PNG Legacy Site Restoration Project – RFP_RMC_2022_01

Final Report

October 25, 2022

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1. Executive Summary

The BC Oil and Gas Research and Innovation Society (BC OGRIS) provided funding to the Halfway River First Nation (Halfway) for the purposes of investigating and developing restoration prescriptions for legacy petroleum and natural gas (PNG) sites within a two-kilometer buffer around Tsaa Nuna.

Tsaa Nuna is a relatively undisturbed area of Crown lands immediately south of Federal Reserve #168, where members of Halfway reside. Because of its undisturbed state and proximity to Reserve #168, Tsaa Nuna is an area where Halfway members may go to hunt, fish, and trap. Hunting, fishing, and trapping are integral to Halfway's culture and Treaty 8 rights. Tsaa Nuna lands are now protected from development and Halfway continues to work towards reducing impacts from surrounding industrial development in order to preserve wildlife connectivity with Tsaa Nuna.

Halfway has identified numerous legacy PNG seismic lines in the vicinity of Tsaa Nuna. Halfway has also identified, through member observations and wildlife cameras, the ease of predator movement over legacy seismic lines that lead into Tsaa Nuna. Reducing predator movement may reduce pressure on ungulates, a key group of animals upon which the members of Halfway rely.

Although Halfway would like to conduct functional restoration throughout the legacy seismic lines within the two-kilometer buffer around Tsaa Nuna, there are a number of factors that must first be considered. Namely, Halfway recognised a need to understand the current status of the seismic features along with current and future industrial developments that overlap the seismic lines.

Through a desktop study, Halfway identified sites for potential functional restoration. Potential sites were further refined through analysis of current and future development. A total of 80 assessment points were identified for field analysis. To guide data collection, a field assessment form was developed.

Of the 80 points identified for field analysis, 62 points were assessed in the field. A total of 27 points were visually inspected; no field form was completed. A field form was completed for the remaining 35 assessment points. Field forms were completed for any point where there was functional restoration potential.

Field data was analyzed for both restoration potential and priority. A total of 19 locations had both a moderate or high restoration potential and moderate or high restoration priority value. These 19 sites are recommended for immediate functional restoration.

Restoration works will depend on engagement with stakeholders, obtaining necessary regulatory permits, and additional funding.

The long-term success of functional restoration will depend on careful evaluation of future access needs by land tenure holders. Halfway recommends functional restoration for 19 out of 35 sites because there is uncertainty over the remaining 16 sites. This uncertainty is related to future access needs that may eliminate functional restoration efforts.

2. Background

For thousands of years, the area of land that comprises Tsaa Nuna (CP212) has been used by First Nations for traditional purposes such as hunting, fishing, trapping, gathering plants and berries, and was traditionally referred to as Tusdzuh. More recently, in 1999, the former Ministry of Forests approved a cutting permit for the area, Cutting Permit 212 or CP212. Since then, the land has commonly been referred to as CP212. Halfway River First Nation (Halfway) sought a judicial review of the decision for the permit, arguing that logging of the sacred area would adversely impact their ability to exercise Treaty and Aboriginal rights. The court agreed with Halfway's arguments and set aside the cutting permit.

In March 2017, the Province and Halfway River First Nation signed a government-to-government agreement that included working together to establish a conservancy in an area of high cultural significance to the community. Conservancies are Crown lands set aside for the protection of their biological diversity and natural environments. They also explicitly recognize the importance of these areas to First Nations for social, ceremonial and cultural uses.

Spanning 5,306 hectares along the southern shore of the Halfway River (approximately 65km northwest of Fort St. John), the largely forested area officially became the Tsaa Nuna Conservancy (sa-nuh-na) in February 2021, ensuring strengthened protection of the land, water, wildlife, providing more certainty around teaching traditional practices and passing along knowledge to the next generation.

Tsaa Nuna is situated across the Halfway River from the community (IR 168), which means it is well-situated for Elders to practise cultural activities and pass on Traditional Knowledge to younger generations. Chief Darlene Hunter stated "It is an important area for our community where we hunt, trap, gather berries and teach our children about traditional practices and our way of life. The protection of this area will ensure that we can continue these activities in this area for generations to come." The area is representative of a black and white spruce forest, and contains a mix of coniferous, deciduous and marshlands and includes significant cultural and natural values. The area is rich with berry plants and home to moose, deer, lynx, fisher and porcupine. One of five major watersheds in the region, the Halfway River is a migration route for bull trout, whitefish, and other important cultural species.

Halfway has defined a two-kilometer buffer around Tsaa Nuna as a way of protecting the core area. Numerous seismic lines cross through this two-kilometer buffer and Halfway has identified, through the placement and monitoring of wildlife cameras, that wolves, grizzly bears, ungulates, and other animals utilize these corridors in addition to recreational users using them to access the area. In addition, Traditional Knowledge indicates historic use of the area by caribou.

Functional restoration efforts along these seismic lines may reduce the use of these features by predators, particularly wolves.

In addition, as per the *Boreal Caribou Habitat Restoration Operational Toolkit for British Columbia* (Golder 2015), the application of techniques on anthropogenic disturbances that deter predation, primary prey and human use in the near term will support long term habitat recovery.

3. Objectives and Scope

The objective of this project is to evaluate functional restoration opportunities on PNG Legacy Sites within the two-kilometer buffer around Tsaa Nuna.

The information gathered in this project will inform future functional restoration activities. Functional restoration may be a cost-effective method to reduce predator access and speed up natural regeneration along legacy seismic lines.

This objective was developed within the broader objectives outlined in the BC OGRIS PNG Legacy Site Restoration Project RFP, which include:

- Address the interests of NEBC Treaty 8 First Nations, government agencies, stakeholders, the public, and funding entities in the restoration of legacy PNG disturbances;
- Support the implementation of restoration strategies and techniques that incorporate both current research and NEBC Treaty 8 First Nation traditional ecological knowledge; and
- Successfully allocate the funding provided by the federal government to support the implementation of the Legacy Sites Reclamation Program.

The scope of this project is constrained to the assessment of legacy seismic lines. The project does not include functional restoration execution. It was deemed unfeasible to carry out restoration activities without first gaining a solid understanding of where functional restoration could be completed.

4. Methods

This project adopts assessment methodology for linear disturbances as found in the *Boreal Caribou Habitat Restoration Operational Toolkit for British Columbia* (Golder 2015). This toolkit methodology includes desktop review of available spatial and imagery data along with field verification of vegetation and ecosystem factors, human and wildlife use, and restoration potential.

In addition to the toolkit methodology, Halfway incorporated additional data into the desktop review and field verification.

Step 1: Desktop Review

Halfway has been collecting wildlife data in and around Tsaa Nuna through placement and analysis of wildlife cameras. Wildlife camera data has been useful in understanding presence and movement patterns. Through wildlife camera analysis, Halfway knows that a number of ungulate and predator species exist in and around Tsaa Nuna. Halfway also understands where vehicle use (ATV, side by side) is prevalent.

The Halfway Lands Department works with industry groups in the area. Through these working relationships, Halfway is aware of upcoming projects including seismic programs, pipelines, wellsites, processing facilities, forestry cut blocks, and associated access roads.

With the above knowledge taken into consideration, a desktop review was performed to identified high priority locations for field verification, based on following factors:

- Established access in and around the 2 km buffer (i.e. wells and cut-blocks);
- Status of the wells and/or cut blocks in the area (i.e. COR, free-to-grow);
- Key access points into areas where restoration is infeasible (i.e. wetlands);
- Seismic intersections, where functional restoration would limit access and line of sight (LOS) in multiple directions;
- Open seismic lines running north/south (towards Tsaa Nuna and the 2km buffer) or connecting to these north/south seismic lines;
- Connection to and visibility from well established roads;
- Existing or natural barriers to human and wildlife movement; and
- Planned or approved new forestry or oil and gas development in the area.

Step 2: Sampling Plan and Field Form

High priority locations identified for field location, identified in Step 1 above, were used to develop the sampling plan. Field locations were mapped according to priority and access. Maps were then provided to the field crew.

Alongside the sampling plan, a customized field form was created. The intention of the field form was to provide a standardized set of data to collect in the field. The form was developed using recommended factors from the Boreal Caribou Habitat Restoration Operational Toolkit for British Columbia (Golder 2015).

As shown in Figure 1 below, data was based on three focus areas: vegetation and ecosystem factors, human and wildlife use, and restoration potential.

Vegetation and ecosystem factors included information on ecosystem type, soil moisture, dominant vegetation stage, cover type and density, height, and adjacent vegetation.

Human and wildlife use factors included information on human use sign, vehicle types, barriers to vehicle movement, primary issues caused by human use, wildlife sign, wildlife use wildlife features, and barriers to wildlife movement.

Restoration potential factors included information on access options for restoration, treatment options, and treatment priority.

Step 3: Field Assessment

A field crew, consisting of an ecologist and a Halfway member, completed assessments of mapped high priority locations.

Two types of assessments were carried out:

(1) A visual assessment was performed where functional restoration was considered unnecessary or infeasible.

Functional restoration was considered unnecessary where observations indicated the seismic line had sufficient growth to limit motorized access and sight.

Functional restoration was considered infeasible where accessible seismic lines intersected with new disturbances (cutblocks).

(2) A written assessment using the field form described above was completed where functional restoration was considered feasible.

SEISMIC ASSESSMENT FORM - HRFN (OGRIS)

Administrative			
Date (DD/MM/YYYY)			
Crew			
Seismic Line ID	*text and/or numeric field*		
Seismic Line Year	*text and/or numeric field*		
Access Road Name	*text*		
Visibility from access road			Description
	Not visible		Not visible a road
	Low		Takes some looking to see it from a road
	High		Highly visible from a road
Vegetation & Ecosystems			
Segment ID (GPS start of each segment)	*numeric: 01, 02 etc*		**Walk line until veg structure changes noticeably; that becomes a new segment**
Segment Ecosystem	Upland		Terrestrial sites; not wetlands
	Lowland		Wetlands
Segment Moisture Class			Drop-down: Select best fit
Soil moisture within segment	Very dry		Very shallow, rocky, lichens etc.
	Dry		
	Average		
	Moist to wet		Evidence of seepage or plants that grow in wet sites
	Very wet		Saturated soil, standing water, ponding etc.
Dominant Veg Stage			Drop-down: Select best fit
Veg structure within segment	Non or sparsely vegetated (mineral soil)		
	Herbs / forbs (including grass / sedge / clover mix)		
	Low shrubs (< 2 m) - conifer		
	Low shrubs (< 2 m) - deciduous		
	Low shrubs (< 2 m) - mixed		
	Tall shrubs (2 - 10 m) - conifer		
	Tall shrubs (2 - 10 m) - deciduous		
	Tall shrubs (2 - 10 m) - mixed		
	Treed (> 10 m) - conifer		
	Treed (> 10 m) - deciduous		
	Treed (> 10 m) - mixed		
Cover Type (Woody stems)			Drop-down: Select best fit
Descrip. of woody cover in segment	Patchy (but low cover)		
	Continuous, uniform		
	Variable cover pattern		
Average Height (cm)			Drop-down: Select best fit
woody stems only - 3.99m2 radius (representative area)	0-50 cm		
	51-100 cm		
	100 cm to 1.4 m		
	1.4 m to 2 m		
	2 m to 3 m		
	> 3 m		
Percent Cover			Drop-down: Select best fit
woody stems only - 3.99m2 radius (representative area)	1 (0 - 10 %)		
	2 (11 - 30%)		
	3 (31 - 50 %)		
	4 (51 - 75%)		
	5 (76 - 100 %)		
Adjacent Vegetation			Drop-down: Select best fit for segment
Describe main vegetation type(s) to 50m either side of segment	Forest - conifer (white spruce)		
	Forest - conifer (mix white spruce / black spruce)		
	Forest - conifer (mix black spruce / lodgepole pine)		
	Forest - conifer (black spruce)		
	Forest - mixed conifer / deciduous		
	Forest - deciduous (aspen)		
	Forest - deciduous (aspen / cottonwood)		
	Cutblock - low (<2 m)		
	Cutblock - tall (<2 m)		
	Wetland - treed (>10m)		
	Wetland - shrub or mix tree/shrub (2-10 m)		
	Wetland - Grass/Sedge		
	Other		
Human & Wildlife Use			
Human Use			Drop-down: Select best fit
Signs of human access in segment	None		No tracks
	Light		Few signs of use, does not appear well used
	Moderate		Tracks / paths common, may be areas with an identifiable pathway through vegetation
	Heavy		Regularly used trail, may have a well-defined path through vegetation
Vehicles	Truck access		
	Other motorized access		
Barriers to movement (humans)	None		
	Few		Some fallen trees and/or large woody debris, thick shrub growth
	Many		Lot of fallen trees and/or large woody debris, thick shrub growth
Primary issues / concerns	Exposed soil (mud, deep ruts)		
	Vegetation damage / cutting		
	Garbage		
	Crossing of creeks and streams		
	Other		
Wildlife Use			Drop-down: Select all that apply
Signs of wildlife tracks in segment	None		
	Light		
	Moderate		
	Heavy		
Other signs of use (wildlife)	Marked or rubbed Trees		
	Browsed shrubs or trees		
	Scat		
	Resting / Bedding		
	Nests		
	Cavities (woodpeckers)		
	Mineral lick		
	Other		

Barriers to movement (wolves and bears)	None		
	Few		
	Many		
Species ID			**Drop-down: Select all that apply**
Species sign in segment	Bear - Black		
	Bear - Grizzly		
	Bear - Unk.		
	Wolf		
	Coyote		
	Moose		
	Deer		
	Elk		
	Caribou		
	Ungulate - Unk.		
	Rabbit / Hare		
	Porcupine		
	Small mammals		
	Amphibians		
	Other		text
Restoration Potential			
Access			**Drop-down: Select all that apply**
Access options for restoration in segment	Foot access only		
	Quad or Side-by-Side		
	Larger equipment		
Restoration Options			**Drop-down: Select all that apply**
Potential type of treatments for segment	Blocking of access at main road intersection		
	Posting signage		
	Planting of trees or shrubs		
	Access control - mounding, trenching		
	Access control - large woody debris placement		
	Falling or placement of larger trees across line		
	Bending of shrubs / small trees		
	Other		text
Estimate of Treatment Priority			**Drop-down: Select all that apply**
Priority within segment	N/A		Treatment not required; **leave as-is**
	Low		Few issues, but not a priority
	Moderate		Several issues, could be a priority based on accessibility
	High		Enough issues that treatment should be prioritized

Figure 1. Seismic Assessment Form

Step 4: Analysis

Desktop analysis and field results were combined to categorize assessment points into functional restoration potential and functional restoration priority.

From the desktop analysis, it was known where future development and / or access may be located. If, for example, access will be needed in the future for dormant wellsite reclamation, potential functional restoration points were eliminated. Another example of ruling out potential functional restoration areas is where existing cutblocks have not yet met “free-to-grow” status and access may be required for additional works to meet this status. A final example of ruling out potential functional restoration is any areas where proposed oil and gas development will occur.

The field assessment results provided data in locations where linear features intersect or along legacy lines.

Combining the desktop and the field assessment results, sites were then rated according to potential and priority.

Considerations for rating a site’s functional restoration potential included accessibility, width of the line, current condition (natural regeneration, etc.), existing blowdown, tress size (for falling, hinging, or bending).

Considerations for rating a sites functional restoration priority included amount of use, line of sight, location in relation to other access points, direction, and connectivity.

Sites rated as not requiring functional restoration included sites that had sufficient natural regen to impede line of sight and/or use, or has adequate natural buffers such as abundance of blowdown or bends in the line (i.e. 3D seismic).

5. Results

From the desktop study, a total of 80 assessment points were identified. Some points were dropped due to access issues and others were not assessed because it was determined that other assessment points on the same line did not require functional restoration. This is to say that an initial assessment point or an ending assessment point had sufficient regrowth or other line of sight barrier to render the interior points inaccessible. In some cases, functional restoration was ruled out because of the need to

Out of the identified 80 points, a total 62 locations were assessed in the field.

Of the 62 field assessments, a Seismic Assessment Form was completed for 35 points and a visual assessment was completed for the remaining 27 locations.

Most of the plots assessed were within the southern border of Tsaa Nuna, as this area had the most legacy seismic activity.

Figure 2 below shows the locations of the 62 field-assessed points.

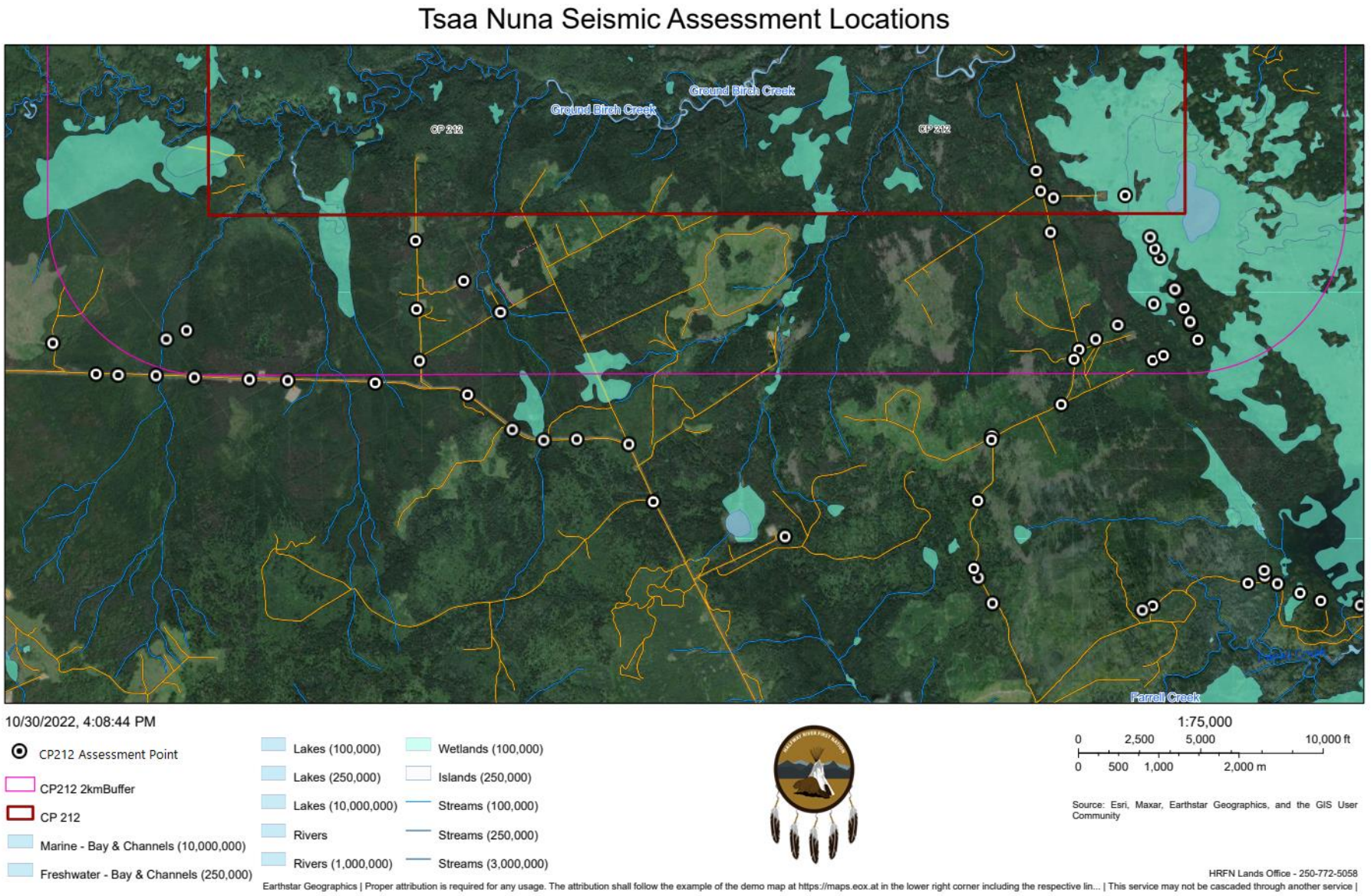

Figure 2. Seismic assessment locations

Of the 35 locations with completed Seismic Assessment Forms, 18 of these locations had high functional restoration potential, 11 had moderate functional restoration potential, with 6 locations not requiring functional restoration. See Table 1 below.

Figure 3 shows and example of a location (assessment point #63) not requiring functional restoration, while Figure 4 shows an example of a location (assessment point #12) with high functional restoration potential.

Figure 3. Assessment point #63, location where functional restoration is not required

Figure 4. Assessment point #12, a location with high functional restoration potential

Of the 35 locations, 12 locations were classified as high priority locations, 7 were classified as moderate priority locations, and 10 were classified as low priority locations. See Figure 5 below.

A total of 19 locations had both a moderate or high functional restoration potential and moderate or high priority value. See Figure 6 below.

Treatment options for the 19 identified locations include a combination of the following:

- Tree hinging / bending
- Tree felling / piling of coarse woody debris
- Screening panels
- Mounding and winter planting (moist to wet sites) immediately adjacent to barriers
- Summer planting (mesic to dry sites) immediately adjacent to barriers
- In areas where mulch is restricting natural regeneration, screefing or other site preparation prior to planting will be necessary

Figure 7 below provides an overview map of the 19 priority locations for functional restoration.

Table 1 – Functional Restoration Potential & Priorities

Assessment Number	Function Restoration Potential (NR / L / M / H)	Functional Restoration Priority (NR / L / M / H)
1	High	Low
2	High	Low
3	High	Low
4	Moderate	Low
5	Moderate	Low
6	High	Low
7	High	Low
8	High	Low
9	Moderate	Low
10	Moderate	Moderate
11	Not Required	Not Required
12	High	High
13	High	Moderate
14	Not Required	Not Required
15	Not Required	Not Required
47	High	High
48	High	High
49	High	High

50	Moderate	High
52	High	Moderate
54	Moderate	Moderate
55	Moderate	Moderate
56	Moderate	Moderate
57	Moderate	Moderate
58	High	High
59	High	High
60	High	High
61	High	High
62	Moderate	High
63	Not Required	Not Required
65	Not Required	Not Required
66	High	High
67	High	High
68	Not Required	Not Required
69	Moderate	Low

The graph below summarizes the number of sites in each functional restoration potential and priority class.

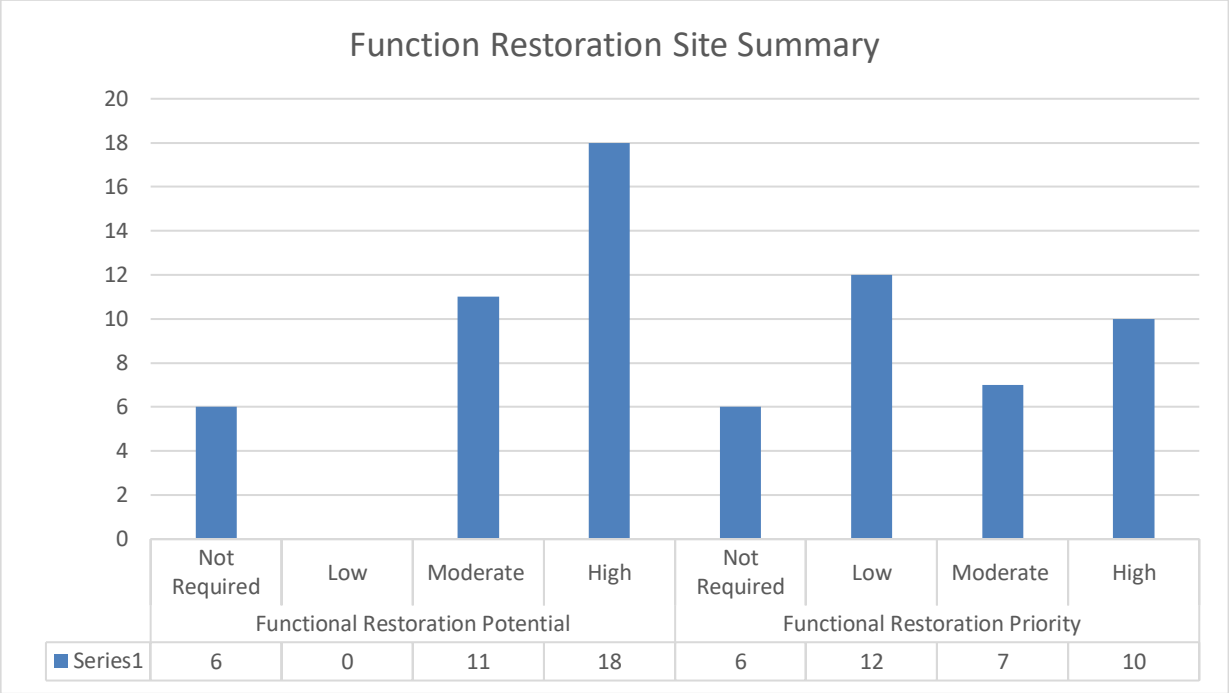

Figure 5. Number of sites in each functional restoration potential and priority class.

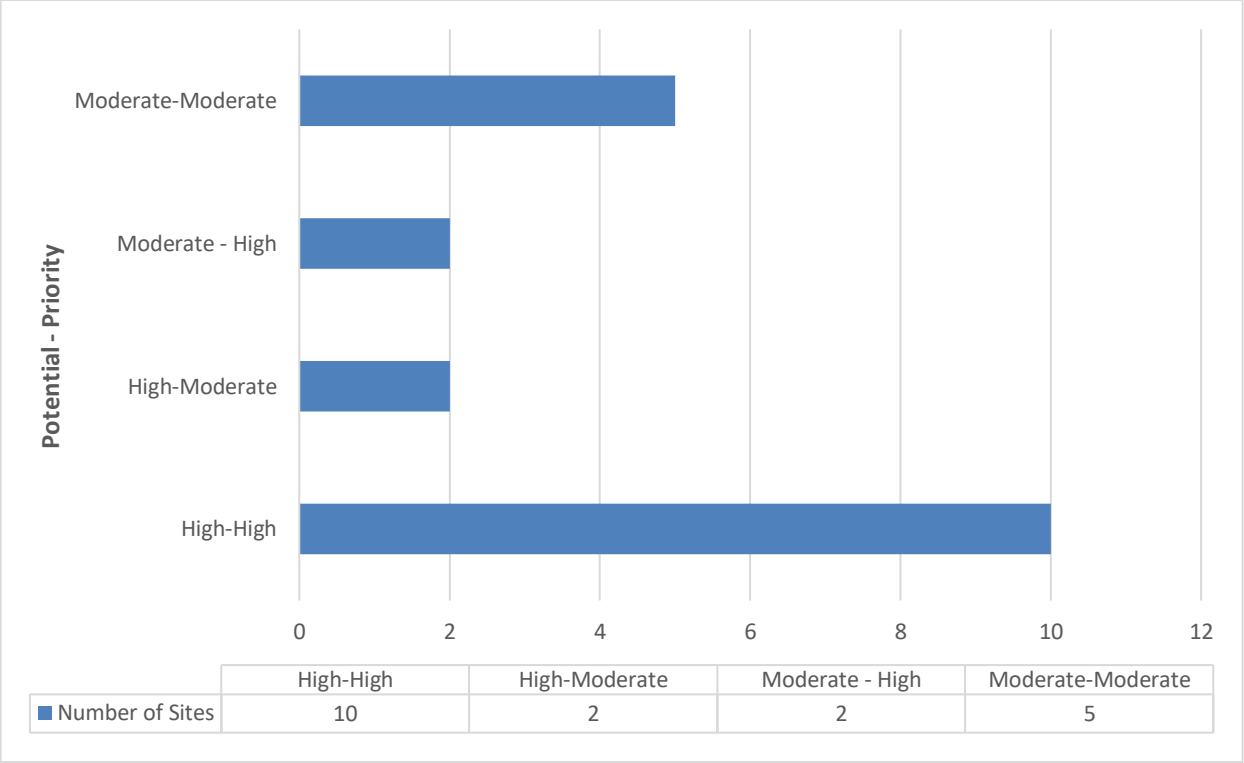

Figure 6. High and moderate functional restoration potential and priority locations

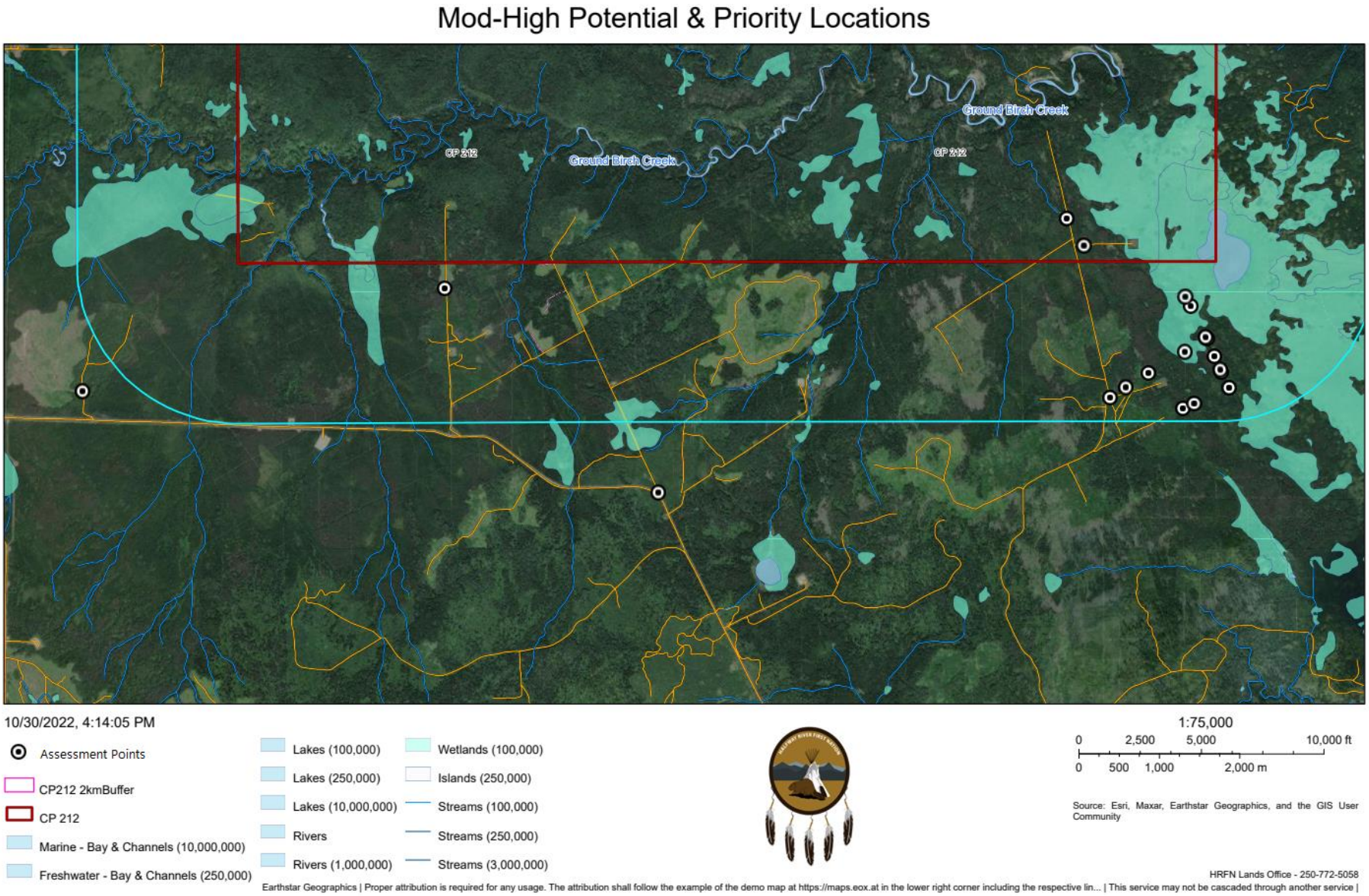

Figure 7. Locations of sites with moderate to high functional restoration potential and priority.

6. Discussion

Seismic Line Density South of Tsaa Nuna

An overview flight was conducted in and around Tsaa Nuna, outside the scope and funding of this project, to assess linear feature status and help narrow the focus for functional restoration efforts. As shown in the desktop mapping, the southern boundary and corresponding 2km buffer has an abundance of seismic lines and access points. The overview flight confirmed that several of the seismic lines are currently well used.

The overview flight also confirmed that the Groundbirch Creek acts as a natural barrier/break for any linear corridors passing through it into the core of Tsaa Nuna. Functional restoration of seismic lines running in northwards from the Kobes Creek Road towards Tsaa Nuna, in conjunction with the natural barrier that the Groundbirch Creek provides, will significantly reduce predator access into the core of Tsaa Nuna.

Land Tenure Obligations

Given the status of some cut blocks (non-free growing), well sites (non-COR'd) and associated access required to fulfill land tenure obligations, coordination with tenure holders in the area will be required to ensure functional restoration efforts are completed in locations that will not be impacted when additional work is required on those features. One approach is to complete functional restoration beyond those featured for now and then complete additional locations in conjunction with the deactivation of those features.

Cost Implications

Given the cost of continuous linear feature functional restoration averaging $12,500/km ($8,000 - $17,000/km, COSIA 2014), and likely closer to $15,000/km average when considering inflation, Halfway recommends focussing on seismic junctions (minimum of 250m of treatment, ideally 500m if possible) and supplementing with opportunistic moderate to high potential locations along the linear feature rather than complete function restoration. Other than areas of high mulch observed on the recent 2019 3D program in the area and some of the wetland areas where less viable seed sources exist, locations were traffic (ATV/UTV) is minimal appear to be naturally regenerating well, so if traffic can be minimized through periodic functional restoration, natural regeneration between these areas should progress well.

Future Development

Future development will occur to the west, south, and east of Tsaa Nuna. Much of the future development will require the construction of linear features which will intersect with legacy seismic features. Functional restoration in these areas may be rendered ineffective. It will be necessary to work with industry to determine the best placement of functional restoration so that it remains an

effective means of re-establishing natural regeneration along selected legacy seismic lines. Halfway will continue to encourage companies to establish natural barriers where linear corridors intersect with legacy seismic lines. Halfway will also continue to encourage the Oil and Gas Commission to include functional restoration in permit conditions.

Challenges of Functional Restoration in Wetlands

In addition, the area southeast and east of Tsaa Nuna contains a number of large wetland complexes (swamp and marsh), which provides very limited potential for functional restoration. Combined with a recent (2019) overlapping 3D seismic program and proposed Arc Resources development providing further access into the area, the limited moderate to high function restoration locations needs to be focussed on and taken advantage of. The absence of suitable sized trees for hinging and bending and the time for planted stock to reach sufficient height limited the short-term effectiveness of function restoration on these types of sites. Discussions with Arc Resources regarding fencing and gating their sites (especially ones that intersect existing linear disturbances) will be critical to ensure some control over access to this currently inaccessible area southeast and east of Tsaa Nuna.

Additional Observations

Additional observations noted during the field assessments included the difference in natural regen success based on mulch thickness (as shown in Figures 8 and 9 below) and how well larch (Tamarack) comes back on wetter sites when there is a viable seed source (as shown in Figure 10 below).

Figure 8. Assessment point #4, heavy mulch impeding natural regen

Figure 9. Assessment point #4, area of less mulch adjacent to the area of heavy mulch in Figure 8

Figure 10. Assessment point #50, successful natural regen of Larch on wetter sites where a viable seed source exists

7. Recommendations

Priority Locations

Halfway recommends immediate functional restoration of the 19 sites and subsequent functional restoration of the remaining 16 sites over time.

The 19 priority sites have been selected because:

- These sites currently allow for vehicular access. Equipment needed to complete the works may get to sites without the need for tree clearing or brushing;
- These sites currently provide ease of predator movement (wolf and grizzly) into the core area of Tsaa Nuna;
- Functional restoration at these key points may provide predator screening;
- Functional restoration at these key points may reduce vehicular access and therefore increase natural regeneration success;
- Natural regeneration success may then further reduce predator movement across the length of these seismic lines.

Halfway recommends completing functional restoration of the remaining 16 identified sites after the initial 19. Current land tenure obligations and future development create some uncertainty. There is no guarantee that functional restoration efforts will not be eradicated by the need for access to dormant wellsites and insufficiently regenerating cutblocks or by the construction of new roads, transmission lines, and pipelines. Additional functional restoration sites should be selected in a north to south direction. Begin with those sites closest to the Tsaa Nuna boundary and least likely to be eradicated.

Stakeholder Engagement and Regulatory Permits

Prior to starting work, communicating with stakeholders to understand their access needs will take place. It may become evident that certain stakeholder groups rely on certain legacy seismic lines for their own access needs. In some cases, and through engagement, it may become clear that access is more important than functional restoration.

Prior to starting work, communication with government agencies will take place. Government agencies will advise on permit requirements necessary to complete functional restoration works. Based on the advice of these agencies, Halfway will procure all necessary permits. Government agencies may also advise on any additional stakeholder engagement that should take place.