



DWB Consulting Services Ltd.

# Whitesail Reach Caribou Calving Islands Rehabilitation Project Plan and Site Prescriptions



Engineering | Environmental | Forestry

Prepared for: **Society of Ecological Restoration in Northern BC (SERNBC)**

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# Signature Page

DWB Consulting Services Ltd. is pleased to submit this report for your review. This report has been prepared using sound technical and professional judgement, based on our knowledge and experience, applicable regulatory framework, industry best management practices, and current understanding of project conditions, design, and project setting.

REPORT TITLE: Whitesail Reach Caribou Calving Islands Rehabilitation – Project Plan and Site Prescriptions

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We do not represent, warrant, undertake or guarantee:

- That all project environmental-related information has been received.
- That regulations and standards of practices shall remain constant through the duration of the project.
- That the use of guidance in the report will lead to any particular outcome or result; or, in particular,
- That by using the guidance in the report, the client will be approved by the contract holder for the applied works.

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# 1.0 INTRODUCTION

## 1.1 PROJECT SCOPE

The Society for Ecosystem Restoration in Northern British Columbia (SERNbc) has retained DWB Consulting Services Ltd. (DWB) to prepare a Project Plan and Site Prescriptions for the Whitesail Reach Woodland Caribou Whitesail Reach Caribou Calving Islands Rehabilitation Project. The work will include the management of standing and floating timber and woody debris along the shoreline of Whitesail Reach, which forms the Nechako Reservoir. The objective of these efforts will be to help restore critical migration routes for the Tweedsmuir-Entiakio Caribou (TEC) herd. TEC are part of the Northern Mountain (DU7) population, designated as a species of Special Concern in Schedule 1 of the Species at Risk Act (SARA) and a blue-listed species by the BC Conservation Data Centre (CDC 2019). TEC are also considered the Northern group of the Southern Mountain population found within the Southern Mountain National Ecological Area (SMNEA; Environment Canada 2014).

The Whitesail Reach is part of the historical migration route for the TEC and contains critical calving islands for the herd. Currently, there is a considerable risk of abandonment of this migration route by the TEC in part due to large accumulations of large woody debris (LWD) creating barriers along the shorelines of calving islands. The accumulation of debris in Whitesail Reach has increased over the past decade as standing flooded tree tops in the reservoir have begun to break off. The majority of the clustered LWD is found along the beach of the reservoir at the mean low-water mark (hereafter referred to as the foreshore), as well as within the water between the shoreline and where the waves steepen and break (hereafter referred to as the nearshore). During the spring, members of the herd access the islands to calve, however, the woody debris has begun to pose challenges of access between the mainland and the islands. The loss of functional calving range could impact calf survival for the TEC, which likely use the range to avoid predators. This Project Plan provides an overview of the approach and activities that will be undertaken by the Cheslatta Carrier Nation (CCN) to manage woody debris within Whitesail Reach as a restorative measure for the calving ranges, as well as a description of the environmental measures that will be implemented during the works.

There are multiple sites within Whitesail Reach that are candidates for LWD management. Porcupine Island has been selected as the Pilot Project site to begin restoring migration routes for the TEC. An additional four islands have also been identified as high priority candidates. The selection and treatment for ~~the total of~~ five candidate island sites are described in this plan. Work planned for the Pilot Project site is scheduled to be completed between ~~May~~ and October 2019. Debris management activities on the additional four islands are planned for subsequent years following the Pilot Project work.

As part of this project, an Environmental Management Plan (EMP) has been developed to provide guidance towards the protection of environmental resources and mitigate potentially adverse impacts to various environmental components during the proposed activities (DWB 2019).

## 1.2 PROJECT LOCATION

Whitesail Reach is approximately 85 km southwest of Burns Lake, BC and forms part of the Nechako Reservoir (Figure 1). The reach, formerly known as Whitesail River and Sinclair Lake prior to flooding, extends from the entrance of Tahtsa Reach to Whitesail Lake. A total of five islands (1 pilot study and 4 additional islands) have been identified for restoration works and are highlighted in Figure 1. Proposed landing sites (ancillary sites) are also highlighted in Figure 1.

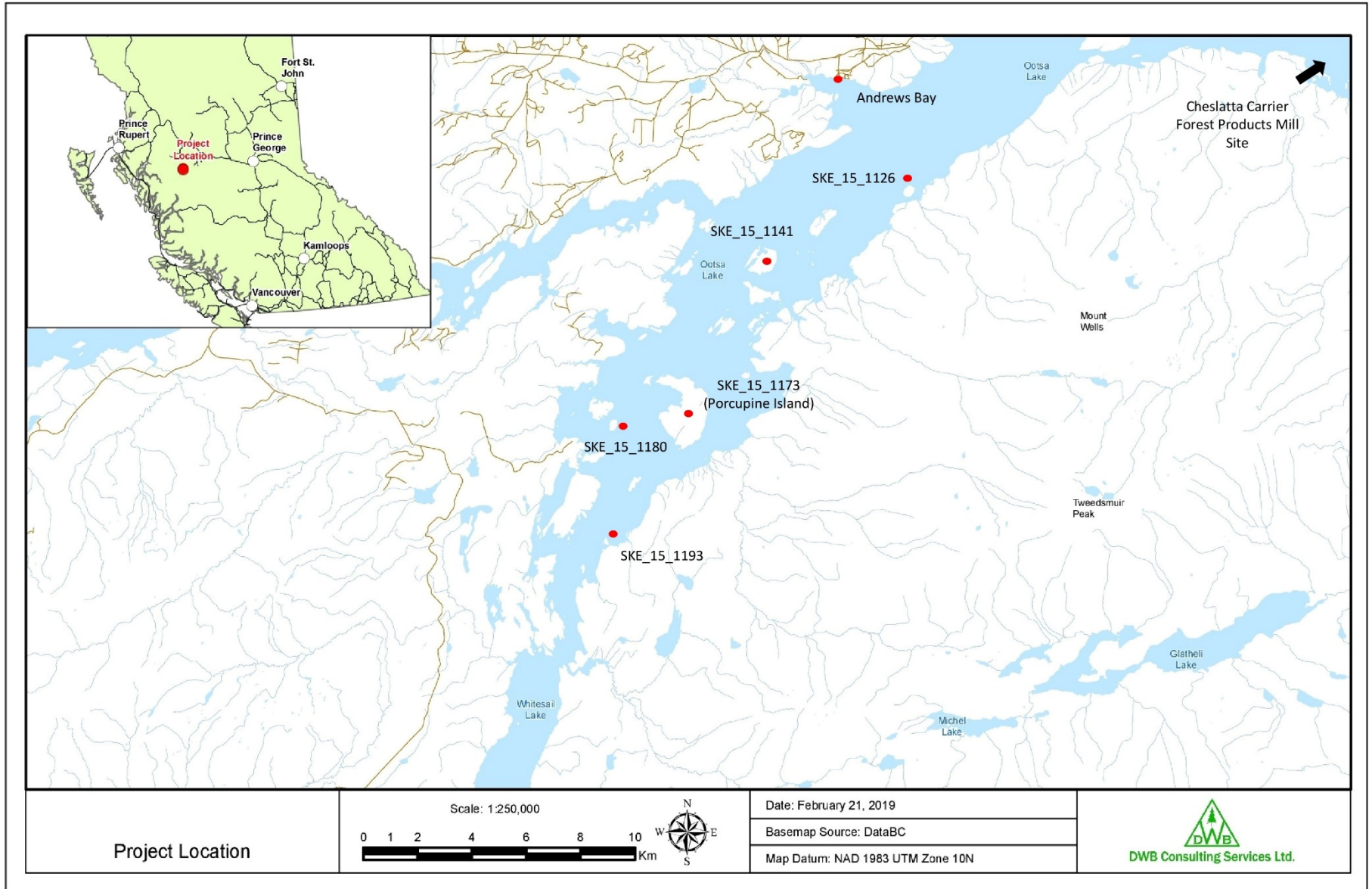


Figure 1: An overview map of Whitesail Reach, located on the Nechako Reservoir.

## 1.3 PROJECT SCHEDULE

Project works may be completed between May and October 2019. However, the preferred period for conducting the project will be between August and October 2019 to account for lower water level timetables and least-risk timing windows for wildlife (refer to Section 6.2 in the EMP). Details in regards to scheduling for debris management activities at the other selected island sites will be made available in future work plans; however, it is anticipated that the future works will be completed in relatively the same time frame (August to October), but in subsequent years.

The Nechako Reservoir becomes ice free by early to mid-May. The lowest reservoir levels occur in May, followed by increasing levels and then peak in July. Reservoir levels then begin to draw down from early late July and into the winter and following spring. Operations will be avoided during TEC calving season (late June-July; Section 6.2 of the EMP) and instead will be completed between August and October to take advantage of the drawdown period and avoid the shoulder season when field conditions may become challenging.

## 1.4 REPORT OBJECTIVES

The objective of the Project Plan and Site Prescription is to outline the rationale for and select candidate islands for rehabilitation works. The report also provides treatment prescriptions for each of the selected islands and outlines debris management and techniques for the project. The report references relevant sections of applicable regulatory standards and environmental best management practices (BMPs). As more information becomes available, this report, the EMP and any accompanying documents, will be updated to reflect the necessary changes and additional information.

# 2.0 CANDIDATE ISLAND SELECTION CRITERIA AND PROCESS

## 2.1 SELECTION CRITERIA

All islands identified as important calving habitat for Caribou within the Morice Land and Resource Management Plan (2007) were selected as the primary candidates for restoration/enhancement of caribou migration through debris management activities. Islands located in close proximity to others (within 200 m of each other) were grouped into a single candidate site. A list of criteria was developed to aid in the selection of islands that would provide the best value for the proposed restoration activities (Table 1). These decisions were made based on a variety of factors that take **into account**: the accessibility and available habitat, and the logistics involved with debris management. More details for debris management are available in Section 7.0 of the EMP.

Currently only single islands within the outlined criteria were chosen as candidate sites (with a slight exception of one small group, SK\_15\_1141, which is would be considered two islands only during high water). Island group data was recorded and categorized within the selection criteria, however it was not included in this exercise. These groups may be categorized with different criteria to accommodate for other environmental factors in these sites. A total of 6 criterion were identified and used to evaluate the islands. The evaluation was completed using a ranking system. For each criterion, a ranking was given between 1 (low) to 5 (high), with 5 being the most ideal and beneficial ranking, and 1 being the most detrimental to caribou use and/or habitat. The total score for all criteria for each island was then calculated with the highest scores selected as final candidate sites.

**Table 1.** Summary of criteria used to select candidate islands, along with description and rationale for each criterion.

CRITERION	DESCRIPTION	SCORE BASIS	RATIONALE
Caribou Presence	<ul style="list-style-type: none"> <li>Telemetry data for the Tweedsmuir-Entiako caribou herd recorded between 1980 and 2018 used to evaluate the estimated level of activity at each island.</li> </ul>	<ul style="list-style-type: none"> <li>This criterion wasn't used to rank the islands, but rather to simply identify which ones confirmed caribou presence, and to determine which islands would move forward in the selection process.</li> </ul>	<ul style="list-style-type: none"> <li>Only islands that were confirmed caribou habitat would be selected as candidates.</li> </ul>
Total Area of Island Habitat Ranking /5	<ul style="list-style-type: none"> <li>The total land area for each island.</li> <li>Recorded in hectares.</li> </ul>	<ul style="list-style-type: none"> <li>Score was proportional to the area (larger island, higher score).</li> </ul>	<ul style="list-style-type: none"> <li>Larger islands may provide greater benefit (more habitat availability) for caribou during calving.</li> </ul>
Debris Density Ranking /5	<ul style="list-style-type: none"> <li>The estimated amount of debris likely to be present at the site.</li> </ul>	<ul style="list-style-type: none"> <li>Debris density estimated using available satellite and orthophotos.</li> <li>Score was inverse of density (high density = low score).</li> </ul>	<ul style="list-style-type: none"> <li>Greater effort will be required to regularly manage debris at locations where debris accumulates to high densities.</li> </ul>
Accessibility Regarding Distance Ranking - Based on wolf predation risk /5	<ul style="list-style-type: none"> <li>The distance between the island or island group and the mainland. With regards to wolves ability to reach the island.</li> <li>Recorded in meters.</li> </ul>	<ul style="list-style-type: none"> <li>Score was proportional to the distance (larger distance = higher score)</li> <li>Islands that were closer to the mainland on the east side of the reach (Tweedsmuir Provincial Park) had their score increased by 1.</li> </ul>	<ul style="list-style-type: none"> <li>Further swimming distances between the islands are not necessarily a negative, as caribou are good swimmers.</li> <li>Islands closer to shore may be more accessible to predators, i.e. wolves</li> <li>Wolves are less likely to swim further distances out to further islands.</li> </ul>
Distance to Nearest Log Sort/Landing (Andrews Bay) Ranking /5	<ul style="list-style-type: none"> <li>The distance between the island and the proposed landing for wood processing (e.g., Andrews Bay).</li> <li>Recorded in kilometers.</li> </ul>	<ul style="list-style-type: none"> <li>Score was inverse of distance (larger distance = lower score).</li> </ul>	<ul style="list-style-type: none"> <li>Greater effort will be required to manage debris and monitor debris conditions for islands further away from the access/landing areas.</li> </ul>

<p>Proximity to Anthropogenic Features Ranking</p> <p>/5</p>	<ul style="list-style-type: none"> <li>○ The proximity of the islands to anthropogenic distances (i.e., linear corridors, forest harvest blocks, landings) on the closest mainland (west or east shoreline of the reach).</li> <li>○ Recorded in kilometers.</li> </ul>	<ul style="list-style-type: none"> <li>○ Score was proportional to distance from disturbance (larger distance = higher score).</li> </ul>	<ul style="list-style-type: none"> <li>○ Caribou are likely to avoid disturbed areas such as forest harvest blocks and linear corridors, particularly during calving.</li> <li>○ Predators may utilize linear corridors, increasing their efficiency of movement.</li> </ul>
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Based on discussions with various stakeholders for the project, a pre-determined target of five sites for the Caribou Migration Restoration/ Enhancement Program was identified. As such, the top five islands with the highest scores were selected as the final candidate sites. Additional criteria are currently being developed as part of a larger tactical plan that aims to identify priority restoration areas for Caribou within Whitesail Reach. The additional criteria will work to stratify islands and shorelines into priority categories based on 1) Caribou use of islands during calving or other non-calving periods and 2) Caribou use of shorelines are associated with islands (adjacent to) during calving, migration, or any other time period.

## 2.2 SELECTION PROCESS

The first criteria selection was to determine whether or not caribou presence was known or unknown. This was established by reviewing telemetry data for the TEC herd provided by Wildlife Infometrics (See Appendix A) to investigate individual observations of caribou presence within Whitesail Reach and its islands. This criterion was used to refine the candidate island selection, and no ranking was provided. After selecting islands where caribou were shown to occur, four additional criteria were applied to the selected islands. Each of these criteria received a ranking.

The total area of each Island was estimated using iMapBC (GOVBC 2019). It was established from previous research and knowledge (DWB 2019) that larger islands can provide more potential forage and cover habitat. Larger islands have a greater chance of providing a variety of habitats, and potentially a more developed stand structure and seral stage, which are key components of caribou forage and cover habitat. Caribou spring and summer foods include grass, forbs, sedges, and terrestrial and arboreal lichens (Morice LRMP. 2007).

**Table 2. Total Island Area Ranking system.**

Rating	Total Area of Island (ha)
1	1.0 - 2.5
2	2.5 - 5.0
3	5.0 - 7.5
4	7.5 - 10.0
5	> 10.0

A Debris Density Ranking was then applied to the selected islands and was based on the estimated efforts required to manage coarse woody debris (CWD) at the island. This rating is based directly off of a visual CWD estimate (including standing timber) around the island. The CWD estimates were completed using the DataBC Orthophoto Web Map Services through iMapBC; Google Earth was used for comparative purposes. Composites of Sentinel-2 satellite data from select sites that were scanned during spring, summer, and fall 2018 were processed using QGIS V3.6 (QGIS Development Team 2019) to provide 10 m<sup>2</sup> band resolution for comparison with the orthophoto imagery. It is estimated the orthophotos were obtained mid-summer to fall 2018.

Ratings were lowered for islands that appeared to be mostly an accumulation of floating or sunken debris with little to not actual ground present. For example, an island with a 3 might be changed to a 2 to account for this. This ranking can provide insight into which islands will require more efforts and work for debris removal. Islands with large amounts of CWD were given lower ratings and are expected to take more effort, and likely more time to have the debris removed for the project.

**Table 3. Debris Density ranking system.**

Rating	CWD volume rating
1	High Amount of CWD build up
2	Moderate-High Amount of CWD build up
3	Moderate Amount of CWD build up
4	Low-Moderate Amount of CWD build up
5	Low Amount of CWD build up

An Accessibility Distance Ranking was applied to the selected islands and was based on the distance (meters) from the island to the mainland shoreline. Previous research has indicated that caribou are good swimmers and that longer swimming distances do not necessarily limit their ability to reach island habitat or their decision to cross water bodies (A de Vu, 1958; Bergerud, 1984). Based on this evaluation and the telemetry data available, it is confirmed that caribou have successfully reached further distance islands from the mainland shores. Therefore, this ranking is based on the distance from the shoreline with regards to predators (i.e. wolves), and how accessible these islands are to predation. Distance ranges for each ranking were established based on the distances recorded for all the islands pre-selection, to gain an overall estimate of the range of distances.

Islands closer to the shoreline were given lower ratings, as these islands are more susceptible to predation than islands further into the Nechako Reservoir. Islands closer to the east side of the reach (Tweedsmuir Park) had their score increased by 1. The further west the location, the less potential for caribou habitat. Due to water levels dropping at certain times of the year, closer islands were predicted as having a higher risk of wolf access.

**Table 4. Accessibility Distance ranking system.**

Rating	Distance (m) from island shoreline	Risk of predators (i.e. wolves) reaching island
1	0 - 100 m	Very high risk
2	100 - 200 m	High risk
3	200 - 300 m	Moderate risk
4	300 - 400 m	Low risk
5	≥ 400 m	Very low risk

A Distance to Nearest Log Sort/Landing ranking was applied to the selected islands and Andrews Bay was chosen as the designated location to place the debris. The Cheslatta Carrier Forest Products Mill site may also be utilized to process wood, if Andrews Bay is not used. There is potential for both areas to be used for log sorting and processing. Distance was determined in kilometers using Google Earth and iMapBC tools, and was measured as the crow flies rather than a route through the reservoir, as routes are currently unknown. Larger distances were given lower rankings, as more effort is required to haul the debris larger distances, and requires more resources (e.g., gas, equipment). Safety and efficiency may also become more of an issue on longer trips. Therefore, islands closer to Andrews Bay would receive a higher ranking.

**Table 5. Distance to Nearest Log sort/Landing Area (Andrews Bay) ranking system.**

Rating	Distance (km)
1	≥ 15
2	< 15
3	< 10
4	< 5
5	< 1

A Proximity to Anthropogenic Features (Linear Corridors/Features) Ranking was applied to the selected islands based on the distance (kilometres) from the island to an anthropogenic disturbance feature (i.e. logging roads or development area). Previous research has indicated that caribou are more likely to avoid these areas, as these areas tend to have lower habitat quality and a higher predation risk (Environment Canada, 2014). Islands that were further away from anthropogenic features received a higher ranking.

**Table 6. Proximity to Anthropogenic features ranking system.**

Rating	Distance (m) to anthropogenic feature
1	< 250 m
2	>250 m
3	< 500 m
4	< 1 km
5	> 1 km

## 2.3 CANDIDATE ISLANDS

After applying the selection criteria, a total of eight islands were remaining. The top five islands out of these eight with the highest scores were selected as the final candidate sites (Table 6). The presence of caribou was already determined using Telemetry data provided by Wildlife Infometrics (Appendix G). The Morice Land and Resource Management Plan has identified important calving islands along Whitesail reach (Table 7.) This LRMP bases their calving habitat use off of the presence of multiple (>3) caribou cows with calves on an island.

**Table 7. Top 5 final candidate islands with final ratings.**

Island ID	Island Area Ranking	Debris Density Ranking	Accessibility Distance Ranking	Distance to Andrews Bay Ranking	Proximity to Anthropogenic Features Ranking	Total Ranking /25
SKE_15_1126	5	3	2	4	5	19
SKE_15_1141	5	1	4	3	5	18
SKE_15_1180	4	3	5	1	5	18
SKE_15_1173*	5	1	5	2	5	18
SKE_15_1193	2	5	4	1	5	17

\*Porcupine Island

## 2.4 ANCILLARY SITES

The five selected islands are all location on the northwestern side of the Nechako Reservoir in Ootsa Lake. This section of the reservoir is along the west side of Tweedsmuir Park. More information is available in Section 7.0 of the EMP (DWB 2019).

Andrews Bay is located on the north side of the Nechako Reservoir near Tatsa Reach off of the Wisteria Mainline (UTM: 9U 657152 5964002). It can be accessed a variety of ways. Take the ferry across François Lake and continue onto Keefes Landing Road. Continue right onto Ootsa Nation Road and the access road for Andrews Bay is ~ 42 km on the left side of the road. The Cheslatta Forest Industries Mill site is just past the junction onto Ootsa Nadina Rd on the left side, approximately 9.5 km E just off Ootsa Nadina Rd from the Skins Lake Dam Spillway (UTM: 9U 690443 5966942).

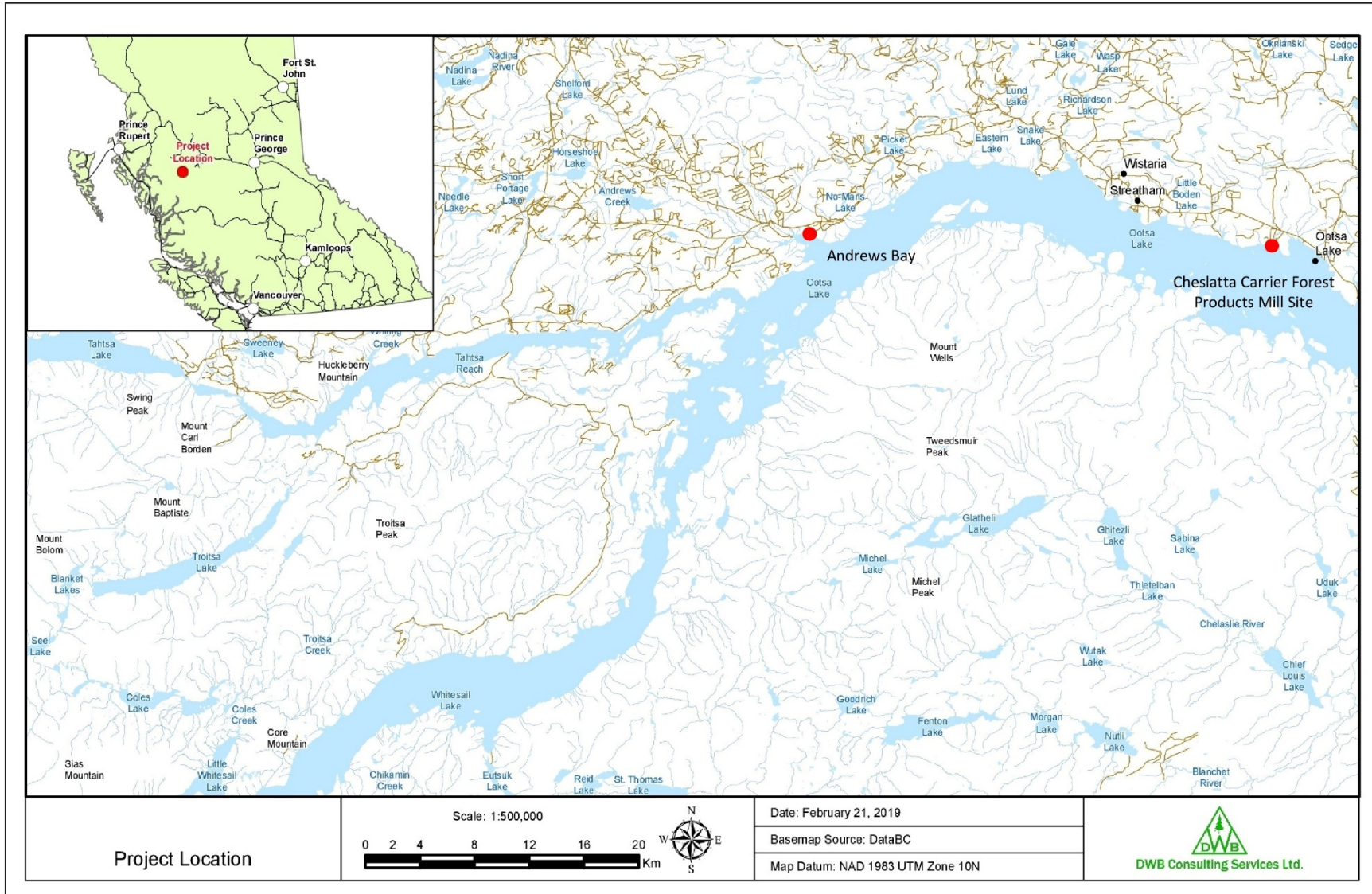


Figure 2. Map showing the two Ancillary Sites, including Andrew's Bay and the Cheslatta Carrier Forest Products Mill Site.

Andrews Bay can also be accessed from Houston, by turning left off Highway 16 onto Morice River Road. Continue on this road as it becomes Morice Owen FSR. At approximately 56 km, turn right onto Morice Nadina FSR. At ~ 23.5 km turn left onto the Wisteria Mainline and continue for another ~ 23.5 km. There is an access road on the right to Andrews Bay. To access the Cheslatta Forest Industries Mill Site from these directions, continue past Andrews Bay for another ~ 42 km just before the junction onto Keefes Landing Road.

## 2.5 SITE ACCESS

Cheslatta Carrier Nations has a large inventory of equipment, boats, barges, and mobile facilities that have been used for debris management activities in previous years. Equipment staging and some of the debris management operations will occur at designated landing sites on the north shore of the Nechako Reservoir (e.g., Andrews Bay, Cheslatta Forest Products Mill Site). Crews and equipment will be transported from landing sites to Project Sites along the reservoir. Some of the available equipment that may be utilized include barges (e.g., fixed frame propane barge), tug boat, crew (jet) boat, mobile office, fuel trailer, modified processor/excavator, chipper, skid steer, boom sticks, feller buncher, modified crane, log grinder, dump truck and loader.

The following BMPs apply:

- Minimize site disturbance including noise, air, and water pollution to the greatest extent feasible.
- Protect vegetation growing above the HWM.
- Follow clearing and grubbing BMPs (Refer to Section 7.5 of the EMP).
- For barge access, locations to unload the excavator from the barge will be carefully selected to prevent/minimize sedimentation and disturbance to the reservoir shores.
- Avoid sensitive areas, including wetlands, nesting grounds, mineral licks, and locations where the ground is easily erodible.
- For truck access, any temporary access detour, haul road, or staging area will be constructed to accommodate all required uses and will be maintained throughout construction to prevent impacts to soil erosion, water quality, and wildlife.
- Adhere to the guidelines contained within the EMP (DWB, 2019) under the direction of environmental monitors and QEPs.

## 3.0 DEBRIS MANAGEMENT APPROACH AND TECHNIQUES

Cheslatta Carrier Nation (CCN) will be the sole owner of all woody debris that is harvested through this program as a primary partner and contributor of resources to the project and the holder of the Special Use Permits, Timber Licenses, and a valid Timber Mark. The debris will be separated based on intended use and piled onshore at a location designated by CCN in such a way as to facilitate its desiccation. The air-drying process may take a period of time ranging from 6 months to 2 years or until such a time that CCN deems the transportation and sale of the fibre to be optimal in terms of the economic incentive. Intact logs may be sent to sawmills while broken or degraded pieces will likely be sold as biomass for energy, to a pellet production facility, or chipped and decomposed into a reclamation mulch.

Submerged timber is likely to have a better preserved due to reduced resin content and increased strength (Lucas, 2007; Thompson et al. 2015). However, there may be complications in the milling process if the debris is heavily embedded with rock or sediment. This concern is likely not as applicable to the wood that

is still attached by root structures to the reservoir bottom as it will have a lower exposure to sediments than the detached debris found along the shoreline. Generally, the lower the moisture content in the fibre the more economical it is to process, especially in terms of hauling and kilning.

### 3.1 SITE RECONNAISSANCE

An initial site reconnaissance will be completed prior to conducting debris management activities at a site. The aim of the recon is to identify site specific environmental and archeological considerations for final planning of debris management activities, including nesting birds, presence of amphibians, other wildlife, notes on the soil firmness for machinery access (no rutting), and noted signs of potential danger trees. The extent of debris management (boundaries in which debris will be removed) will be determined and flagging will be installed at the boundaries to guide management activities and the boundary will be collected via tracking on a GPS. Site reconnaissance efforts will likely be completed after the calving season. Larger woody debris piles and/or standing timber will be investigated to determine the most appropriate approach to harvesting or removing.

A detailed site plan will be prepared during the recon that will include GPS coordinates, photo log, sketch, and notes, including confirmation of the extent of the debris and information on the substrate. The site reconnaissance will be completed by a QEP (preferably the designated Environmental Monitor; see Section 8.0 of the EMP) and a First Nations monitor from CCN. A number of tasks will be completed during the reconnaissance with safety and environmental management considerations being at the forefront of discussion and planning. Recon activities shall include:

- Inspection of the shoreline for potential short- and long-term ESC concerns (e.g., slumping potential).
- Bird nest searches within and around woody debris and water-bound standing timber (e.g., osprey).
- Site inspection for signs of recent/regular wildlife activity (e.g., tracks) and amphibian activity (e.g., breeding/egg masses).
- Inspection, GPS, and flagging of any sensitive features, potential barge access locations, and potential danger trees that may require hazard assessment.
- Inspection of shoreline and woody debris for any significant cultural or heritage materials (see Archaeological Management Plan in Section 12.0 of the EMP).
- Debris volume estimations and logistical planning considerations.

If any clearing and grubbing of vegetation along the shoreline is anticipated or required (e.g., potential danger trees), then the extent of the proposed area will be delineated by flagging and the boundary will be collected via tracking on a GPS. During the reconnaissance, the QEP and representatives from CCN will also discuss the potential use of log booms for long term debris management to determine whether the approach may be practical and beneficial for the site. Potential for burning debris piles on location will also be considered and planned out in relation to positioning of piles to avoid ladder fuels. The QEP and monitors will also check on camera monitoring stations to ensure that the batteries are operational, that no damage has occurred, and that photos are being taken. Camera trap installations are being planned in some initial trial locations (e.g., Porcupine Island) prior to the calving season.

It is assumed that large volumes of submerged timber are not visible in the available orthophotos from iMapBC (GOVBC 2019) and therefore the presence and extent could not be determined during the desktop assessment. Attempts will be made to complete an assessment of submerged standing timber

within the boundaries of the debris management area by boat, but this will be dependent upon weather, turbidity levels, and visibility at depth. Estimations will be adjusted accordingly at the time of underwater logging with the equipment and incorporating the experience of CCN personnel that have completed underwater logging in previous years.

Site reconnaissance information will be incorporated into a site-specific plan. This will include maps of stream locations, mitigation required (e.g., fish isolation, amphibian salvage, bird nest sweeps, water quality monitoring, spill management, etc), and referenced into context of the overarching EMP document. The QEP will identify and flag out suitable docking sites where the barge may be able dock to either deliver the equipment onto the shoreline (i.e., non-sensitive areas, firm substrate, and clear line of access) or to operate the excavator from the barge to collect stranded wood along the shoreline and the drawdown area.

It is anticipated that a mid-sized excavator equipped a rake bucket will work along the shoreline to gather the debris. A skid-steer will work with the excavator to move the debris as needed, into piles or for loading onto the barge. The logistics for equipment and method of execution will be discussed with the CCN manager to include this information with the site plan memo. The site plan and memo will form the addenda and will be included as part of the EMP field package for environmental monitors to review and have on location for applicable management.

### 3.2 CLEARING AND GRUBBING

For the purposes of this plan clearing and grubbing activities can only occur on Special Use Permit (SUP) or a Road Permit (RP). A Park use Permit is also required for work within the Tweedsmuir Provincial Park area. At the start of work activities further clearing and grubbing may be required for particular locations on site. Suggested locations are:

- Locations designated for piling and burning of non-merchantable timber above the HWM.
- Ancillary sites for temporary storage and loading of merchantable timber.

Designated locations will be discussed between the onsite QEP and equipment operator, and marked and flagged by the QEP prior to clearing/grubbing activities. It is necessary that the areas designated as potential burn piles are cleared down to mineral soil and ladder fuel considerations are accounted for, as to not create fire risks. All burning must meet requirements of the Wildfire Act including lighting during open wet seasons and that venting indices are being monitored. Refer to Section 7.8 of the EMP for BMPs related to piling and burning of non-merchantable woody debris.

Additionally, the clearing of shrubs may be required at the ancillary sites where merchantable timber may be piled and stored to dry. These areas may also serve as truck loading areas for the timber. If clearing works are to occur during the bird breeding window, nest surveys will need to be conducted prior to the start of the works by the QEP following bird nest survey protocols (refer to Section 9.3 of the EMP).

Only a minimal amount of clearing and grubbing is expected and will only occur under dry conditions. Leftover stripping and soil will be stockpiled a minimum distance of 30 m from the edge of the HWM to prevent sediment from entering the reservoir. Data on caribou habitat locations will be included in maps and geo-marked as sensitive to ensure that there is no intrusion or disturbance into these locations unless QEP approved as part of the required restoration works. Vegetation clearing/grubbing should be kept to a minimum at all times, and clearing shall extend no further than the operation requires to limit disturbance and soil compaction.

The selected landing site is not expected to require any clearing/grubbing works as this location is already an active site (e.g. Andrews Bay). Preliminary site preparation may be required for access to some of the island shorelines (e.g. SKE\_15\_1141), however the debris is primarily below the vegetation line and disturbance is not expected.

### 3.3 MECHANIZED CLEARING OF SUBMERGED AND EMERGENT STANDING TIMBER

Submerged and emergent standing timber will be salvaged from nearshore and foreshore of Project Sites using an excavator, processing head and/or feller buncher, modified crane, submersible saws, etc., or other equipment as deemed necessary by the harvesting company (CCN).

- Areas for clearing will be pre-determined based on caribou access routes. Telemetry data and distance from the mainland will be used to determine how caribou are likely accessing the candidate islands from the mainland.
- Groups of standing timber around the candidate islands will be selected for harvest from the desktop first to determine where removal would be most effective.
- Logs still rooted must be harvested under the OLTC (Occupied Licence to Cut) and unrooted logs under the FLTC (Forestry License to Cut).
- Merchantable timber may need to dry out for a period of time at the ancillary sites before being transported by truck.

An excavator with a rake and thumb could be used to collect floating debris in the water, as well as debris-build-up on shore. The excavator will access the shoreline from the barge and barge ramp. Rutting into the mineral layer will be avoided and mitigated should this occur. No disturbance to vegetation should occur.

- Floating debris that is collected from the water will be temporarily stored on the barge until it can be transported to a suitable location.
- Non-merchantable wood may be temporarily stored on the island during shoreline debris management; however, it must be transported to a designated site for pile/burn on the mainland before the island works are completed.

All works must be conducted following BMPs. The QEP must complete daily inspections of all equipment prior to daily work commencement to ensure equipment is in clean condition, free of fluid leaks and contain spill kits. Refer to Section 8.0 of the EMP regarding monitoring and work stoppage procedures during activities. In addition to shoreline debris removal, emergent timber will primarily need to be removed from areas in between the island and off the mainland shoreline of all selected islands.

### 3.4 INSTALLATION OF LOG BOOMS FOR LONG-TERM DEBRIS MANAGEMENT

Following the removal of all woody debris and water-bound standing timber from a site, log booms can be installed to prevent future buildup of debris within the managed area.

The log booms may be designed to intercept floating woody debris from entering the area where debris are removed.

- Locations for log booms will need to be selected so that they do not interfere with caribou access on and off the target island.

- Booms collecting debris will need to be inspected after the first year to ensure they are still effective.
- Booms may need to be cleaned out if they are filling with debris quickly on a seasonal basis.
- Monitoring plan should be established to ensure caribou are not getting tangled and drowning in the booms.
- If the volume of accumulating debris decreases, the log booms may be removed.

Booms are typically installed using boom sticks, chains, swifter wires and logs. The log booms will be anchored to concrete blocks that can be installed on the shoreline and/or lake bottom.

Current plans do not include the implementation of log booms.

### 3.5 TRANSPORT OF MERCHANTABLE TIMBER, NON-MERCHANTABLE AND WOODY DEBRIS

All merchantable and non-merchantable timber will be transported to one of the ancillary sites (Andrews Bay, Cheslatta Forest Products Mill Sites) via barge. The ancillary site will be chosen and confirmed prior to work commencement and, if required, will be prepared (e.g. clearing/grubbing) to improve site access and create piling areas. Once materials are at the ancillary site, the debris becomes property of CCN to dispose of as they see fit.

- An excavator will be used to load all floating and standing timber onto the barge.
- The ancillary site should be accessible enough that the barge ramp is able to provide easy equipment access to the shoreline.
- Equipment should not mobilize in the water at any time.
- A tug boat will be used to tow the barge to the ancillary site.
- If necessary piled logs will be left to dry before transport.
- Logs will be temporarily piled, sorted, and loaded onto haul trucks for transport to a local sawmill.
- Non-merchantable woody debris may be ground, following drying, at the landing/sorting site for shipment to a local pellet plant or for use as hog fuel.
- Refer to Section 7.8 BMP's in EMP for log transport.

Due to the high volume of logs to be transported to the ancillary site, log booms may be used for transportation across the reservoir. The logs will be pushed into bundles and held together using boomsticks, chains and swifterwires to create a flat raft. Tugboats will move the booms to the ancillary site to be sorted, piled, dried and transported depending on its value as merchantable/non-merchantable timber.

Once non-merchantable timber has been transported to the ancillary site it will be moved via truck to local mills or composted following chipping/grinding (See Section 1.7).

### 3.6 PILING AND BURNING OF NON-MERCHANTABLE WOODY DEBRIS

Non-merchantable timber will be collected from the nearshore and foreshore and transported by barge to a designated site on the mainland. All burn piles should be above the HWM to avoid burned debris

scraps from re-entering the water post burning, and/or to prevent debris pile from washing away if burning is delayed. Burning of piles will be conducted following the requirements of the Wildfire Act.

- The designated site must be prepared prior to works and cleared/grubbed down to mineral soil (refer to Section 3.1).
- Debris removed from the water will be piled separately to allowing drying prior to burning.
- Debris will be piled to not disturb or harm living vegetation or potential wildlife habitat.
- Prior to burning a permit is required.
- See Section 7.9 of the EMP for BMPs related to piling and burning.

### 3.7 CHIPPING AND/OR COMPOSTING NON-MERCHANTABLE WOODY DEBRIS

As an alternative to piling and burning, non-merchantable woody debris ~~that is~~ transported to a designated landing can be either chipped for supply to local mills or ~~can be~~ composted. Chipped wood could be hauled to a local mill to use as hog fuel or for production of wood pellets. As a more novel alternative, chipped wood could also be composted utilizing a portable Ag-Bag system, which would result in a minimal carbon emission (in comparison to burning). Onsite composting would provide an opportunity to use wood waste to create organic material that could be utilized for future reclamation/restoration projects.

### 3.8 UTILIZATION OF WOOD DEBRIS AND WOOD PRODUCT BY LOCAL BUSINESSES

As a primary partner and contributor of resources to the project and the holder of the Special Use Permits, Timber Licenses, and a valid Timber Mark, Cheslatta Carrier Nation (CCN) will be the **sole owner** of all woody debris that is harvested through this program. The debris will be separated based on intended use and piled onshore at a location designated by CCN (i.e. Andrews Bay) in such a way as to facilitate its desiccation. The air-drying process may take a period of time ranging from 6 months to 2 years or until such a time that CCN deems the transportation and sale of the fibre to be optimal in terms of the economic incentive. Intact logs may be sent to sawmills while broken or degraded pieces will likely be sold as biomass for energy or to a pellet production facility. A cursory examination of the subject seems to indicate that submerged timber could have easier 'machinability' due to reduced resin content and increased strength (Lucas, 2007). However, some in the industry are concerned that there could be complications in the milling process if the wood is heavily embedded with sediments. This concern is likely not as applicable to the wood that is still attached by root structures to the reservoir bottom as it will have a lower exposure to sediments than the detached debris found along the shoreline. Generally, the lower the moisture content in the fibre the more economical it is to process, especially in terms of hauling and kilning.

## 4.0 CANDIDATE ISLAND TREATMENT PRESCRIPTIONS

An assessment of woody debris and environmental features was completed to aid with final planning for debris management activities for each of the candidate islands selected for treatment. Visual assessments were completed by review of iMapBC (GOVBC 2019) orthophotography imagery. The resolution of the orthophoto imagery is estimated at 50 cm, which allowed for clear identification of individual debris pieces. Stream data layers from Habitat Wizard (MOE 2019) were reviewed to locate streams within or in close proximity to the planned debris management areas. All streams that were detected within the project area have yet to be classified for fish presence or absence.

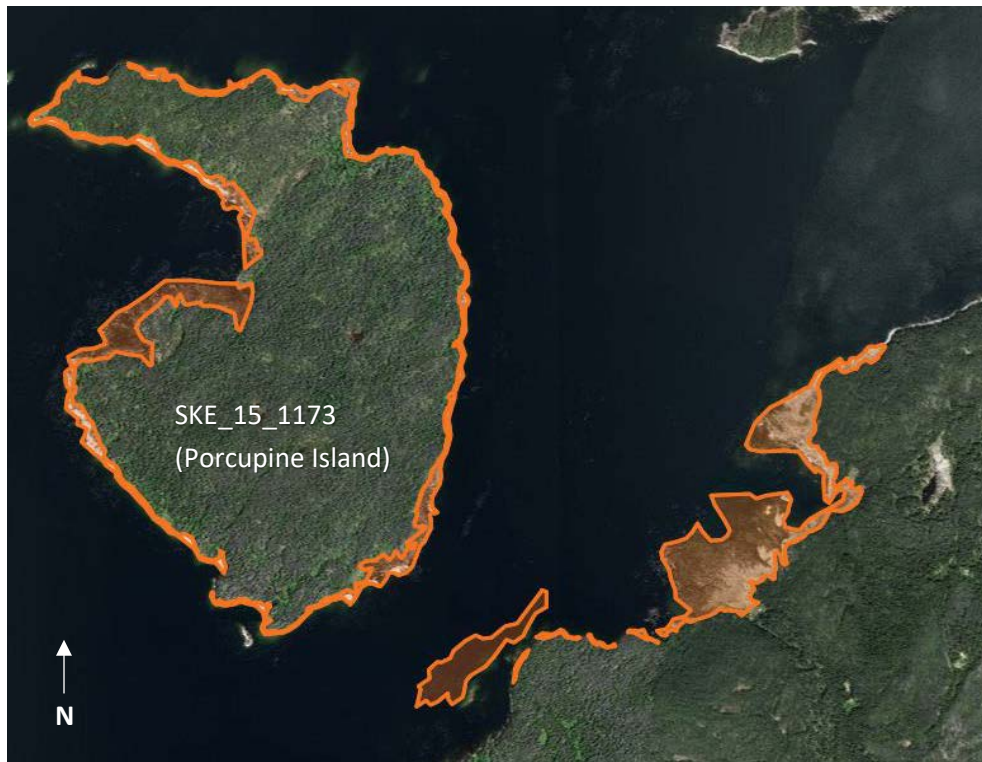
## 4.1 SKE\_15\_1173 (PORCUPINE ISLAND)

Porcupine Island is the largest of the five islands selected for debris management. It is just under 300 ha in size (Table 8). The shortest distance between the island and the mainland is approximately 700m (Figure 5). This island has the largest accumulation of debris along the shoreline and there is a significant amount of accumulation along the parallel mainland shoreline (Figure 3 and 4), which extends out as much as 100 m from the shoreline. The island is mostly forested (SBSmc2; Banner et al. 1993) with a few small wetlands are present. The adjacent south shoreline is within the bounds of Tweedsmuir North Provincial Park.

The larger volume of concentrated debris is either floating or piled along the island shoreline. Standing emergent and submerged timber is concentrated in some areas, particularly within the bay on the west side of the island. The debris along the shoreline appears to be mostly standing emergent and submerged timber, with some floating debris that have collected around the shallow areas. Sections may require the use of the excavator from the barge, as well as the modified crane to remove standing debris. There are notable beach areas where stranded debris has also accumulated and concentrated where lower lying wetlands connect to the reservoir or at stream discharge points. Four 4<sup>th</sup> order streams do enter the reservoir from the mainland where island debris management activities may occur. None of these streams have been assessed for fish presence (MOE 2019) and may have to be surveyed in accordance with the site plans.

**Table 8. SKE\_15\_1173 (Porcupine Island) features table.**

Island ID	UTM Location	Island Area (ha)	Estimate Area of CWD (ha)	Distance to Andrews Bay (km)	Distances to Anthropogenic Feature (km)
SKE_15_1173 (Porcupine Island)	9U 652708 5951255	296.0	Island (31.6) Mainland (40.6)	13.5	> 1



a)

Figure 3. Aerial photograph of Porcupine Island. Debris management activities are planned to be completed along the shoreline of the island and the mainland; woody debris management areas are highlighted in orange.



a)



b)

**Figure 4. Aerial photographs showing a) the western shoreline of Tweedsmuir Provincial Park adjacent to the island and b) the south eastern portion of Porcupine Island. Woody debris management areas are highlighted in orange.**



**Figure 5. Aerial photograph showing the shortest distance between Porcupine Island and the mainland along the western portion of Tweedsmuir Provincial Park.**

## 4.2 SKE\_15\_1126

This island is the most northern island in Whitesail reach (Table 9). The majority of the debris around this island is either floating or stranded along a relatively narrow beach area (Figure 6a). The shoreline appears to be in deeper water, with potentially some shallow shores on the northern side. The island is forested (SBSmc2; Banner et al. 1993) and no wetlands or open areas are present. The shoreline Adjacent to the island along Tweedsmuir Provincial Park appears to consist of mostly floating debris (Figure 6a). A much smaller amount of standing emergent timber is present in the waters between the mainland and the island. A smaller island occurs in close proximity to the shoreline with floating debris accumulated along its western shore. The adjacent south shoreline is within the bounds of Tweedsmuir North Provincial Park.

A single 2<sup>nd</sup> order stream enters the reservoir along the mainland adjacent to the island where debris management activities are likely to occur. The stream has not yet been assessed for fish presence (MOE 2019). The shortest distance between the island and the mainland is approximately 200 m (Figure 6b).

**Table 9. SKE\_14\_1126 Island features.**

Island ID	UTM Location	Island Area (ha)	Estimate Area of CWD (ha)	Distance to Andrews Bay (km)	Distances to Anthropogenic Feature (km)
SKE_15_1126	9U 660100 5960084	12.67	Island (1.3) Mainland (6.1)	5	>1



a)



b)

Figure 6. Orthophoto showing a) woody debris management areas on the island and mainland highlighted in orange, and b) the shortest distances between the island and the western shore of Tweedsmuir Provincial Park.

### 4.3 SKE\_15\_1141

This island group is located just north of Porcupine Island and consists of two islands within 100 m of each other (Table 10). There is abundant debris around the shorelines, a majority of which appears to be floating (Figure 7). Water between the two islands is likely to be absent during low water as the stretch of water between the two is very shallow. Debris accumulated around the islands includes large dense pockets of floating debris, specifically on the south end of the larger island and between the two islands suggesting that debris floats into the area from the south. There is a large patch of emergent standing timber and then some standing timber distributed throughout the area between the islands and the western shoreline of Tweedsmuir Provincial Park.

The islands are mostly forested (SBSmc2; Banner et al. 1993) with a few linear corridors of shrub dominated open areas on the larger island. No streams discharge into the reservoir along the shoreline of the park adjacent to the island where debris management activities are planned. The shortest distance between the island and the mainland is approximately 520 m (Figure 8).

Table 10. SKE\_15\_1141 Island group features.

Island ID	UTM Location	Island Area (ha)	Estimate Area of CWD (ha)	Distance to Andrews Bay (km)	Distances to Anthropogenic Feature (km)
SKE_15_1141	9U 655056 5957108	68.50	Island (3.11) Mainland (6.32)	7.0	< 1



Figure 7. Orthophoto of the SKE\_15\_1141 island group. Debris management activities are planned to be completed along the shoreline of the island and the mainland; woody debris management areas are highlighted in orange.



Figure 8. Orthophoto showing the shortest distance between the Island group and the mainland along the western portion of Tweedsmuir Provincial Park.

#### 4.4 SKE\_15\_1180

This island is located west of Porcupine Island on the west side of Whitesail Reach (Table 11). This island is adjacent to another island that was not selected as a candidate for the debris management activities. The island appears to be surrounded by emergent standing timber in shallow water with some floating and stranded debris along the shoreline (Figure 9a). Directly between the mainland and the island, there are patches of standing emergent timber. Between this island and the non-selected island to the northwest, there is some emergent standing timber and the shoreline of the non-selected island has accumulated floating and stranded debris. The island consists of forest cover (SBSmc2; Banner et al. 1993) with no open areas of wetlands.

The shortest distance between the island and the mainland is approximately 850 m (Figure 9b). One 1<sup>st</sup> order and one 2<sup>nd</sup> order stream enters the reservoir along the mainland southwest of the island but does not occur within areas where debris management activities are expected. The stream has not yet been assessed for fish presence (MOE 2019).

Table 11. SKE\_15\_1180 Island features.

Island ID	UTM Location	Island Area (ha)	Estimate Area of CWD (ha)	Distance to Andrews Bay (km)	Distances to Anthropogenic Feature (km)
SKE_15_1180	9U 649958 5950824	9.29	Island (8.73) Mainland (0.58)	15	> 1



a)



b)

**Figure 9. Aerial photographs showing a) where debris management activities are planned to be completed along the shoreline of the island and the mainland (highlighted in orange) and b) the shortest distance between the island the western shoreline of Whitesail Reach and between the two islands.**

## SKE\_15\_1193

This island is the smallest and most southern out of the selected candidates within Whitesail Reach (Table 12). The island has a limited amount of debris present on the western side, which appears to be mostly floating debris (Figure 10). The island appears to be surrounded by a shallow water which quickly drops off. There is large amount of floating debris just off of the western shoreline of Tweedsmuir Provincial Park. The island is mostly forested (SBSmc2; Banner et al. 1993), with the bottom third of the island being a more open forest and area.

A large amount of standing emergent timber is present along the mainland adjacent to the island in addition to some floating and stranded debris along its shoreline. The shortest distance between the island and the mainland is approximately 205 m (Figure 11). A single 1<sup>st</sup> order stream enters the reservoir along the mainland in a bay south east of the island where debris management activities are likely to occur. The stream has not yet been assessed for fish presence (MOE 2019).

**Table 12. SKE\_15\_1193 Island features.**

Island ID	UTM Location	Island Area (ha)	Estimate Area of CWD (ha)	Distance to Andrews Bay (km)	Distances to Anthropogenic Feature (km)
SKE_15_1193	9U 649302 5945607	3.0	Island (0.19) Mainland (7.42)	20	> 1



**Figure 10. Aerial photograph of the SKE\_15\_1180. Debris management activities are planned to be completed along the shoreline of the island and the mainland; woody debris management areas are highlighted in orange.**



Figure 11. Aerial photograph showing the shortest distance between the Island group and the mainland along the western portion of Tweedsmuir Provincial Park.

## 5.0 EFFECTIVENESS MONITORING

Prior to conducting the restoration at other islands within Whitesail Reach, restoration efforts must be confirmed as delivering a positive outcome. Therefore, baseline data and post-restoration monitoring will be conducted to confirm that woody debris removal improves caribou accessibility to the island. Restoration projects are defined as either functional or ecological where the former aims to slow or deter predator movement in caribou habitat, where the goal of the later is to restore habitat to a pre-disturbance conditions ~~using mechanical site prep~~ (Bsteh and Thompson 2019). The Whitesail Reach project falls under a functional restoration program, ~~which includes restoring habitat to SBSmc2 site series (Banner et al. 1993) as exists in areas surrounding the reservoir.~~

If successful, debris management activities should result in continued or increased use of targeted calving islands in Whitesail Reach. Measures that assess treatment and success will provide important information regarding unforeseen challenges, treatment efficacy, and recommendations for improvement that will inform future management decisions. This adaptive management approach will be applied to all candidate treatment sites in the Whitesail area ~~that are targeted under a continued CCN debris management sustainability program.~~

Collecting baseline information from the candidate treatment sites in Year 1 is highly recommended in order to compare caribou-use of the islands prior to, and after, debris management. It is understood that an overarching Tactical Plan for the Tweedsmuir-Endiako herd is in process that will include further details on research and monitoring. However, this document provides some site-specific recommendations for monitoring in relation to the planned restoration works with the understanding that any data collected will be coordinated and integrated with higher level monitoring plans.

Data on ecological features, such as island vegetation and forest structure, would also provide valuable feedback as to why the caribou are selecting the targeted islands and whether there are environmental constraints other than debris build-up that may deter females from using the islands during calving. Further recommendations for building a monitoring framework, data collection, and data management can be found in the Boreal Caribou Habitat Restoration Monitoring Framework (Golder 2015; see also Bsteh and Thompson 2019). Habitat mapping can be achieved using a desktop exercise including use of orthophotos, satellite data, LiDAR (if available), and incorporating location and telemetry data into context of field observations. A baseline Data Management Plan should include the following:

1. Record GPS point in GPS and on notepaper for each observation.
2. Take photo – log this into hand written field notes.
3. For each record within your notes include:
  - a. Simple code ID (e.g., 1, 2, 3)
  - b. Coordinates,
  - c. Date,
  - d. Time,
  - e. Species,
  - f. Dead / Alive,
  - g. Observer name(s),
  - h. Names of other personnel (Government biologists) or monitors (First Nations), and
  - i. Other data collection details on notepaper (e.g., Temp, pH, cloud cover, weather, etc. as applicable).
4. Ensure that 1 & 2 are matched to 3 by a common code identifier as listed in 3a above.
5. Upload 1-2 onto DWB server when you return from field and ensure completion within 24 hrs upon return.
6. Scan field notes, save pdf copies onto server, and store hard copies into project folder.

## 5.1 VEGETATION MONITORING

Vegetation monitoring is not required within the work zones as it is anticipated that the debris removal will not disturb vegetation on the islands. However, vegetation monitoring may be conducted to observe how the overall islands vegetation structure changes over time in correlation to the caribou population. This may help to further understand any changes that are observed in regards to caribou activity within the Whitesail Reach migration corridor. Some potential recommendations for monitoring include flora diversity and abundance, presence of mountain pine beetle, and an overall forest inventory. Furthermore, if seeding or other forms of revegetation are required due to currently unforeseen disturbance or vegetation clearing efforts, then these sites should be included in the monitoring program. It is also necessary that any seeding or revegetation efforts follow a prescription of local indigenous plants to target the reference ecosystem.

Vegetation monitoring can include forbes and shrub species caribou rely on as forage, the presence and abundance of mountain pine beetle (MPB) affected trees, ~~and how the islands seral stands change over time.~~ The expectation is that the ~~islands~~ islands will be monitored into the long term and therefore baseline data will help to better understand how the vegetation has established over time, and how in turn that may affect the TEC's activity. Monitoring collection standards will be based on the Field Manual for Describing Terrestrial Ecosystems (BC Ministry of Forests and Range and BC Ministry of Environment, 2010).

### 5.1.1 Flora

The implementation of ground-based monitoring may consist of vegetation plots monitored over a number of study years. Field procedures will be followed as per the guidelines in the Field Manual for Describing Terrestrial Ecosystems and a plot will be established for every 25 ha of land on the island (BC Ministry of Forests and Range and BC Ministry of Environment, 2010). Plots should be selected prior to field work using stratified random sampling strategy. Parameters to be collected would include: presence and type of forage species, species diversity, percent cover, and vegetation community composition. Vegetation field forms will also be completed for each plot.

Understanding the inventory of particular species is imperative to understanding the caribou's presence on the islands, as they have preference to particular forage. During the winter forage for Northern Caribou consists primarily of terrestrial lichens (*Cladina*, *Cladonia*, *Cetraria*, and *Stereocaulon*), with arboreal lichens fed upon opportunistically (Cichowski, Kinley and Churchill 2004). During the spring and summer months, forage consists of a variety of forbes, graminoids, lichens, fungi and the leaves of some shrubs (Cichowski, Kinley and Churchill 2004).

### 5.1.2 Mountain Pine Beetle

An important component involved with the recovery of caribou herds is understanding the long-term effects of the mountain pine beetle on areas of critical habitat (Environment Canada, 2014). The TEC herd's current range coincides with an area affected by the MPB outbreak (Cichowski and Banner 1993) and studies have been ongoing to assess the impacts of MPB on caribou forage (Cichowski and Haeussler 2013). It is therefore suggested that the islands under restoration be monitored for the presence and/or abundance of mountain pine beetle to understand how critical caribou habitat functions in response to changes over time (Environment Canada, 2014). If MPB begins to affect the islands, it is likely that this will have consequential effects on the availability and amount of forage to the caribou during the calving season.

### 5.1.3 Forest Inventory

Included within the monitoring prescriptions of the islands should be the stand and timber information. This includes variables such as tree species, diameter, height and age; sapling species and diameter; shrub species and percent cover, etc. This information will be imperative to understanding the important ecological and physical attributes of the habitat provided by these islands that are considered as a critical component of the TEC range. It is recommended that this inventory include data on coarse woody debris as it relates to ease of access.

## 5.2 WILDLIFE MONITORING

Typical monitoring efforts for ungulates rely on aerial surveys, radio-collared telemetry, pellet plots, tracking and wildlife cameras. Caribou have already been identified as being active within the area, and the use of the islands has been observed during the calving season as part of an ongoing monitoring program that is being coordinated by MFLRNORD. Monitoring for the debris program should be focused primarily towards wildlife cameras, with ancillary data on incidental sightings, tracks, pellet counts, and radio collar data. Wildlife monitoring may also involve birds, amphibians, or other species in relation to the debris removal program and this shall be managed through the EMP. All data collected and wildlife

sightings will be recorded and uploaded annually into the BC Wildlife Species Inventory submissions<sup>1</sup>. The objectives of this monitoring plan are to ensure that restoration efforts achieve the goals of the restoration plans to:

- Improve migration and access to islands
- Reduce rates of predation by wolves

### 5.2.1 Wildlife Cameras

Wildlife cameras can be a reliable, cost effective, and less-labour-intensive method to capture data on population demographics and behaviour (Caravaggi et al 2017; Gillespie et al. 2015). For example, camera studies conducted in Banff National Park have helped managers understand the efficacy of road impact mitigation strategies (Clevenger and Waltho 2005; Ford et al. 2009) and have been used to test corridor model predictions (LaPoint et al 2013). Similarly, the use of this survey tool for the Project could offer useful insight into the effectiveness of woody debris removal in improving caribou access.

The use of wildlife cameras may help to gain a better understanding of caribou access from the reservoir shoreline to the islands, and which areas are more or less accessible. The primary goal of the camera monitoring is to observe the behaviour of individuals in relation to the areas that have been treated (i.e., debris removed). The hope is to obtain imagery that captures information on caribou behaviour in specific relation to the challenges of the woody debris along the shorelines prior to treatment and how that differs to behaviours following restoration clearing activities. This information may help to guide restoration efforts in terms of efficiency and help to guide management decisions for restoration on other islands within the reservoir. A number of experts have been consulted for the camera work on this project (Dr. Roy Rea UNBC) and MFLNRORD has experienced experts providing assistance and input on this work.

There are also methods for establishing a systematic sampling array of camera traps where distance sampling correction factors can be used to obtain estimates on density or occupancy (Howe et al. 2017). There may opportunity to integrate camera trap sampling data on behaviour and density. Plans are currently being developed to install and trial a few camera's traps (Reconyx) in relation to Porcupine Island (preferably the east side) on March 29<sup>th</sup>, 2019. It is important that the cameras are installed prior to calving season to ensure that the caribou are not being disturbed. Data sheets for camera installation procedures are being developed and logistical planning is the objective for this initial phase of camera installation. A total of 40 cameras have been purchased and more may be forthcoming as camera monitoring is anticipated to increase in scope.

As the islands are predominantly used for calving, the use of the cameras may be able to provide some insight into how many calves are leaving the islands each year. Additional useful information that might be provided is the amount of predator activity. It is anticipated that other wildlife species will be captured in the camera data and may provide important information, such as movement of predators (wolves or bears) in relation to the shoreline and islands.

There is a cost-benefit trade off for installing cameras in locations for systematic sampling design (e.g., Howe et al. 2017) versus convenience sampling that may better ensure data are collected on the animals and behaviour of interest. In the initial phases of this project it is anticipated that cameras will be set up at locations that provide a wide view of the shoreline where the caribou are expected to be coming to from the mainland, or where signs are indicative of activity (e.g. game trails, tracks, pellets). These

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<sup>1</sup><https://www2.gov.bc.ca/gov/content/environment/plants-animals-ecosystems/wildlife/wildlife-data-information/submit-wildlife-data-information>

locations will be chosen in areas where restoration activities will be conducted. These areas will be preselected prior to implementing the cameras either through aerial imagery or on the ground assessments. Vandalism is unlikely to be a concern, but information postings should be placed on the cameras to contact project representatives should local passerby's have any questions or concerns.

Previous studies have suggested mounting cameras at approximately 1 m height, with directional angle towards a location with at least 10 m of open view (Pfeffer 2017). A placement of at least 1 m helps to prevent the cameras being covered in any fresh snow that may fall during the early spring monitoring season and will help to get a better overall scope of the area. An increased height may provide a better image of animals approaching through the water. The cameras should also be positioned away from the direct path of sunlight to avoid UV damage. The cameras should be set to take daily control photos to confirm they are operational throughout the study period (Pfeffer 2017). Vegetation that can blow into the visual field should be cleared to avoid unwanted motion sensor activity that can drain the battery and fill the data card.

The current plan is to use still images, but there may be future utility in obtaining video footage. Due to the expected short time frame that Caribou are expected to utilize the islands for calving (late May to early June; approximately 30 days; COSEWIC 2014) video cameras may be an option. However, collecting video consumes battery and memory space much quicker in comparison to still cameras and produces a large amount of material, making it time consuming for post-processing (Caravaggi et al. 2017). Yet, video footage can provide more in detail in regards to behavioural displays that a still camera or high-speed burst camera may not be able to capture.

### 5.2.2 Radio Collars & Telemetry

An ongoing monitoring effort is already being conducted by the MFLNRORD through the use of telemetry collars on both members of the TEC herd as well as predatory wolves within the critical habitat study area. The data from this research has already been made available to the DWB team<sup>2</sup> and will be used in future phases of the project. This information may provide insight into the current activity level on the islands prior to restoration, and might relay whether or not debris removal has improved presence during the calving period.

### 5.2.3 Track and Pellet Counts

The use of tracks and pellet counts is a valuable tool for conservation managers to better understand a species' diversity, population size and habitat use within an area (Bagherirad and Abdullah 2013; Patterson et al. 2014; Skarin 2009). Counting of pellet groups may be a useful tool for gaining a better understanding of the caribou's use of the islands before and after restoration activities are conducted, and to understand the access routes more dominantly used by the herd. While telemetry data and cameras may be able to capture sufficient data, pellet counts may be used as a supplemental source of information to further improve understanding activity use on the islands.

Some of the challenges with monitoring pellet counts is the difficulty to distinguish one species from another and unlike cameras do not provide behavioural data in regards to island accessibility.

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<sup>2</sup> Under signed non-disclosure agreements.

### 5.3 DEBRIS MONITORING

As the primary objective of this project is to improve access along the migratory corridor for the TEC, monitoring should be conducted to ensure that debris accumulation along the shorelines is kept minimal. Monitoring can be conducted by aerial photographs to observe the annual accumulation and to assess whether or not further restoration is required. It is anticipated that clearing of shoreline will generally remain free of debris for up to 2-years after which maintenance clearing may be required.

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# Appendix A

## CARIBOU TELEMETRY MAP

