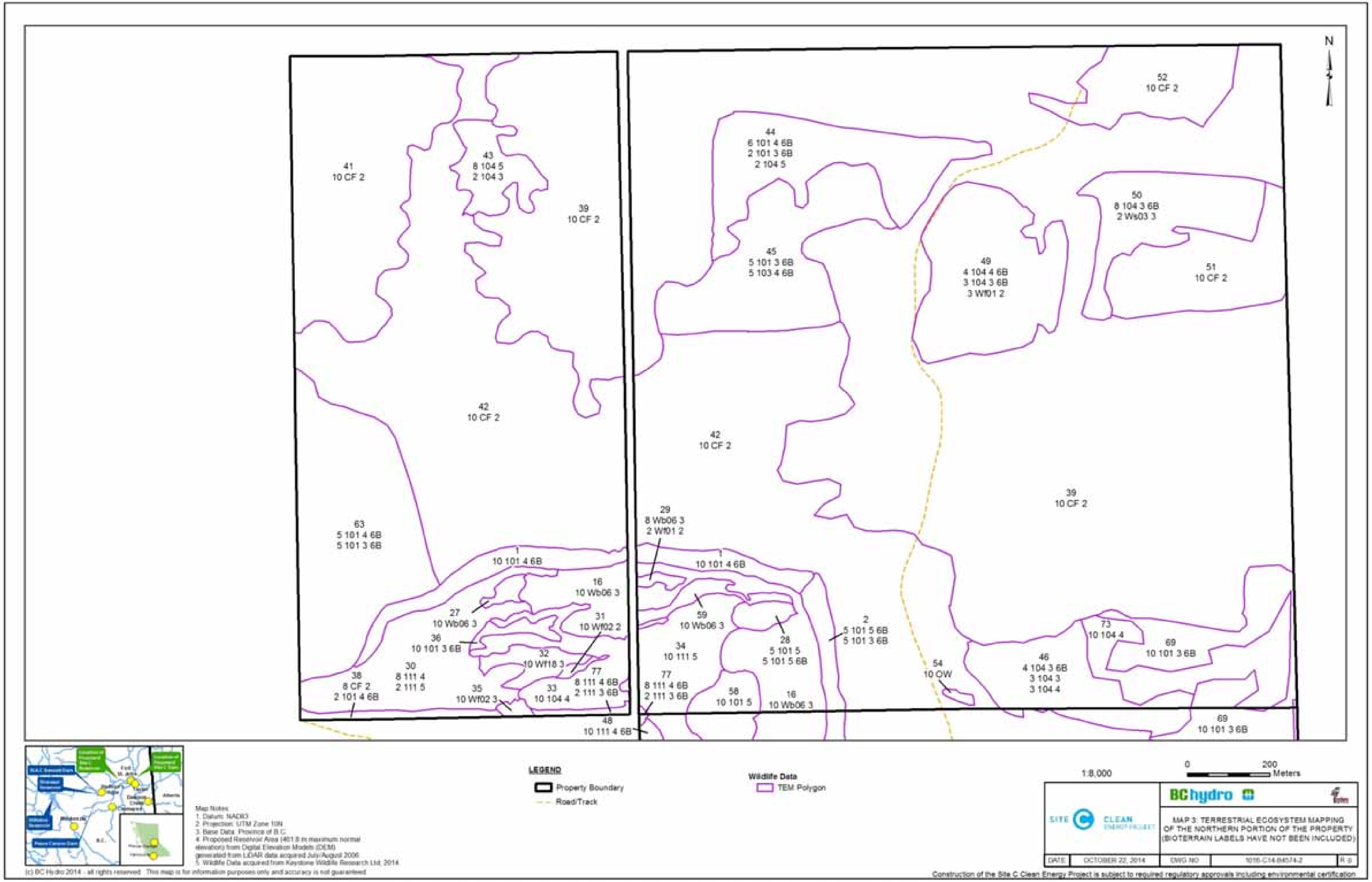

Figure 4. Terrestrial Ecosystem Map of Marl Fen Property: North

Source Simpson et al. 2014

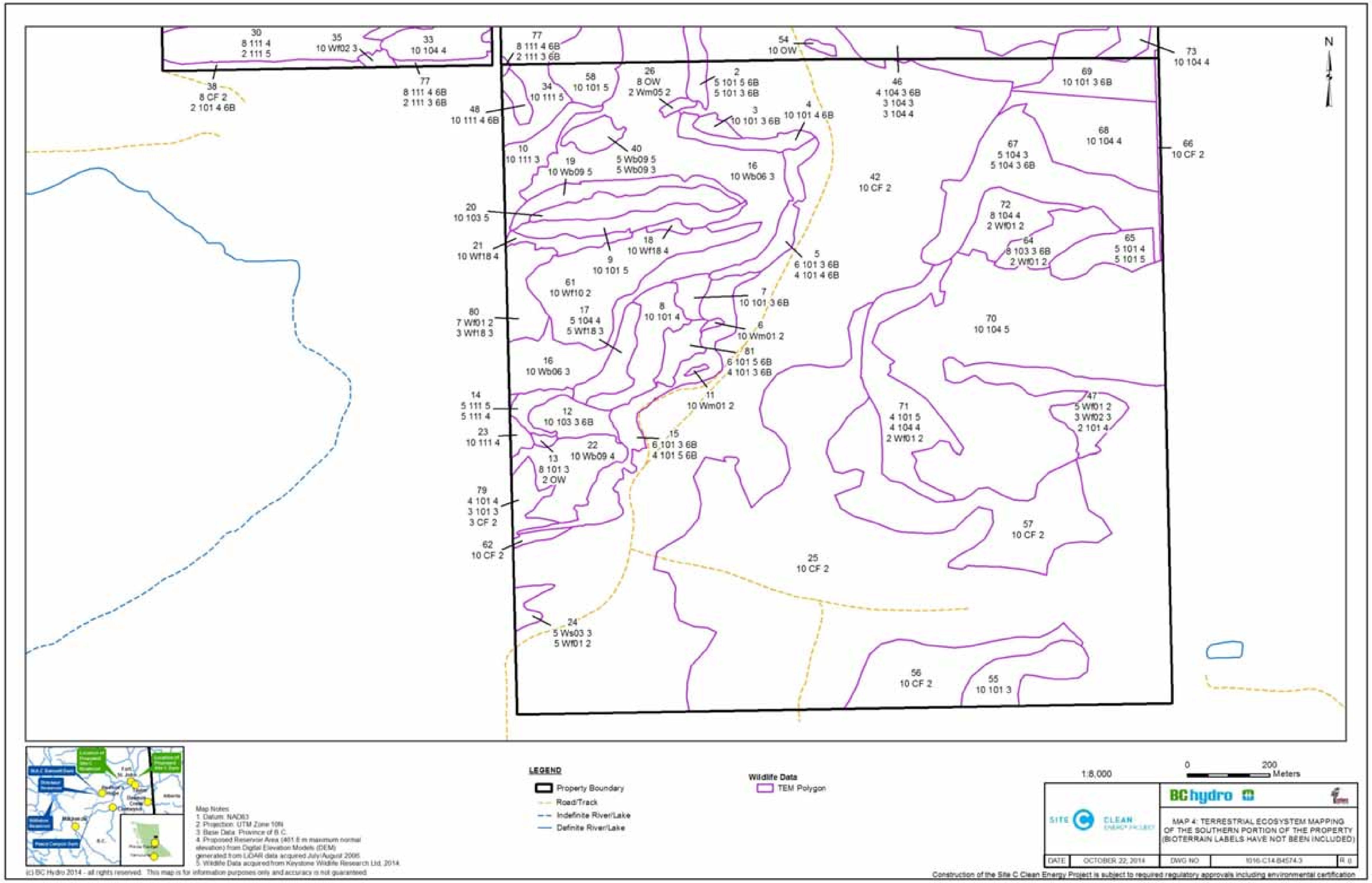

Figure 5. Terrestrial Ecosystem Map of Marl Fen Property: South

Source: Simpson et al. 2014.

Table 3. Ecosystems and area mapped

Map Code	Ecosystem Name	Ha mapped
Forested Ecosystems: Coniferous		
101	Sw-Trailing raspberry-Step moss	16.5
103	SwPl-Soopolallie-Fuzzy-spiked wildrye	2.2
104	Sb-Labrador tea-Step moss	59.6
Forested Ecosystems: Seral		
101B	At-Rose-Creamy peavine	65.6
103B	At-Rose-Fuzzy-spiked wildrye	9.3
104B	At-Labrador tea-Lingonberry	21.1
111B	At-Cow-parsnip-Meadowrue	1.2
Wetland Ecosystems		
111	Sw-Currant-Horsetail	15.5
Wb06	Tamarack-Water sedge-Fen moss	26.4
Wb09	Black spruce – Common horsetail-Sphagnum	6.1
Wf01	Water sedge-Beaked sedge	8.4
Wf02	Scrub birch-Water sedge	1.1
Wf10	Hudson Bay clubrush-Red hook-moss	6.5
Wf18	Tamarack-Scrub birch-Buckbean	3.9
Wm01	Beaked sedge-Water sedge	0.2
Wm05	Cattail Marsh	0
Ws03	Bebb's willow-Bluejoint	1.8
OW	Open Water	0.4
Anthropogenic		
CF	Cultivated Field	428.6
TOTAL		674.3

For the purposes of discussing rare plant occurrence, wildlife use and future management the property has been divided into 8 sub-areas based on ecosystems mapped within the property (**Table 4, Figure 5:** Simpson *et al*. 2014). The areas are:

- Northern cultivated field
- Northern mesic forest
- Northern wetland complex
- Eastern wetland complex
- Southern cultivated field
- Southern mesic forest
- Western wetland complex
- Western mesic forest

Table 4. Habitats found within each sub-area within the Property.

Area	Habitat
Northern cultivated field	Fields 3-7
Northern mesic forest	101, 103, 104, 101B
Northern wetland complex	104B, Wf01, Ws03
Eastern wetland complex	101, 104, 101B, 103B, 104B, Wf01, Wf02
Southern cultivated field	Fields 1 and 2
Southern mesic forest	101
Western wetland complex	101, 104, 103, 101B, 103B, 111BWf02, Wf18, Wb06, Wb09, Wf10, Wm01, Wm05, Ws03
Western mesic forest	101

5.1.2 Rare plants

Rare plant surveys were conducted on the Property in 2012 and 2014. A detailed description of the surveys and results can be found in Simpson *et al.* 2014. Seven vascular rare plants were documented within the property (**Table 5, Figure 7**: Simpson et al. 2014). Two species are on the BCCDC's Red list, the remaining five are on the Blue list. None are SARA or COSEWIC listed. All vascular rare plants were documented in wetland or forested areas. No rare plants were documented in cultivated fields.

Table 5. Rare vascular plants occurring within the Property.

Common Name	Scientific Name	BC List	Occurrences	Location
Tawny Paintbrush	*Castilleja miniata var. fulva*	Red	1	Eastern Wetland Complex Western Wetland Complex Northern Mesic Forest Western Mesic Forest
Slender-leaf Sundew	*Drosera linearis*	Blue	1	Western Wetland Complex
Northern Bog Bedstraw	*Galium labradoricum*	Blue	1	Western Wetland Complex
Bog Rush	*Juncus stygius ssp. americanus*	Blue	1	Western Wetland Complex
Small-flowered Lousewort	*Pedicularis parviflora ssp. parviflora*	Blue	1	Western Wetland Complex
Autumn Willow	*Salix serissima*	Blue	2	Western Wetland Complex Southern Mesic Forest
Purple-stemmed Aster	*Symphyotrichum puniceum var. puniceum*	Blue	3	Northern Wetland Complex Western Wetland Complex Northern Mesic Forest

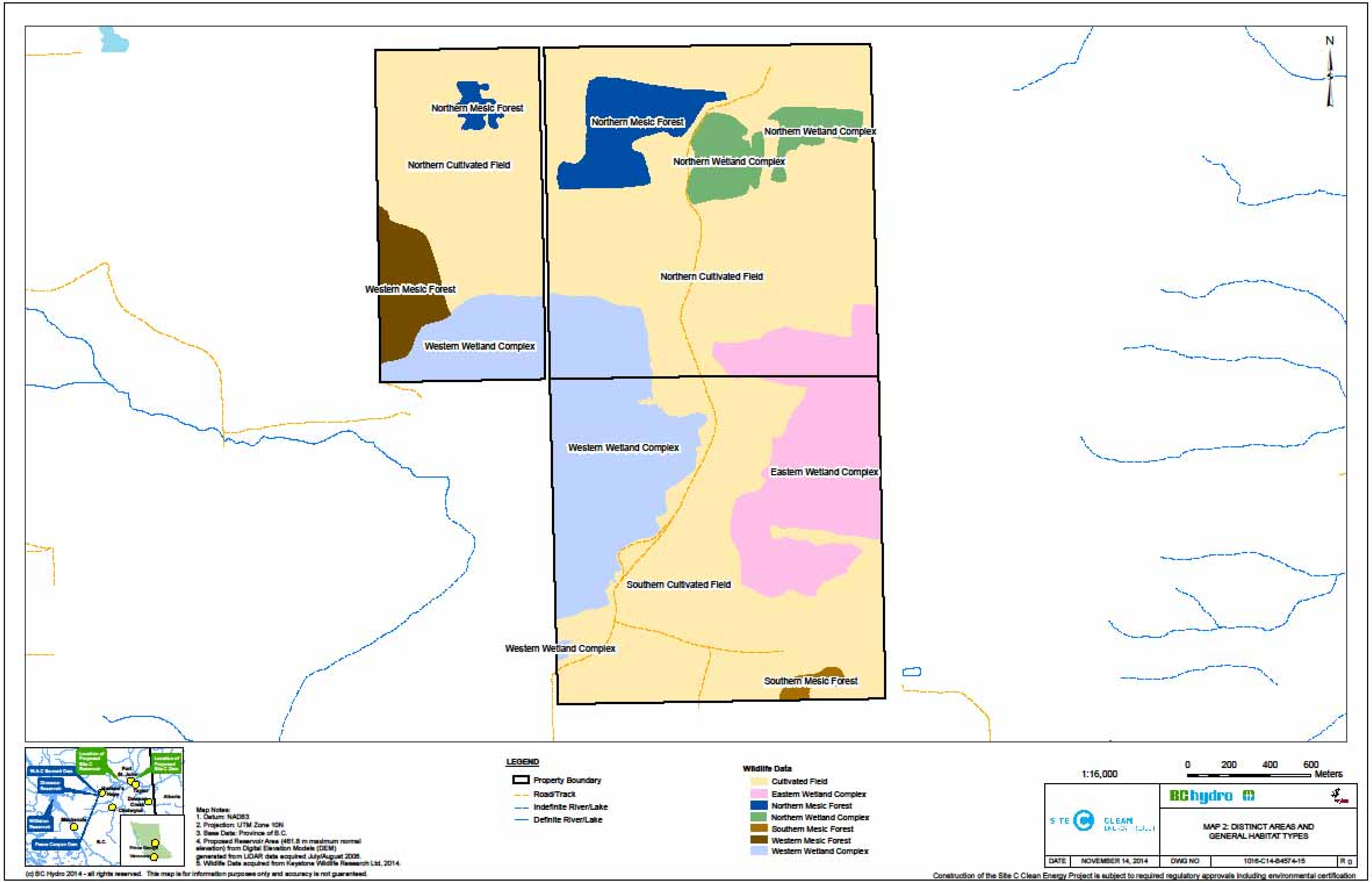

Figure 6. Sub-areas within the Property

Source: Simpson et al. 2014.

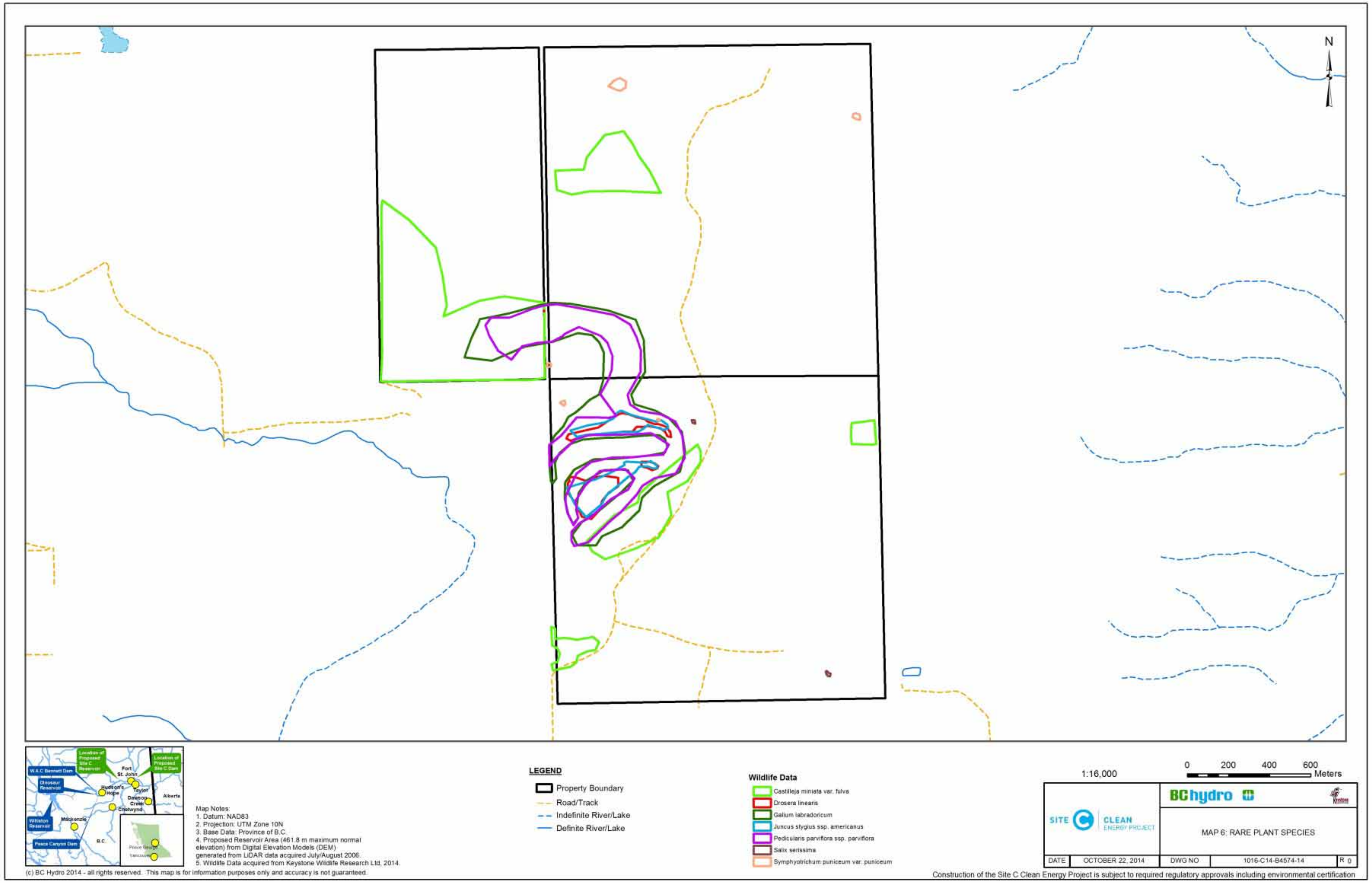

Figure 7. Rare vascular plant occurrences within Property

Source: Simpson et al. 2014.

6.0 BASELINE WILDLIFE PRESENCE AND USE OF THE PROPERTY

Wildlife data presented in this management plan were collected during surveys of the property in 2012 and 2014. Detailed descriptions of the methods and results can be found in Simpson *et al.* 2014 which is appended to this management plan (See **Appendix 2**). Wildlife management will focus on managing habitat for Key Indicator Species used to assess the potential effects of the Site C Clean Energy Project on Wildlife Resources (BC Hydro 2013) including invertebrates, amphibians, birds and mammals.

6.1 Invertebrates

Nine species of dragonflies have been documented on the property: sedge darner, zigzag darner, boreal whiteface, crimson-ringed whiteface, four-spotted skimmer, whitehouse's emerald, black meadowhawk, white-faced meadowhawk. None are classified as species at risk.

Six species of damselflies have been documented on the property: American emerald, taiga bluet, northern bluet, boreal bluet, spotted spreadwing, northern spreadwing, emerald spreadwing. None are classified as species at risk.

One blue-listed butterfly, the bronze copper, has been documented on the Property.

6.2 Amphibians

Three species of amphibian were documented on the property: boreal chorus frog, wood frog and western toad. The western toad is blue-listed provincially and is on Schedule 1 of the *Species at Risk Act.*

6.3 Birds

Eighty (80) bird species were documented on the property. Four species are classified as species at risk:

- The Rusty Blackbird and Barn Swallow are blue-listed provincially and on Schedule 1 of the *Species at Risk Act*.
- The Upland Sandpiper is red-listed provincially.
- The Le Conte's Sparrow is blue-listed provincially.

Sixty-two are non-wetland migratory birds, 17 of which are species of conservation concern for Bird Conservation Region 6. Eighteen are wetland migratory birds, 13 of which are species of conservation concern Bird Conservation Region 6. **Table 6** below summarizes this and indicates which habitats within the property each species is expected to use for breeding and migration. The property does not provide habitat for Canada Warbler, Cape May Warbler of Bay-breasted Warbler.

Table 6. Bird species observed on the Marl Fen Property and habitat preferences

Species	Non-Wetland Migratory Birds	Wetland Migratory Bird	Species of Conservation Concern BCR 6	Breeding habitat	Migration habitat
Alder Flycatcher	X		X	Wb06, Wf01, Wf02, Wf10, Wm01, Ws03	
American Crow	X			101, 103, 104, 111, 101B, 103B, 104B, 111B	01, 103, 104, 111, 101B, 103B, 104B, 111B
American Kestrel	X		X	CF	CF
American Pipit	X			n/a	CF
American Redstart	X			101, 103, 104, 111, 101B, 103B, 104B, 111B	01, 103, 104, 111, 101B, 103B, 104B, 111B
American Robin	X			101, 103, 104, 111, Wb06, Wb09, Wf02, Wf18	101, 103, 104, 111, Wb06, Wb09, Wf02, Wf18
American Three-toed Woodpecker	X		X	101, 104, 111,	
Barn Swallow*	X		X		Wb06, Wf01, Wf02, Wf10, Wm01, OW, PD
Black-and-white Warbler	X			101B, 103B, 104B, 111B	101B, 103B, 104B, 111B
Black-billed Magpie	X		X	CF	
Black-capped Chickadee	X		X	101, 104, 111, Wb06	101, 104, 111, Wb03/05, Wb06
Brown-headed Cowbird	X			101B, 103B, 104B, 111B, CF	101B, 103B, 104B, 111B, CF
Blue-headed Vireo	X			101, 103, 104, 111, 101B, 103B, 104B, 111B	101, 103, 104, 111, 101B, 103B, 104B, 111B
Blackpoll Warbler	X		X	101, 104, 111, Wb06	
Bank Swallow	X			NA	CF, Wb06, Wf01, Wf02, Wf10, Wm01, Wm05, Ws03
Blue Jay	X			101B, 103B, 104B, 111B	101B, 103B, 104B, 111B
Boreal Chickadee	X		X	BT, Wb06, 101, 104, 111	BT, Wb06, 101, 104, 111
Bufflehead		X	X	PD	PD
Blue-winged Teal		X	X	Wf01, Wf02, Wf10, Wm01, OW, PD, Ws03	Wf01, Wf02, Wf10, Wm01, OW, PD, Ws03
Canada Goose		X		101, 103, 104, 111, 101B, 103B, 104B, 111B, Wb06, Wb09, Wff02,	CF

Species	**Non-Wetland Migratory Birds**	**Wetland Migratory Bird**	**Species of Conservation Concern BCR 6**	**Breeding habitat**	**Migration habitat**
				Wf18	
Clay-colored Sparrow	X		X	CF	CF
Chipping Sparrow	X			101, 103, 104, 111, 101B, 103B, 104B, 111B	101, 103, 104, 111, 101B, 103B, 104B, 111B
Common Raven	X			101, 103, 104, 111, 101B, 103B, 104B, 111B	NA
Common Yellowthroat	X		X	Wb06, Wf01, Wf02, Wf10, Wm01, Ws03	Wb06, Wf01, Wf02, Wf10, Wm01, Ws03
Dark-eyed Junco	X			101, 103, 104, 111, 101B, 103B, 104B, 111B, Wb09	101, 103, 104, 111, 101B, 103B, 104B, 111B, Wb09
Downy Woodpecker	X			101, 103, 104, 111, 101B, 103B, 104B, 111B, Wb06, Wf18, Wb09	101, 103, 104, 111, 101B, 103B, 104B, 111B, Wb06, Wf18, Wb09
Fox Sparrow	X			101, 103, 104, 111, 101B, 103B, 104B, 111B	101, 103, 104, 111, 101B, 103B, 104B, 111B
Golden-crowned Kinglet	X			101, 103, 104, 111, 101B, 103B, 104B, 111B, Wb09	101, 103, 104, 111, 101B, 103B, 104B, 111B, Wb09
Gray Jay	X			101, 103, 104, 111, 101B, 103B, 104B, 111B, Wb09	101, 103, 104, 111, 101B, 103B, 104B, 111B, Wb09
Greater Yellowlegs		X	X	Wb06, Wf01, Wf02, Wf10, Wm01, Ws03	OW, Wb06, Wf01, Wf02, Wf10, Wm01, Ws03
Hairy Woodpecker	X			101, 103, 104, 111, 101B, 103B, 104B, 111B, Wb09, Wb06, Wf18	101, 103, 104, 111, 101B, 103B, 104B, 111B, Wb09, Wb06, Wf18
Hermit Thrush	X			101, 103, 104, 111	101, 103, 104, 111
Killdeer	X		X	CF, Wf01, Wf02, Wf10, Wm01, Ws03	CF, Wf01, Wf02, Wf10, Wm01, Ws03
Lapland Longspur	X			N/A	CF
Long-billed Dowitcher		X		N/A	CF, Wf01, Wf02, Wf10, Wm01, Wm05
Le Conte's Sparrow*	X		X	Wf01, Wf02, Wf10, Wm01, Wb06, CF, Ws03	CF
Least Flycatcher	X		X	101, 104, 111,Wb03, Wb06, 101B, 104B, 111B	101, 104, 111,Wb03, Wb06, 101B, 104B, 111B
Lesser Yellowlegs		X	X	Wb06, Wf01, Wf02, Wf10, Wm01, Ws03	OW, Wb06, Wf01, Wf02, Wf10, Wm01, Ws03

Species	Non-Wetland Migratory Birds	Wetland Migratory Bird	Species of Conservation Concern BCR 6	Breeding habitat	Migration habitat
Lincoln's Sparrow	X			Wb06, Wf01, Wf02, Wb09	Wf10, Wm01, Ws03, Wf18, Wm05
Mallard		X	X	Wf01, Wf02, Wf10, Wm01, Ws03, OW, PD	Wf01, Wf02, Wf10, Wm01, Ws03, OW, PD, CF
Mountain Chickadee	X			101, 103, 104, 111	101, 103, 104, 111
Northern Flicker	X		X	101, 102, 104, 111, 101B 111B	101, 102, 104, 111, 101B 111B
Northern Harrier	X		X	CF, Wf01, Wf02, Wf10, Wm01, Wb06	CF
Northern Pintail		X	X	Wf01, Wf02, Wf10, Wm01, Ws03, OW, PD	Wf01, Wf02, Wf10, Wm01, Ws03, OW, PD, CF
Northern Shoveler		X	X	Wf01, Wf02, Wf10, Wm01, Ws03, OW, PD	Wf01, Wf02, Wf10, Wm01, Ws03, OW, PD
Northern Waterthrush		X		Wb06, Wb09, Wf18, 104, 111	Wb06, Wb09, Wf18, 104, 111
Orange-crowned Warbler	X			101, 103, 104, 111, 101B, 103B, 104B, 111B	101, 103, 104, 111, 101B, 103B, 104B, 111B
Pectoral Sandpiper		X		NA	CF, PD
Pine Siskin	X			101, 103, 104, 111, 101B, 103B, 104B, 111B	101, 103, 104, 111, 101B, 103B, 104B, 111B, CF
Pacific-slope Flycatcher	X			101, 104, 111, Wb06, Wb09, Wf18	101, 104, 111, Wb06, Wb09, Wf18
Purple Finch	X			101, 103, 104, 111, 101B, 103B, 104B, 111B, Wb06, Wb09, Wf18	101, 103, 104, 111, 101B, 103B, 104B, 111B Wb06, Wb09, Wf18
Rose-beaked Grosbeak	X			101, 103, 104, 111, 101B, 103B, 104B, 111B Wb06, Wb09, Wf18	101, 103, 104, 111, 101B, 103B, 104B, 111B Wb06, Wb09, Wf18
Red-breasted Nuthatch	X			101, 103, 104, 111, 101B, 103B, 104B, 111B	101, 103, 104, 111, 101B, 103B, 104B, 111B
Ruby-crowned Kinglet	X			101, 103, 104, 111	101, 103, 104, 111, 101B, 103B, 104B, 111B, CF
Red-eyed Vireo	X			101, 103, 104, 111, 101B, 103B, 104B, 111B	101, 103, 104, 111, 101B, 103B, 104B, 111B
Red-tailed Hawk	X			101, 103, 104, 111, 101B, 103B, 104B, 111B, Wb06, Wb09, Wf18	101, 103, 104, 111, 101B, 103B, 104B, 111B, Wb06, Wb09, Wf18
Rusty Blackbird*		X	X	Wb06, Ws03	CF, Wb09, Wf18, Ws03

Species	Non-Wetland Migratory Birds	Wetland Migratory Bird	Species of Conservation Concern BCR 6	Breeding habitat	Migration habitat
Ruffed Grouse	X			101, 103, 104, 111	N/A
Red-winged Blackbird		X		CF, Wb06, Wf01, Wf02, Wf10, Wf01, Wm05, Ws03	CF, Wb06, Wf01, Wf02, Wf10, Wf01, Wm05, Ws03
Sandhill Crane		X	X	Wb06, Wf01, Wf02, Wf10, Wm01, Ws03, OW, PD	Wb06, Wf01, Wf02, Wf10, Wm01, OW, PD, CF
Savannah Sparrow	X			N/A	CF
Sora		X	X	Wb06, Wf01, Wf02, Wf10, Wm01, Ws03	Wb06, Wf01, Wf02, Wf10, Wm01, Ws03
Solitary Sandpiper		X	X	Wb06, Ws03	OW, Wb06, Wf01, Wf02, Wf10, Wm01, Ws03
Song Sparrow	X			Wb06, Wf01, Wf02, Wf10, Wf18, Wm01, Wm05, Ws03	Wb06, Wf01, Wf02, Wf10, Wf18, Wm01, Wm05, Ws03
Swainson's Thrush	X			101, 103, 104, 111	101, 103, 104, 111, 101B, 103B, 104B, 111B, Wf20, Wf18, Ws03
Tennessee Warbler	X			Wb06, Wb09, Wf18	101, 103, 104, 111, 101B, 103B, 104B, 111B
Townsend's Solitaire	X			101, 103, 104, 111	101, 103, 104, 111
Tree Swallow	X			101, 103, 104, 111, Wb06, Wb09, Wf18	101, 103, 104, 111, Wb06, Wb09, Wf18
Upland Sandpiper**		X	X	CF	CF
Varied Thrush	X			101, 103, 104, 111, 101B, 103B, 104B, 111B	101, 103, 104, 111, 101B, 103B, 104B, 111B
Vesper Sparrow	X			CF	CF
Warbling Vireo	X			101B, 103B, 104B, 111B	101B, 103B, 104B, 111B, Wf02, Wf18, Ws03
White-crowned Sparrow	X			101, 103, 104, 111, 101B, 103B, 104B, 111B	101, 103, 104, 111, 101B, 103B, 104B, 111B
Wilson's Snipe		X	X	Wb06, Wf01, Wf02, Wf10, Wm01, Ws03	Wb06, Wf01, Wf02, Wf10, Wm01, Ws03
Wilson's Warbler	X			101, 104, 111, 101B, 104B, 111B,Wb06, Wb09, Wf18	101, 104, 111, 101B, 104B, 111B,Wb06, Wb09, Wf18
White-throated Sparrow	X		X	101, 103, 104, 111, CF, Wb06	101, 103, 104, 111, 101B, 103B, 104B, 111B, Wm05
Yellow-bellied Flycatcher	X			101, 103, 104, 111, Wb06, Wb09, Ws03	101, 103, 104, 111, Wb06, Wb09, Ws03

Species	Non-Wetland Migratory Birds	Wetland Migratory Bird	Species of Conservation Concern BCR 6	Breeding habitat	Migration habitat
Yellow-bellied Sapsucker	X		X	101, 111, 101B, 104B, 111B	101, 111, 101B, 104B, 111B
Yellow Warbler	X			101, 103, 104, 111, Ws03, Wb06, Wb09, Wf18	101, 103, 104, 111, Ws03, Wb06, Wb09, Wf18
Yellow-rumped Warbler	X			101, 103, 104, 111, 101B, 103B, 104B, 111B	101, 103, 104, 111, 101B, 103B, 104B, 111B
* blue-listed provincially **red-listed provincially					

6.4 Mammals

Ten mammal species were documented on the property: long-eared Myotis, little brown Myotis, northern Myotis, silver-haired bat, hoary bat, moose, elk, mule deer, black bear and coyote. The northern Myotis is blue-listed. Both the northern Myotis and little brown Myotis have recently been added to Schedule 1 of the *Species at Risk Act*. This is due to the high levels of mortality associated with White-nose Syndrome. While White-nose Syndrome has not been documented in BC at this time, it is moving westward across Canada.

7.0 MANAGEMENT OBJECTIVES

7.1 Vegetation

Management of the Property will aid in fulfilling the following conditions attached to the Project's environmental certification:

- **Federal condition 16:** The Proponent shall ensure that potential effects of the Designated Project on species at risk, at-risk and sensitive ecological communities and rare plants are addressed and monitored
- **Federal condition 16.2:** The Proponent shall develop, in consultation with Environment Canada, a plan setting out measures to address potential effects of the Designated Project on species at risk, at-risk and sensitive ecological communities and rare plants.
    - 16.3.3: The plan shall include measures to mitigate environmental effects on species at-risk and sensitive ecological communities and rare plants
- **Federal condition 11:** The Proponent shall mitigate the potential effects of the Designated Project on wetland habitat use by migratory birds, species at risk and for current use of lands and resources for traditional purposes by Aboriginal Groups
    - 11.2: The Proponent shall develop, in consultation with Environment Canada, Reservoir Area Aboriginal groups and Immediate Downstream Aboriginal groups, a plan that addressed potential effects of the Designated Project on wetland habitat use by migratory birds, species at risk and for current use of lands and resources for traditional purposes.
    - 11.4.4: compensation measures to address the unavoidable loss of wetland areas and functions supporting migratory birds, species at risk, and the current use of lands and resources by Aboriginal people in support of the objective of full replacement of wetlands in terms of area and function
- **Provincial condition 12:** The EAC Holder must develop a Wetland Mitigation and Compensation Plan. The Wetland Mitigation and Compensation Plan must include an assessment of wetland function lost as a result of the Project that is important to migratory birds and species

at risk (wildlife and plants). The Wetland Mitigation and Compensation Plan must be developed by a QEP with experience in wetland enhancement, maintenance and development. The Wetland Mitigation and Compensation Plan must include at least the following:

- o Maintain or improve hydrology where avoidance is not feasible;
- o Replace like for like where wetlands will be lost, in terms of functions and compensation in terms of area
- o Improve the function of existing wetland habitats

7.1.2 Target species

Management of the Property will focus on protecting and managing the large wetland complex in perpetuity to retain both its function and area and maintaining the seven rare vascular plants documented on the Property (**Table 4**).

This will be achieved through:

- fencing of the wetland to exclude cattle and prohibit future disturbance by cattle
- prohibiting use of the wetland by the leaseholder
- management of the cultivated fields (see Section 8 below)

7.2 Wildlife

Management of the Property will aid in fulfilling the following conditions attached to the Project's environmental certification:

- **Federal condition 10.1:** The Proponent shall mitigate the potential effects of the Designated Project on non-wetland migratory bird habitat
- **Federal condition10.2:** The Proponent shall develop, in consultation with Environment Canada, a plan that addresses potential effects of the Designated Project on non-wetland migratory bird habitat
  - o 10.3.4 compensation measures to address the unavoidable loss of non-wetland migratory bird habitat
  - o 10.3.5 an approach to monitor and evaluate the effectiveness of the mitigation or compensation measures to be implemented and to verify the accuracy of the predictions made during the environmental assessment on non-wetland migratory bird habitat, including migratory bird use of that habitat.
- **Federal condition 16.1:** The Proponent shall ensure that potential effects of the Designated Project on species at risk, at-risk and sensitive ecological communities and rare plants are addressed and monitored
- **Federal condition 16.2:** The Proponent shall develop, in consultation with Environment Canada, a plan setting out measures to address potential effects of the Designated Project on species at risk, at-risk and sensitive ecological communities and rare plants.

- 16.3.3: The plan shall include measures to mitigate environmental effects on species at-risk and sensitive ecological communities and rare plants
    - 16.3.6 an approach to monitor and evaluate the effectiveness of mitigation measures and to verify the accuracy of the predictions made during the environmental assessment on species at risk, at-risk and sensitive communities and rare plants
- **Provincial condition 16:** If loss of sensitive wildlife habitat or important wildlife areas cannot be avoided through Project design or otherwise mitigated, the EAC Holder must implement the following measures, which must be described in the Vegetation and Wildlife Mitigation and Monitoring Plan. The Vegetation and Wildlife Mitigation and Monitoring Plan must include the following compensation measures:
    - Compensation options for wetlands must include fish-free areas to manage the effects of fish predation on invertebrate and amphibian eggs and larvae and young birds.
    - Establishment of nest boxes for cavity-nesting waterfowl developed as part of wetland mitigation and compensation plan, and established within riparian vegetation zones established along the reservoir on BC Hydro-owned properties.
- **Provincial condition 21:** The EAC Holder must ensure that measures implemented to manage harmful Project effects on wildlife resources are effective by implementing monitoring measures detailed in a Vegetation and Wildlife Mitigation and Monitoring Plan. The Vegetation and Wildlife Mitigation and Monitoring Plan must be developed by a QEP. The Vegetation and Wildlife Mitigation and Monitoring Plan must include at least the following:
    - Monitor waterfowl and shorebird populations and their use of natural wetlands, created wetlands, and artificial wetland features.

7.2.1 Target species

Management of the Property will focus on managing habitat (breeding, feeding and migration) for species known to use the Property and Key Indicator Species that could use the property if suitable habitats are created (e.g. Short-eared Owl, Northern Harrier). Should additional species at risk or of conservation concern for Bird Conservation Region 6 be documented on the property the management plan will be revised as required to ensure their habitat is maintained on the Property. Target species include:

- Invertebrates
- Western toad
- Bird species listed in Table 5.
- Bats
- Fisher

Management will be achieved through protecting wetland and forested habitats within the Property and managing cultivated fields to provide a balance between agricultural production and breeding, feeding and migration habitat for invertebrates, amphibians, birds and mammals. **Table 7** summarizes which bird species documented on the property use each sub area and will thus benefit from management outlined in Section 8 of this document.

Table 7 Species use by Property sub area

	Project sub area										Project sub area							
Species	Northern cultivated field	Northern mesic forest	Northern wetland complex	Eastern wetland complex	Southern cultivated field	Southern mesic forest	Western wetland complex	Western mesic forest		**Species**	Northern cultivated field	Northern mesic forest	Northern wetland complex	Eastern wetland complex	Southern cultivated field	Southern mesic forest	Western wetland complex	Western mesic forest
Sedge darner		X	X	X		X	X			**Barn Swallow***			X	X			X	
Zigzag darner		X	X	X		X	X			Black-and-white Warbler			X					
Boreal whiteface		X	X	X		X	X			Black-billed Magpie	X		X		X			
Crimson-ringed whiteface		X	X	X		X	X			Black-capped Chickadee		X				X		X
Four-spotted skimmer		X	X	X		X	X			Brown-headed Cowbird	X		X		X			
Whitehouse's emerald		X	X	X		X	X			Blackpoll Warbler		X				X		X
Black meadowhawk		X	X	X		X	X			Blue-headed Vireo		X		X		X	X	X
White-faced meadowhawk		X	X	X		X	X			Bank Swallow	X		X	X	X		X	
Bronze Copper		X	X	X		X	X			Blue Jay			X					
Boreal chorus frog		X	X	X	X		X			Blue-winged Teal			X	X			X	
Wood Frog		X	X	X	X		X			Boreal Chickadee		X		X		X	X	X
Western toad		X	X	X	X		X			Bufflehead	X				X		X	
Alder Flycatcher			X	X			X			Canada Goose		X	X	X		X	X	X
American Crow		X	X			X		X		Clay-colored Sparrow	X		X		X			
American Kestrel	X		X		X					Chipping Sparrow		X	X	X		X	X	X
American Pipit	X		X		X					Common Raven		X	X	X		X	X	X
American Redstart		X	X			X		X		Common Yellowthroat			X	X			X	
American Robin		X				X		X		Dark-eyed Junco		X	X	X		X	X	X

	Project sub area										Project sub area							
Species	Northern cultivated field	Northern mesic forest	Northern wetland complex	Eastern wetland complex	Southern cultivated field	Southern mesic forest	Western wetland complex	Western mesic forest		**Species**	Northern cultivated field	Northern mesic forest	Northern wetland complex	Eastern wetland complex	Southern cultivated field	Southern mesic forest	Western wetland complex	Western mesic forest
American Three-toed Woodpecker		X				X		X		Downy Woodpecker		X	X	X		X	X	X
Fox Sparrow		X	X	X		X	X	X		Northern Shoveler			X	X			X	
Golden-crowned Kinglet		X	X	X		X	X	X		Northern Waterthrush		X				X	X	X
Gray Jay		X	X	X		X	X	X		Orange-crowned Warbler		X	X	X		X	X	X
Greater Yellowlegs			X	X			X			Pectoral Sandpiper	X		X		X			
Hairy Woodpecker		X	X	X		X	X	X		Pine Siskin		X	X	X		X	X	X
Hermit Thrush		X		X		X	X	X		Red-eyed Vireo		X	X	X		X	X	X
Killdeer	X		X	X	X		X			Pacific-slope Flycatcher		X		X		X	X	X
Lapland Longspur	X				X					Purple Finch		X	X	X		X	X	X
Le Conte's Sparrow*	X		X	X	X		X			Red-breasted Nuthatch		X	X	X		X	X	X
Least Flycatcher		X		X		X	X	X		Red-tailed Hawk		X	X	X		X	X	X
Lesser Yellowlegs			X	X			X			Red-winged Blackbird	X		X		X			
Lincoln's Sparrow			X	X			X			Rose-beaked Grosbeak		X	X	X		X	X	X
Long-billed Dowitcher	X		X	X	X		X			Ruby-crowned Kinglet	X	X		X	X	X	X	X
Mallard	X		X		X					Ruffed Grouse		X		X		X	X	X
Mountain Chickadee		X		X		X	X	X		**Rusty Blackbird***	X				X			
Northern Flicker		X		X		X	X	X		Sandhill Crane	X		X		X			
Northern Harrier	X		X		X					Savannah Sparrow	X		X		X			
Northern Pintail	X		X	X	X		X			Sora			X	X			X	

	Project sub area										Project sub area							
Species	Northern cultivated field	Northern mesic forest	Northern wetland complex	Eastern wetland complex	Southern cultivated field	Southern mesic forest	Western wetland complex	Western mesic forest		**Species**	Northern cultivated field	Northern mesic forest	Northern wetland complex	Eastern wetland complex	Southern cultivated field	Southern mesic forest	Western wetland complex	Western mesic forest
Solitary Sandpiper			X	X			X			Wilson's Warbler		X	X	X		X	X	X
Song Sparrow			X	X			X			Yellow-bellied Flycatcher		X	X	X		X	X	X
Swainson's Thrush		X		X		X	X	X		Yellow-bellied Sapsucker		X	X	X		X	X	X
Tennessee Warbler		X	X	X		X	X	X		Yellow Warbler		X	X	X		X	X	X
Townsend's Solitaire		X		X		X	X	X		Yellow-rumped Warbler		X	X	X		X	X	X
Tree Swallow		X		X		X	X	X		Long-eared Myotis	X	X	X	X	X	X	X	X
Upland Sandpiper**	X		X		X					Little brown Myotis	X	X	X	X	X	X	X	X
Varied Thrush		X	X	X		X	X	X		Northern Myotis	X	X	X	X	X	X	X	X
Vesper Sparrow	X		X		X					Silver-haired bat	X	X	X	X	X	X	X	X
Warbling Vireo		X	X	X		X	X	X		Hoary bat, moose	X	X	X	X	X	X	X	X
White-crowned Sparrow		X	X	X		X	X	X		Elk	X	X	X	X	X	X	X	X
White-throated Sparrow		X	X	X		X	X	X		Mule deer	X	X	X	X	X	X	X	X
Wilson's Snipe			X	X			X			Black bear	X	X	X	X	X	X	X	X

Installation of cattle exclusion fencing around cattle water sources will provide/protect additional breeding habitat for wildlife adjacent to water. Invertebrates, amphibians and birds are expected to use habitats within the fence line.

7.3 Agriculture

7.3.1 Management Objectives

The primary objective of forage field management is to maintain and enhance historic forage production levels, both for cattle and wildlife, while also protecting wildlife habitats within the property. This will be achieved through a program of field management that will include:

- Fencing of the wetland to exclude cattle;
- Repair of existing fences and field accesses;
- Installation of cross-fencing to enhance field management;
- Renovation and replanting of existing fields to hay/pasture mixes (grasses/legumes);

The site specific proposed improvements are presented in Section 8 below.

7.3.2 *Grazing Management*

In terms of domestic animals, only cattle grazing will be allowed, in keeping with historic site use and to protect the quality of the fields. No over-wintering of cattle will be permitted under this management plan.

Although cut hay crops have been harvested from at least some parts of the Property in the past, and might be considered in future years, at this time forage fields will be managed through cattle grazing rotations only.

7.3.2.1 Grazing Season and Carrying Capacity

Historically, the Property has been grazed between mid-to late May and mid-to late October, with the actual period of grazing in a given year dependant on weather and field/grass conditions. According to the former operators, in most years, 400-450 cow/calf pairs were grazed on the Property for 4-5 months, depending on field conditions. Under the proposed grazing management regime, in some years, the grazing period could be extended at either end, but pushing the season could result in soil and crop damage, which in turn could lead to reduced wildlife values. Accordingly, extension of the grazing period will generally not be permitted under this Plan, unless extenuating circumstances warrant it.

There are 422 ha (928 ac) of hayfields and pastures (which include treed areas) within the Property, of which 386 ha are cultivated (Table 7). Under optimal pasture management, the intensively cultivated fields (Fields 1, 2, 3, 4 and 7) should support about two tonne/ha (1,800 lbs/ac) annually, or about 6 AUMs/ha (animal unit months – the amount of forage required to support a cow/calf pair for a month).

In order to optimize the habitat values as outlined in the Plan, some fields (Fields 5 and 6) will be managed as “old field” habitat under a less intensive grazing regime. These less intensively managed pastures should support about one tonne/ha. As shown in Table 8, this translates to an assigned carrying capacity for all pastures of approximately 1,377 AUMs, or 344 animals (cow/calf pairs, and/or yearlings or mature animals) for 4 months. The actual numbers of animals and the timing and extent of the grazing period will vary from year to year, depending on existing field/grass conditions and management decisions regarding the grazing rotation plan in a given year.

The assigned carrying capacity of individual fields and the proposed number of animals is discussed more detail in section 8.4.2.

Table 8. Assigned carrying capacities for pastures on the Marl Fen Property

Field	Cult Area (ha)	T/ha	Total T	Total AUMs	Assigned AUMS	Designated Use
1	97	2	194	569	455	Intensive Pasture
2	30	2	60	176	141	Intensive Pasture
3	44	2	88	258	207	Intensive Pasture
4	30	2	60	176	141	Intensive Pasture
5	50	1	50	147	117	Old Field Pasture
6	73	1	73	214	171	Old Field Pasture
7	62	1	62	182	145	Intensive Pasture
Totals	**386**		**587**	**1722**	**1377**	

7.3.2.2 Grazing Rotation

Continuous grazing (over the grazing season) can lead to overgrazing resulting in increased weed growth and soil damage, while controlled (or rotational) grazing, helps to maintain the quality and longevity of the forage stand. Rotational grazing entails more intensive field management whereby a pasture is rested for several weeks or months, following a period of grazing for several days or weeks. The optimal number of livestock is placed in the pasture and distributed evenly throughout the field by salting and water placement to ensure even grazing pressure over the entire field. The management decision on when to start grazing, end grazing, and then re-graze a pasture, is based on several factors, including the density and height of the grass/legume cover and ground (soil) conditions.

Rotational grazing is used to manage both native (natural) forested and grassland ranges and improved pastures and pasture/hayfields such as occur within the Property. For native ranges, the period of use is generally rotated annually between the earlier and later grazing season in order to achieve optimal forage health and production levels. Early spring grazing by cattle increases the palatability of the forage for ungulates, while the later fall grazing helps to rejuvenate the forage yield the following year. For intensively managed pastures, forage stands are generally grazed for several days, then rested for several weeks to allow the grass to regrow to a desired height. Once the grass reaches the desired height, the pasture can be re-grazed with the cattle then removed for the season once the grass is grazed to a set height.

Two general rotation patterns are proposed for management of cultivated fields within the Property:

Old Field: For “old field habitats” a simple rotation of predominantly light, later season grazing (August to mid-October) one year, will be followed by earlier, light spring (mid-May to end of June) grazing the following year. The interval (e.g. every second or third year) with which the fields would be grazed in the spring would be determined based on actual field conditions. The objective will be to allow about 50% of the grasses to go to seed each year of later grazing and 100% of the field to go to seed in each year of early grazing. The determination of both the intensity of grazing and the frequency of spring grazing would be based on maintaining “old field habitat” as opposed to the optimal pasture objective of the more intensively managed fields.

Because of proposed lighter use, the “old field habitats” have been assigned a grazing intensity of about half their carrying capacity, or 1 t/ha, or 3 AUMs/ha (0.5 tons/ac; 1.3 AUMs/ac).

Intensively managed fields: A grazing rotation during the 5 month period of mid-May through to mid-October will be followed for the intensively managed fields/pastures. This will generally entail a period of short term intensive grazing, followed by several weeks of rest, followed by an additional short grazing period as described above. The timing of the start of the first grazing period will be dependent on adequate soil and grass conditions to support grazing. This will be determined annually by the lessee. The grass stand will be grazed to a height of ~6 in during early grazing. The second grazing period would only occur if it could be accomplished without major damage to the grass and soil. This will require monitoring by the lessee to ensure that the grass stand has achieved the desired density and height and that soil moisture conditions are optimal, before placing cattle back on the field.

The exact rotation schedule will be based on seasonal monitoring. Individual field specific rotations will be determined in consultation with the Property lessee on an annual basis. Implementation of this rotational system will require intensive management during the grazing season, including regular field maintenance (e.g. rejuvenation) and timely movement of cattle between fields, by the lessee.

The strategic placement of salt blocks and use of a mobile watering system will help to distribute cattle more evenly throughout the fields. These methods, as well as periodic active movement of cattle to more desirable areas, will be the responsibility of the lessee.

Mob grazing, which uses high numbers (20 animals/acre) of cattle on site for a short time (7-10 days) to graze grass to 6-8 inches could also be used if desired by the lease holder. In order to initiate a mob grazing management regime, the fields would need to be subdivided into smaller pastures by the lessee. The most efficient way to achieve this is through the use of electric fences (mob grazing will be discussed further with the lessee, when the opportunity arises).

7.3.2.3 Field Rejuvenation

The current grasses and legumes observed within the fields, or described as having been planted in the past by former operators, include meadow and smooth brome grasses (both of which need early grazing), creeping red fescue (which is good for over-winter survival and available in early spring, but not good for grazing before mid-July), tall fescue, alfalfa and Timothy. Native sedges and reed canary grass occur in the poorly drained depressions or channels, particularly in the northerly fields. These wetland or riparian species are generally self-seeding and do not require replanting under normal field renovation conditions.

Typically, Peace River upland hayfields and pastures require renovation (tilling, seeding and fertilizing) every 5-8 years in order to maintain optimal forage production levels. Some of the existing fields have not been renovated in more than a decade. Fields that are to be intensively managed for forage (described in detail in later sections) will be renovated. Renovated fields will be planted to a hardy Peace River pasture grass mix containing brome grass (meadow or smooth), tall fescue, creeping red fescue, orchard grass, alfalfa and timothy, or equivalent agronomic species and fertilized at the time of seeding. The exact seeding (and fertilizing) specifications will be worked out for each field area in liaison with the lessee and local seed and fertilizer suppliers.

8.0 DETAILED MANAGEMENT PLANS

8.1 Site Cleanup

Overall, the Property is in a clean state with only minor debris and abandoned materials noted. A cleanup should be carried out to remove:

- Dilapidated shed near metal silos (**Appendix 1: Photo 1**);
- Any stored seeds/grains in the storage bins (**Appendix 1: Photo 2**);
- Old lumber cattle loading ramp and corrals (**Appendix 1: Photo 7**);
- Large number of plastic bale bags (**Appendix 1: Photo 8**);
- Several large propane tanks near dugout #1 (**Appendix 1: Photo 9**);
- Dry well at dugout #1 (**Appendix 1: Photo 10**);
- Timber crib bases used to support watering troughs near dugout #1.

Grain silos will be emptied of seed and retained to provide nesting habitat for Barn Swallow.

8.2 Fencing

Repair of the existing fences, fencing off the wetland and repair and installation of additional gates will need to be carried out as soon as field conditions allow in 2015 prior to cattle returning to the Property. A fencing contractor will need to complete a site inventory in order to identify required repairs and prepare a budget. The proposed fencing works are summarized below.

8.2.1 Proposed Works: Fencing

8.2.1.1 Scope of Work

Installation of fencing and gates at four dugouts (**Figure 6: sites 4, 5, 6 and 8**) located in cultivated fields within the property.

Installation of a fence and gates around the perimeter of the large wetland area along the southwest part of the property.

Task 1. Installation of Perimeter fencing around dugouts # 4, 5, 6 and 8

- Fencing installation will be guided by the staking BC Hydro has established around dugouts 4, 5 and 8. Fencing will completely exclude cattle from these dugouts.
- Fencing installation will be guided by the staking BC Hydro has established around dugout 6 and include fencing to allow cattle access to wetted portions of the dugout at the two access ramps, access ramps are 16 feet wide. Fencing will enter the wetland such that cattle will have access to the dugout in dry, low water-years.
- Fencing is to be installed as per the BC Agricultural Fencing Handbook (Ministry of Agriculture Food and Fisheries 2002 available at: http://www.agf.gov.bc.ca/resmgmt/publist/300Series/307000-1.pdf.
  Additional notes that apply are:
  - Fencing to be installed by driving in fence posts, not auguring out post holes;
  - Line posts to be 7’ 4-5” diameter pressure treated posts;
  - Brace posts to be 8’ 4-5” diameter pressure treated posts;
  - Brace rails to be 10’ long;
  - Line posts to be spaced 15’ apart;
  - Wire spacing is 8” apart, beginning 18” above the ground with a top wire height of 42”;
  - Top and bottom wires to be 12½ gauge high-tensile smooth wire. Middle wires to be 12½ gauge double strand barbed wire.
  - One 12 foot access gate to be installed at each dugout
    - The gate will be located so it is easily accessible from the cultivated field.

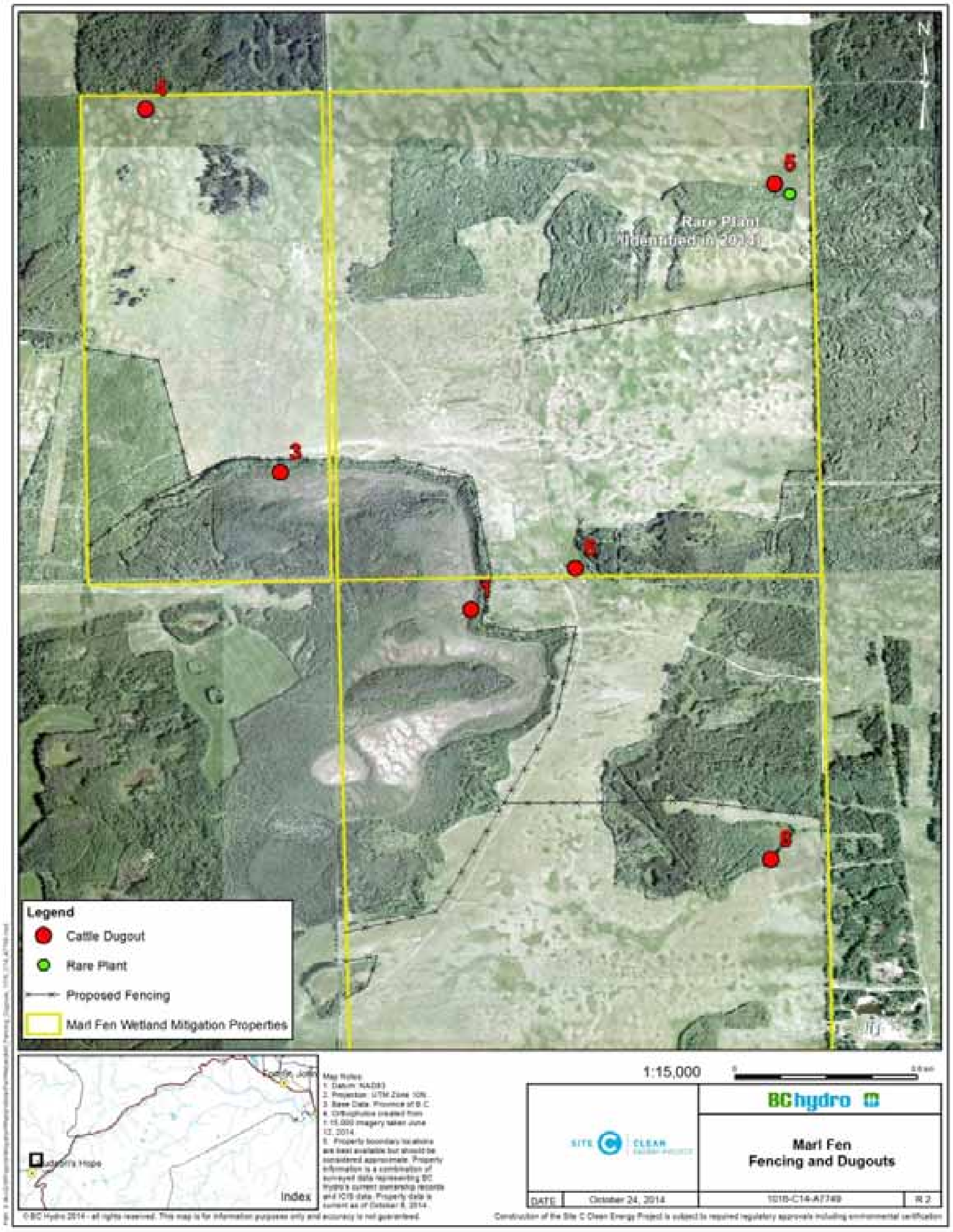

Figure 8. Location of worksites within the Marl Fen Property

Task 2. Wetland Exclusion Fence

Install fencing to isolate wetland from the adjacent cultivated fields as delineated by BC Hydro staking. The fence line has been located so sections are straight. This has resulted in the fence being offset from the edge of the wetland. Edges of existing cultivated field will be located on the inside of the fence along the edge of the wetland.

- Fencing to be installed as per the BC Agricultural Fencing Handbook (Ministry of Agriculture Food and Fisheries 2002 available at: http://www.agf.gov.bc.ca/resmgmt/publist/300Series/307000-1.pdf. Additional notes that apply:
    - Fencing to be installed by driving in fence posts, not auguring out post holes;
    - Line posts to be 7' 4-5" diameter pressure treated posts;
    - Brace posts to be 8' 4-5" diameter pressure treated posts;
    - Brace rails to be 10' long;
    - Line posts to be spaced 15' apart;
    - Wire spacing is 8" apart, beginning 18" above the ground with a top wire height of 42";
    - Top and bottom wires to be 12½ gauge hi-tensile smooth wire. Middle wires to be 12½ gauge double strand barbed wire.
    - Two 12 foot gates will be installed in the fencing at corners in the fencing (locations TBD).
- Two 12 foot gates will be installed at corners of the fence along the wetland (location TBD).
- One 12 foot access gate to be installed at each of the two water sources at the edge of the wetland (**Figure 6: sites 1 and 3**).
    - The gate will be located so it is easily accessible from the cultivated field.

8.3 Cattle Watering

The existing cattle watering dugouts will be improved in order to maximize capacity, protect and maintain water quality and assist in optimizing field grazing use by increasing options for both temporal (seasonal) and spatial distribution of cattle grazing. A detailed review of existing cattle watering facilities and plans for improving the current dugout and cattle watering systems are summarized below.

8.3.1 Proposed Works: Dugouts

8.3.1.1 Scope of Work

Rehabilitation of four dugouts (**Figure 6: sites 4, 5, 6 and** 8) located in cultivated fields within the property.

Creation of a water channel at the edge of the wetland at a current cattle access site (**Figure 6: site 3**)

Installation of cattle watering infrastructure at two sites adjacent to the wetland (**Figure 6: sites 1 and 3**). Infrastructure to be provided includes: two water troughs, a support structure for a seasonal above ground pumping system and a support structures for two above ground water storage tanks.

BC Hydro will establish access routes to worksites within the property. Contractor will enter and move all vehicles and equipment around the property on rubber tired vehicles along established access routes.

The contractor will only access the site when the fields are dry or frozen. No access will be permitted when the fields are wet and subject to rutting damage.

Dugouts # 4, 5, 6 and 8

Task 1. Remove existing organics from bottom of dugouts.

- Remove organic stained surface soils (cow footprints) - approximately 12 inches of organics to be removed. Use caution not to disturb any potential seal at the bottom of the basin.
    - Areas of removal have been staked;
- Excavated organics are to be put on top of the existing spoil pile
    - At dugout 8 organics will not encroach on the wetland area adjacent to the dugout;
- Spoil pile with new organics is to be shaped with moderate slopes and then seeded.
- Seed will be Certified and a seed certificate of analysis to be provided to BC Hydro. Seed mix to be used: Slender wheat grass (25%), meadowbrome (25%), creeping red fescue (25%), and alfalfa (25%), percentages by seed count. By weight the mix is approximately: slender wheat grass (27%), meadowbrome (45%), creeping red fescue (10%), and alfalfa (18%).

Task 2. Prepare two access ramps for cattle at dugout 6.

- The access ramps will be at least 16 feet wide, have a maximum slope of 16:1 and follow the design outlined in Quality Farm Dugouts, Alberta Agricultural and Rural Development (http://www1.agric.gov.ab.ca/$department/deptdocs.nsf/all/eng10361). A conceptual drawing of the ramps is illustrated below.
- The access ramp will extend down into the center of the dugout to allow cattle access during dry, low water years.
- Geofabric, or some other material to prevent sediments from entering the gravel base, will be placed along the access ramp prior to laying down gravel. The material will extend beyond the width of the ramp such that fencing can be put through the material to provide additional anchoring.

Task 3. Prepare level location for portable pumping trailer system to be located approximately 20-50 feet outside the exclusion fencing at dugouts # 4, 5 and 8.

- Location will have the following dimensions: 10 feet wide by 20 feet long.
- Area to be seeded with the same seed mix previously mentioned.

Dugout 4

Dugout 5

Dugout 8

Dugout 6: May

Dugout 6: July

Dugout 6: September

Wetland Water Source# 1

Task 1. Install permanent platform to support pump and fuel storage

- The platform will be 4-8 feet;
- Construct the platform roughly like a dock;
- The platform will be located on the inside slope of the spoil along the edge of the channel but above high water level;
- A diagram of the proposed layout will be provided;
    - o BC Hydro will review and approve the layout prior to the contractor initiating installation.

Task 2. Decommission and make safe the dry well

- Remove and safely dispose of the lumber;
- Backfill the hole with material from the spoil pile.

Wetland Water Source #1 and Dry Well (to be filled in)

Wetland Water Source # 3

Task 1. Remove organics from existing non-vegetated area to create a channel.

Task 2. Install permanent platform to support pump and fuel storage

- The platform will be 4-8 feet;
- Construct the platform roughly like a dock;
- The platform will be located on the inside slope of the spoil along the edge of the channel but above high water level.

Wetland Water Source 3

8.4 Field Improvements

8.4.1 Field Layout

In order to achieve greater flexibility and control of cattle grazing, and to ensure a more even distribution of grazing pressure on the fields, the five existing fields will be further subdivided into a total of 7 fields, by constructing cross-fences as shown on **Figure 3**. The proposed fencing is 4 strand barb wire on treated, driven poles, as described in the BC Agricultural Fencing Handbook (Ministry of Agriculture Food and Fisheries 2002 available at: http://www.agf.gov.bc.ca/resmgmt/publist/300Series/307000-1.pdf.

The existing property access gates, as well as existing field gates are shown on **Figure 3**. At least 3 additional internal field gates will be installed, as shown on **Figure 3**.

The wetland will be fenced along the perimeter, on the upland side, as shown on **Figure 3**. The purpose of this fencing is to exclude cattle from the wetland. The fencing will be driven, treated poles, 4-strand, with top and bottom wire smooth, bottom wire 18” above ground level, and middle 2 wires barbed (per BC MAF&F Fencing Handbook specifications) and 4 gates will be installed. The purpose of the gates is to a) allow access to the wetland for monitoring and b) provide a means of getting cattle (calves) out of the wetland should they get through the fence. Additional electric fences may be installed by the lease holder to further sub-divide fields, as required.

8.4.2 Proposed Field Management

8.4.2.1 Fields 1 and 2

The cultivated area of Field 1 is 97 ha and the cultivated area of Field 2 is 30 ha. These fields will continue to be used for intensive pasture.

These southerly fields are for the most part located on well drained, fine sandy soils and primarily support agronomic grasses, including bromegrass, tall fescue, and alfalfa (recently planted in the southeast corner). Field 2 has numerous depressional channels that are seasonally inundated and support native sedges and reed canary grass. The forested stands along the easterly field boundaries have not been and will not be fenced off. These stands provide limited forested grazing and cover for livestock. No harvesting of live or dead trees will be permitted.

The alfalfa recently planted in the southeast corner of Field 1 should be closely monitored and will need to be scarified (harrowed) and re-seeded by the lessee within the next two years. The newly seeded area should not be grazed in the establishment year.

The remaining areas of both Fields 1 and 2 should be renovated within the next 3 years by the lease holder and re-planted to the Peace River pasture grass mix. The fields will also be fertilized at the time of seeding. These fields will be grazed annually on a seasonal rotation (see section 7.3.2.2 above). Renovation will be required every 5-8 years to maintain productivity (newly seeded areas should not be grazed in the establishment year).

Under the proposed management regime, the carrying capacity of Field 1 is about 455 AUMs. The carrying capacity of Field 2 is about 141 AUMs. The number of head to be placed on the fields and duration of grazing will be worked out with the lessee annually.

Cattle watering dugouts will be improved within both field areas, at Site #1 and Site #8 (**Figure 3**). These improvements should enhance the ability to distribute cattle and achieve even grazing throughout the entire field area. Additional portable watering facilities may also be required to distribute cattle. This would be the responsibility of the lease holder.

If in the future the leaseholder wishes to produce a hay crop these fields would be where this would occur. Production of hay on other fields will not be permitted in the current Plan.

8.4.2.2 Fields 3 and 4

The cultivated area in Field 3 is 44 ha and the cultivated area of Field 4 is 30 ha. These fields will continue to be used for intensive pasture.

Fields 3 and 4 are located along the north side of the wetland and are similar to Fields 1 and 2, although Field 3 may have somewhat coarser textured (sandier) soils (based on conversations with former operators). These fields should be renovated following completion of Fields 1 and 2 within 4-5 years of the lease award.

The existing cattle watering dugout (site #3), along the north margin of the wetland within Field 4, will be improved. Water from this dugout will be provided to cattle via a pumping system (to be provided by leaseholder).

Water for cattle using field 3 will be provided via a portable system that is filled with water from either site 1 or 3 (to be provided by leaseholder).

Under the proposed management regime, the carrying capacity of Field 3 is about 207 AUMs. The carrying capacity of Field 4 is about 141 AUMs.

8.4.2.3 Field 5

Field 5 is located in the north-west corner of the Property and has a cultivated area of 50 ha.

Field 5 appears to have a greater extent of poorly drained channeled soils dominated by native sedges, as well as scattered tree stands. This field will be allowed to continue to mature to “old field habitat” to enhance wildlife values. Cattle grazing will initially be allowed in mid-to late summer (e.g. August-September), with cattle removed when about 50% of the mature grass cover has been grazed to ~6 inches in height. Depending on field conditions, this would be followed by an early rotation from mid-May to June 30, with cattle removed when grass height is ~6 inches over about 50% of the field. The early spring rotation would be followed by mid-to late summer grazing (August-September) in the following year. No later grazing season use (October-November) will be permitted. The actual timing and intensity of cattle grazing will be based on annual monitoring of field conditions by the lessee. It is expected that early spring grazing will occur every 2 to 3 years, with mid-to late summer grazing occurring in years where early spring grazing does not occur.

Grass values would be increased for limited cattle grazing purposes by light scarification (eg, using a harrow) and over-seeding on the ridges to a Peace River pasture mix, combined with limited fertilizer application. The poorly drained channels and depressions will not be cultivated and re-seeded. This improvement work will be carried out over the next 3 years by the lessee, in consultation with BC Hydro.

The dugout at site #4, along the north field boundary, will be improved. Water from this dugout will be provided to cattle via an external water trough (to be provided by leaseholder).

Under the proposed management regime, the assigned grazing rate of Field 5 will be about 117 AUMs.

8.4.2.4 Field 6

Field 6, located in the north east corner of the Property, is approximately half open field and half interspersed tree stands, and has a cultivated area of 73 ha.

The open fields have largely reverted to “old field habitat” and are a complex mix of well drained, sandy ridges and poorly drained, sedge and reed canary grass dominated swales. It is proposed that this area be managed to retain and enhance the old field habitat. Grazing in this field would be limited to mid-to-late summer and would be of very low intensity. This will maintain old field habitat and protect the sharp tailed grouse lek(s).

Dugout at site #5, near the east field boundary, will be improved. Water from this dugout will be provided to cattle via an external water trough (to be provided by leaseholder).

Under the proposed management regime, the assigned grazing rate of Field 6 will be about 171 AUMs.

8.4.2.5 Field 7

Field 7, located along the mid-east Property boundary, has a cultivated area of 62 ha.

Field 7 was recently renovated and reseeded to a “Peace River pasture/hay mix”, which contained Timothy and alfalfa and likely also contained brome grass and other agronomic species. The westerly and southerly portions of the field are in good condition but the north east quarter is weedy and sparsely revegetated. Light scarification (eg, harrow) and re-seeding of this area should be completed within the next 5 years. Continued treatment of the noxious weeds in this area will be required (see Section 9 below).

The existing cattle watering dugout at site #6, in the southwest corner of the field, will be improved. Cattle will access water in this dugout via ramps. A short section of the existing fence will be removed to allow access to this dugout.

Under the proposed management regime, the carrying capacity of Field 7 is about 141 AUMs.

9.0 WEED TREATMENT

The leaseholder will be responsible for continued control of noxious weeds on the Property. BC Hydro's noxious weed specialist will conduct a weed inventory of the entire Property in early June of 2015 once plants have grown enough to be identified to determine the status of the known infestations. The results of the inventory will be provided to the leaseholder. The BC Hydro noxious weed specialist will assist the leaseholder in development of a treatment program.

Post-treatment inspections, by the BC Hydro noxious weed specialist, will be carried out on all chemically treated areas within 10-14 days of herbicide application or as directed by the label to assess the efficacy of the treatment.

One of the dangers of applying the same chemicals to an infestation is the development of chemical resistance. In order to ensure the infestations does not develop herbicide resistance, chemical groups used will be rotated over the years and efficacy will be assessed during the post-treatment inspection. If signs of resistance are observed (e.g. plants not being killed) then the herbicide group will be changed.

A thorough final weed audit will be conducted at the end of the growing season (September-October) to assess the efficacy of the treatments and to aid in the development of future treatment and management recommendations for the site.

10.0 ADDITIONAL REQUIREMENTS AND/OR RECOMMENDATIONS

- No polypropylene twine or wire is to be used for any hay brought on site. Only degradable twine is to be permitted.
- The lease holder should consider carrying out soil tests for soil fertility management.
- Placement of bee hives on the Property should be considered.

11.0 MONITORING AND FOLLOW-UP TO MANAGEMENT OF PROPERTY

11.1 Lessee record keeping requirements

At a minimum the lease holder will keep records of the following:

- Date cattle enter property;
- Number of cattle on site;
- Rotation of cattle through fields (dates on and off each field);
- Grass length at time cattle enter and leave fields (average based on measurements from 5 sites within the field);
- Weather conditions (dry year, wet year);
- Number of times cattle get into the wetland;
- Wildlife observations, including any issues with wildlife;
- Data cattle removed from Property.

11.2 Monitoring by BCH

BC Hydro will conduct the following surveys and monitoring observations on the Property:

- Breeding bird surveys (see Sections 7.1.1.2-A and 7.2.7 of the *Vegetation and Wildlife Mitigation and Monitoring Plan*) including Sharp-tailed Grouse lek surveys (e.g. May-June);
- Waterfowl and shorebird follow-up monitoring (see Section 7.1.1.2-C of the *Vegetation and Wildlife Mitigation and Monitoring Plan*);
- Monitoring of water extraction infrastructure (when cattle on site - frequency TBD);
- Monitoring of field conditions (when cattle on site);
- Monitoring of general property conditions (TBD).

11.3 Annual meetings to discuss/update management plans

To be determined in consultation with leaseholder.

12.0 REFERENCES

BCLI, 1979. Land Capability for Agriculture, 1:50,000 Mapsheet 94A/4 (Hudson Hope).

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Environment Canada. 2013. Bird Conservation Strategy for Bird Conservation Region 6: Boreal Taiga Plains.

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Simpson, L., 2104. C. Churchland, T. Jones and T.K. Simpson. 2014. Site C Clean Energy Project: Wildlife, Vegetation and Mapping Inventory for the Marl Fen Property. Keystone Wildlife Research.

Appendix 1. Photos

Photo 1. Dilapidated Shed

Photo 2. Steel silos

Photo 3. Reservoir in wetland

Photo 4. Existing fencing in good condition

Photo 5. Existing fencing needing repair

Photo 6. Damaged gate

Photo 7. Existing cattle handling infrastructure needing repair

Photo 8. Plastic bale bags

Photo 9. Old propane tanks

Photo 10. Dry well at dugout #1