Ecosystem Restoration Opportunities in the Skeena Region

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Organizations:

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FLNRORD-Ecosystems	FLNRORD-Stewardship	FLNRORD-Fish&Wildlife	Natural Resource Canada
FLNRORD-Major Projects	FLNRORD-Research	FLNRORD-Reg. Initiatives	Min of Environ-EIAssessm
FLNRORD-Nadina	Min of Environ-Cons. Sci.	BC Parks-Skeena	Babine Wtshd Monit Trust
DFO-Habitat Restoration	Cheslatta First Nation	NW Guide Outfitters	MOTI Environmental Prog
Skeena Watershed Coalit.	Office of the Wet'suwet'en	Gitanyow First Nation	Gitxsan First Nation
Burns Lake Comfor	Terrace Comfor	World Wildlife Foundation	Skeena Wild
Bulkley Stream Keepers	Skeena Knowledge Trust	Symbios Research	UNBC
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INTRODUCTION

Background And Genesis Of The Plan

The B.C. Ministry of Forests, Lands, Natural Resource Operations and Rural Development (FLNRORD) is responsible for stewardship of Provincial crown land and natural resources, and protection of B.C.'s archaeological and heritage resources. One aspect of the Ministry's operations is their Ecosystem Restoration (ER)[1] program which is responsible for developing regional ecological restoration plans, coordinating and monitoring restoration treatments, and providing advice on ecological restoration to FLNRORD staff and clients: https://www.for.gov.bc.ca/hra/restoration/. There are several regional ER implementing agencies that operate under this umbrella. One such agency is SERNbc (the Society for Ecosystem Restoration in Northern BC – www.sernbc.ca). SERN is a society under the B.C. Societies Act and its membership, funding, and Board of Directors come from many different stakeholders including, for example, FLNRORD, the Ministry of Environment, BC Parks, UNBC, the College of New Caledonia, the BC Trappers Association, the BC Fish and Wildlife Federation, the Nechako Environment and Water Stewardship Society, and Chucho Environmental from the Tsay Key Dene, amongst others.

SERNbc and its precursor, have been operating in the Omineca Region since 2007, and in the Peace Region since 2017. The Society is now considering how it can further ecosystem restoration activities in the Skeena Region. Its mission is to identify, treat, and monitor vulnerable or degraded ecosystems to achieve a desired future condition that will sustain ecological services and human socio-economic needs. SERN focuses on identifying priority ecosystems that are degraded or at risk of becoming degraded and that have high functional importance for wildlife and biodiversity. Because SERN has no direct authority over crown or private land in BC, its role is often one of coordinating restoration activities, undertaking research, disseminating technical information, and fostering collaboration amongst First Nations and stakeholders. SERN is, however, also directly involved in managing ER programs and operations and, by virtue of its diverse membership, partners, and collaborators, can often respond to restoration needs more quickly and with greater independence, than other agencies.

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This plan is based primarily on a review of pertinent literature and information obtained from a selection of more than 50 government and First Nations resource specialists and stakeholders during meetings, phone calls, and email exchange in February and March, 2018. It is recognized that not everyone who may have an interest in ecosystem restoration was contacted during the short time this project took place, but expect that many of the key activities and priorities for the region have been identified. In the following pages, the biophysical characteristics of this ecologically diverse area are summarized, what is meant by ecosystem restoration is more fully detailed, expectations on climate change are explored, related program initiatives are described, and potential ecosystem restoration opportunities, priorities, and funding sources are discussed. A map has also been produced depicting nearly 100 locations where potential ER project work has been identified.

Purpose And Benefits Of The Plan

This document provides a framework for integrating ecosystem restoration into other land management activities and sets broad direction for a program over the next two to five years. It is expected that the plan will help SERN and other agencies involved in ecosystem restoration:

- deliver existing programs such as land management planning, cumulative effects mitigation, climate mitigation, mitigation of mid-term timber supply shortfalls, enhancement of forest carbon sequestration, creation of safer, more natural fire environments, and enhancement of terrestrial and aquatic habitats;
- leverage funding through the establishment of partnerships with First Nations and stakeholders with similar ecosystem management objectives;

[1] Ecosystem restoration has been internationally defined as the process of assisting with the recovery of an ecosystem that has been degraded, damaged or destroyed by re-establishing its structural characteristics, species composition, and ecological processes. This concept is fleshed out in further detail in subsequent sections.

- acquire and share data and mapping products required to make better management decisions;
- build capacity in terms of ecosystem restoration skills and knowledge;
- raise awareness and generate dialogue about ecosystem restoration; and
- help improve relations between government agencies, First Nations, and other land management organizations through collaborative delivery of ecosystem restoration projects.

While it is expected that the plan will provide interested organizations and individuals with the information they need to identify ER opportunities, identify potential partners and other stakeholders, and initiate a restoration project, the document is strategic in nature and is not meant to replace detailed planning and prioritization. For any work to be initiated through SERN, a project proponent or champion external to the Society, or from within the SERN Board or membership, will typically need to step forward with a project description, and then submit a proposal for funding, technical assistance, or project management assistance. The potential projects identified in this document are often conceptual with varying levels of supporting data and, in all cases, will require a more thorough analysis before implementation.

Area Of Interest

The geographic area of interest in this plan is the Skeena Forest Region (dark green in figure 1) extending from the Yukon border to south of Kitimat, and from the coast inland as far as Burns Lake, covering about a quarter of British Columbia (243,594 km^2). While the regional boundary does not necessarily coincide with ecological boundaries, it is administratively

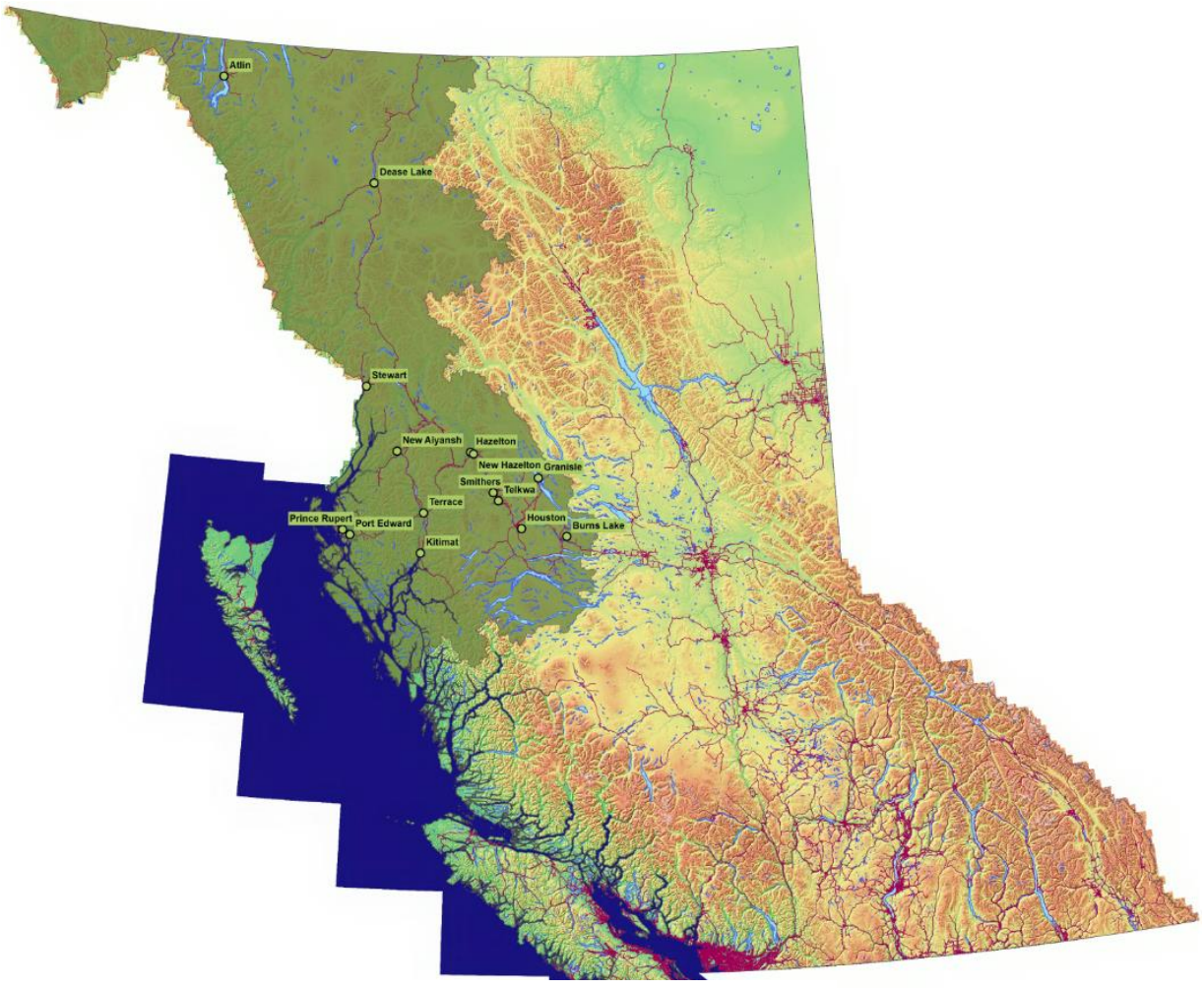

Figure 1. The Skeena Region (dark green section in the NW of the Province)

important and so the geographic scope was set on this basis.

First Nations peoples have been involved in land management activities within the Skeena region for thousands of years and forest and land development activities have been ongoing for over 100 years. The cumulative effects of resource development and, more recently, climate change are having profound impacts on regional ecosystems. Fish habitat is of particular concern in the region. Resource management and development pressures within the Skeena Region include ongoing forest harvesting including the harvest of mountain pine beetle (MPB) impacted stands, development of the Northwest Transmission Line between Terrace and Bob Quinn Lake, the Rio Tinto Alcan expansion and modernization, the potential development of linear utility corridors (e.g. transmission lines and pipelines) crossing the region, as well as the legacy of road construction for forest harvesting and mineral exploration on public lands, and for agriculture on private lands. There is increased evidence of climate related pressures include large wildfires, forest insects and disease outbreaks, and increased weather extremes leading to flooding, drought, and increased stream temperatures in some areas.

These changes will continue to have a variety of effects on ecosystem structure, function, and resilience. In many cases, effects are relatively short in duration, while other influences, individually or in concert, have more lasting effects. Some effects are very site specific while others occur at a landscape scale. When the impacts result in ecosystems that are not able to cope or respond effectively to disturbance, they become vulnerable and could become degraded. Key to the continuing presence of healthy ecosystems is our ability to understand when ecosystems are vulnerable and to alter our management approach to foster resilience. Key to ecosystem restoration is our ability to identify degraded ecosystems and implement activities that will restore these ecosystems and their ability over time to provide ecological and socio-economic products and services.

PLAN CONTEXT

Bio-Physical Characteristics Of The Region

The physiography of the Skeena Region includes coastal lowlands, several mountain ranges and interior plateaus. The Coast Mountains divide the region into coastal and interior portions with very different climatic regimes. Valleys associated with large river systems, including the Skeena, Nass and Stikine-Iskut, cut through the mountains, allowing coastal influence to travel inland. These river systems are some of the most productive habitat for salmon and other fish species in the world.

This section of the granitic Coast Mountains includes two distinct ranges: the Kitimat Ranges (south of the Nass River), and the Boundary Ranges (north of the Nass River). The Kitimat Ranges are characteristically round-topped and dome-like because they were overridden by glacial ice, while the Boundary Ranges are higher and more serrated, with numerous “Matterhorn” peaks that protruded above the ice. Extensive icefields still remain in the Boundary Ranges; the lower Kitimat Ranges contain smaller remnant glaciers. These ranges

Figure 2. Mountain ranges of the Skeena Region

are intersected by numerous river valleys and associated coastal fiords.

The St. Elias Mountains — the British Columbia portion, also known as the Haines Triangle area — include some of North America's most rugged, heavily glaciated country and British Columbia's highest mountain peak, Mount Fairweather (elev. 5489 m). The mountains are drained by the Tatshenshini and Alsek Rivers.

The Hecate Lowland is a low-lying region of rocky coastal islands. Sloping bog or muskeg forest occurs where the soils are shallow and poorly drained. The productive estuaries and tidal flats of the Nass, Skeena, and Kitimat rivers and numerous smaller river systems form a rich interface between upland and marine ecosystems.

Coastal forests are dominated by western hemlock and western red cedar, with lesser amounts of amabilis fir and Sitka spruce. Coastal subalpine forests have mountain hemlock and amabilis fir. Along the windward spine of the Coast Mountains, treeline is relatively low due to heavy and prolonged snow cover. Dwarf heath and krummholz vegetation is prominent, where the terrain is not occupied by glaciers or recently exposed bare rock. Leeward alpine slopes are significantly drier and support alpine grasses.[2]

The interior differs from the coastal portion of the Skeena Region in that it is underlain chiefly by volcanic and sedimentary rocks, rather than by granite, and overall is less rocky and rugged. The climate is continental, but Pacific air masses find their way inland along the major river valleys. Rainshadow effects of the Coast Mountains cause some areas to be relatively dry.

The Skeena Mountains are divided into numerous smaller ranges by prominent northwesterly trending valleys through which flow portions of the Spatisizi (Stikine), Sustut and Babine (Skeena) rivers. The Nass Basin is a volcanic area of low relief, which is drained by the Nass River and its tributaries and by the Kitwanga and Kispiox rivers. The floor of the basin is dotted with hundreds of small lakes. The Hazelton Mountains are a complex group of small ranges (the Nass, Kispiox, Bulkley, and Tahtsa ranges) lying just leeward of the Coast Mountains. These interior forests have a transitional climate between coast and sub-boreal interior. The forest includes both coastal and interior plant species. Dominant tree species include western hemlock, subalpine fir, Roche spruce, and western red cedar.

In the southwest, the Nechako Plateau is gently rolling country characterized by a number of high shield volcanoes overlain by deep blankets of glacial till. Numerous very long, narrow lakes gouged out by the glaciers once drained eastward into the Fraser Basin via the Nechako river. Since construction of the Kenney Dam by Alcan in the 1950's, these waters now form part of the Ootsa Lake reservoir that flows westward to power the Kemano hydroelectric station near Kitimat. The rolling plateau landscape is broken by a few isolated mountains, and a single mountain range, the Quanchus Range (max. elev. 2254 m) at the northern end of Tweedsmuir Provincial Park.

The central-interior forests of the Nechako Plateau are sub-boreal in character, and typically dominated by hybrid white spruce, subalpine fir and lodgepole pine. The climate is continental, but temperature extremes are subdued as a result of coastal influences. The southeastern corner of the region has a cooler, drier climate, and is characterized by the dominance of poor stands of lodgepole pine with varying amounts of reindeer lichen and kinnikinnick on the forest floor.

Wildfires have played a major role in the sub-boreal forest, resulting in many mid to late seral forests of lodgepole pine and aspen. Paper birch is another seral species that occurs on moist rich sites. A combination of wildfire, aboriginal burning, and more recent settlement and land clearing has contributed to the abundance of hardwood stands in the Bulkley, Kispiox, Babine, Skeena, and Nass valleys. Black cottonwood dominates stands on alluvial fans and floodplains. The initial seral stages are established after flooding events and, less frequently, by debris flows on alluvial fans. In the far north is the Yukon Plateau physiographic region, which has relatively gentle, high elevation terrain. This region drains northward into the Yukon and interior Alaska. The Liard Plain to the east is much lower in elevation, with slight relief and many shallow lakes, drained by the Liard River and its tributaries. The Stikine Plateau is a large and dissected terrain lying mostly below the level of the surrounding mountains. Relief is variable, from low elevations along the Stikine, Nahlin, and Klastline river valleys, to rolling alpine. The Cassiar Mountains region is made up of high, wide valleys, flat-topped ridges, rounded mountains, and a few high serrated peaks. Some portions drain west into the Stikine, some east towards the Peace, and some north into the Yukon.

[2] Physiographic and vegetation descriptions from Banner et al 1993, Meidinger and Pojar 1991, Williams et al 2001.

These northern boreal forests are dominated by white spruce, black spruce and lodgepole pine. Above the boreal forest lies an extensive subalpine zone of subalpine fir, white spruce, and dense thickets of willow and dwarf birch. At alpine elevations, the willow scrub and krummholz gets progressively shorter, giving way to extensive areas of alpine tundra.

Climate Change Expectations

According to the Pacific Climate Impacts Consortium, complex topography and the strong influence of El Niño and the Pacific Decadal Oscillation in the Pacific ocean, lead to considerable variation in climate over relatively short distances and from year to year (https://www.pacificclimate.org/sites/default/files/publications/Climate_Summary-Skeena.pdf) in the Skeena Region. The varied climate is expressed in broad changes in vegetation patterns from coastal western hemlock forests in the mountainous areas in the west, to lodgepole pine and white spruce forests in the interior plateau, spruce willow birch forests in the north, and sub-alpine fir and alpine tundra in high elevation areas. In most areas, precipitation has been greatest in the autumn and winter seasons, and least in the spring and summer but the amount of precipitation is highly variable. Mean annual precipitation for the region is 1393 mm, with higher amounts (2300 mm) occurring in the mountains west of Terrace and lower amounts (circa 500 mm) in the Stikine and north areas and in the rainshadow of the Coast Mountains. Most precipitation occurs in the fall resulting from incoming low-pressure systems from the coast. Summers are the driest season, but rainfall is still considerable. Extreme temperatures are more moderate than in the other regions in the North Area; they are typically below 30°C in the summer and do not drop below –30°C in the winter. Mean annual temperature is 4.2°C[3].

Climate projections for the Region were made for 2055 (2041–2070) using the most recent version of ClimateBC and compared to 1961−1990 climate normals[3]. Mean annual temperature in the Skeena Natural Resource Region is projected to increase by 3.1°C (ranging from 3.0°C in the Kalum District to 3.4°C in the Stikine), with minimum temperatures increasing more than maximum temperatures. Mean annual precipitation for the region is projected to increase by 7%, ranging from 5% in the Nadina District to 11% in the Stikine. Increases will likely be as rainfall because precipitation as snow is projected to decrease by about 35%. For the Kalum District, which is closest to the coast, precipitation as snow is projected to decrease by 72%. The number of growing degree-days will increase, and the number of frost-free days will increase. Evaporation and climate moisture deficit will increase despite moderate increases in summer precipitation because of increases in temperature.

To better illustrate the differences between different areas in the Region, climate projections for the Houston (interior), Terrace (coastal), and Dease Lake (northern) areas within the Skeena, were simulated in Climate BC ver. 5.5 (Table 1).

Table 1. Baseline climate data for the Houston, Terrace, and Dease Lake areas, in comparison to climate projections for the years 2055 and 2085, using the CanESM2_rcp45 model. Climate variables include Mean Annual Temperature (MAT), Mean Annual Precipitation (MAP), May to September Precipitation (MSP), Frost Free Period (FFP), Average Winter Temperature (Tave_wt), and Average Summer Temperature (Tave_sm).

Area	Year	MAT (°C)	MAP (mm)	MSP (mm)	FFP (Days)	Tave_wt (°C)	Tave_sm (°C)
Houston	Normal 1961 - 1990	3	412	183	93	-12.9	5.8
	2055	6.6	436	180	144	-4.7	17.8
	2085	7.5	455	187	159	-3.8	18.8
Terrace	Normal 1961 - 1990	6.7	1236	290	161	-2.3	15.6
	2055	10.4	1349	283	224	1.5	20

[3] Foord, V. 2016. Climate Patterns, Trends, and Projections for the Omineca, Skeena, and Northeast Natural Resource Regions, British Columbia.

	2085	11.2	1410	291	244	2.4	21
Dease Lake	Normal 1961 - 1990	-0.7	459	245	70	-14.4	11.5
	2055	2.9	517	271	120	-10.2	15.5
	2085	3.8	530	275	133	-9.3	16.5

Using CanESM2_rcp45_2085, a moderately conservative model, Climate BC predicts substantial changes for all three areas in the Skeena Region (Table 1) with mean annual temperature increases of 150%, 67%, and 643%, respectively for the Houston, Terrace, and Dease Lake areas. Precipitation changes are more modest at 10%, 14%, and 16%, respectively in the Houston, Terrace, and Dease Lake areas by 2085. Mean summer precipitation is not expected to change much in any of the three areas, indicating a potential increase in moisture stress during these summer months as temperatures are expected to rise.

Another way to visualize how changes in temperature and precipitation may influence the Skeena region is to look at how BGC zones are expected to react (figure 3). In the Houston area, for example the valleys, which are currently in the SBS zone, will experience moisture-temperature conditions more typical of the IDF, and around Dease Lake the BWBS will become more widespread at the expense of the SWB. The CWH zone around Terrace will expand up the mountain slope and high elevation zones will shrink. It is important to note that while changes in climate variables will occur, it will take time for species to respond to these predicted changes and so vegetation patterns will likely be different than what is currently found for a particular zone.

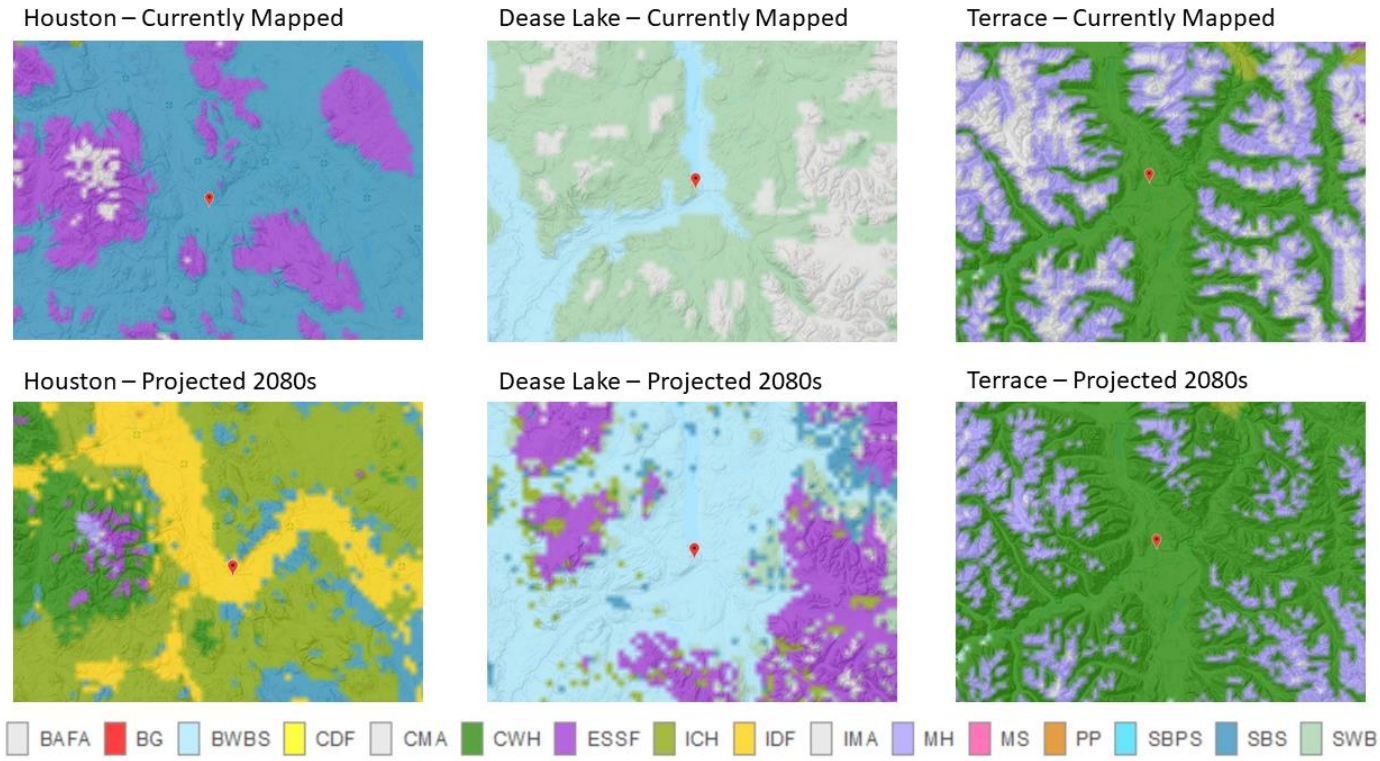

Figure 3. Changes in BCG zones for the Houston, Dease Lake, and Terrace areas by 2080

The type of climate shift that is expected within the Skeena region has the ability to greatly impact ecosystem structure and function, potentially resulting in increased frequency of extreme fires, insect outbreaks (e.g. the mountain pine beetle epidemic), disease, wind events, changes in stream flow (increasing in the winter with higher peak plows and decreasing in the summer), summer moisture deficits, changes in wetland and riparian vegetation, shifts in upland vegetation species and cover, possible increased tree growth at high elevation and decreased growth at low elevation, and migration and

extirpation of forest fauna. Of course, some changes will occur more rapidly than others. Vegetation shifts will take time and future structure and function will not necessarily conform to current patterns. The FLNRO Extension Note *Adapting Forest And Range Management To Climate Change In The Skeena Region*: provides an excellent summary of climate change projections, impacts, and mitigation/adaptation measures (available at - https://www2.gov.bc.ca/assets/gov/environment/natural-resource-stewardship/nrs-climate-change/regional-extension-notes/skeenaen151125.pdf) including the following insight into adaptation:

> *Many climate change adaptation strategies are similar across BC. With the exception of assisted migration, most strategies are not new, but rather are elements of ecosystem management that require broader application. Strategies to reduce risks to forest ecosystems include promoting resilience by maintaining or increasing diversity at all scales, guiding ecological transformation by maintaining landscape connectivity and assisting migration, combating detrimental change by controlling invasive plants and excessive disturbance, and limiting cumulative effects of multiple landuse activities. Strategies to reduce risks to forestry-dependent communities include increasing monitoring of change, strategically harvesting at-risk forests, managing fire in wildland-urban interfaces, increasing capacity of infrastructure to withstand extreme events, and increasing community capacity to respond to change (e.g., by economic diversification).*

Land Uses And Economic Development

HUMAN SETTLEMENT

The population of the Skeena Region is around 75,000, with equal numbers residing in the Regional Districts of Kitimat-Stikine and Bulkley-Nechako. Major communities (over 1000 people) are Prince Rupert, Terrace, Kitimat, Hazelton, Smithers, Telkwa, Houston, and Burns Lake. About 40% of the population lives rurally, on reserves, or in small villages. The people of the Skeena Region make up less than 2% of the population of BC. The economy of the region is 60% resource-based, led by forestry and mining, and the service industry and public sector make up the remainder.

The northern half of the Skeena Region – the Cassiar – makes up almost 40% of the land area, yet is home to less than 2000 people, 65% of whom are First Nations. The Cassiar is unique in that it is largely unroaded. Wilderness recreation opportunities, including big-game hunting, are world class and provide seasonal work for many people. Gold rushes in 1862 and 1874 brought thousands of people to the Cassiar. Asbestos was mined at Cassiar from 1952 to 1992. The community once had a population of 1500 but is now abandoned. Placer mining has perhaps had the greatest impact in the area due to degradation of forest soils.

FOREST SECTOR DEVELOPMENT

Historically forestry has been one of the main drivers of the regional economy throughout the southern portion of the Skeena Region. There are five major sawmills in operation, two pellet plants ("waste" wood that would have been burned in slash piles is now being utilized as a source of bioenergy), and a number of smaller sawmills, but no pulp and paper plants with the closure of the mills in Kitimat and Prince Rupert.

In the interior portion of the Region, the mountain pine beetle epidemic resulted in temporary increases in allowable annual cut to capture dead timber before it became too decomposed to be used. These levels were not sustainable however, and new allowable cut levels in the Lakes, Morice, and Bulkley Timber Supply Areas TSAs will be up to 50% lower in the future, likely resulting in reduced mill capacity and fewer primary processing jobs.

With a shrinking timber supply, and increasing pressure to remove areas from the timber harvesting land base (approximately 25% percent of the Skeena Region has been set aside, for example, as parks and protected areas not including other areas under special management for values such as old growth, water, ecosystems at risk, wildlife habitat, scenic viewscapes and cultural features), operators are turning to lower volume stands (as low as 100 – 140 m3 per hectare) and longer haul distances, and there are a number of initiatives by government to encourage the salvage of damaged timber stands (usually by assisting with silviculture obligations). However, there are still fire impacted stands or mountain pine beetle affected stands in the Region that are outside of the economic margins suitable for timber salvage

but which may be suitable for some type of stand intervention. There are also other categories of land such as old access roads or rail lines that may be suitable for some forest enhancement activity. Such areas could be important potential candidates for ecosystem restoration initiatives.

MINING

Mining continues to be a strong economic driver in B.C. Gross mining revenues for the BC mining industry were $8.7 billion in 2016, and the BC mining industry made total payments to the government and government agencies of $650 million that year. The province's Northwest and Southeast regions accounted for more than three quarters of exploration activity in 2017. According to the Mining Association of BC, in the province's northwest region there are 3 mines in operation, 2 mines in an advanced state of exploration, 14 with permitting/environmental impact assessments complete, and 3 that are in a maintenance phase. Jeff Kyba indicated[4], however, that at least 92 projects remained active in the Skeena Region (2015 data). While there may be some opportunity for SERNbc to be involved with mitigation activities associated with active mines, it is more likely that abandoned sites will require restoration.

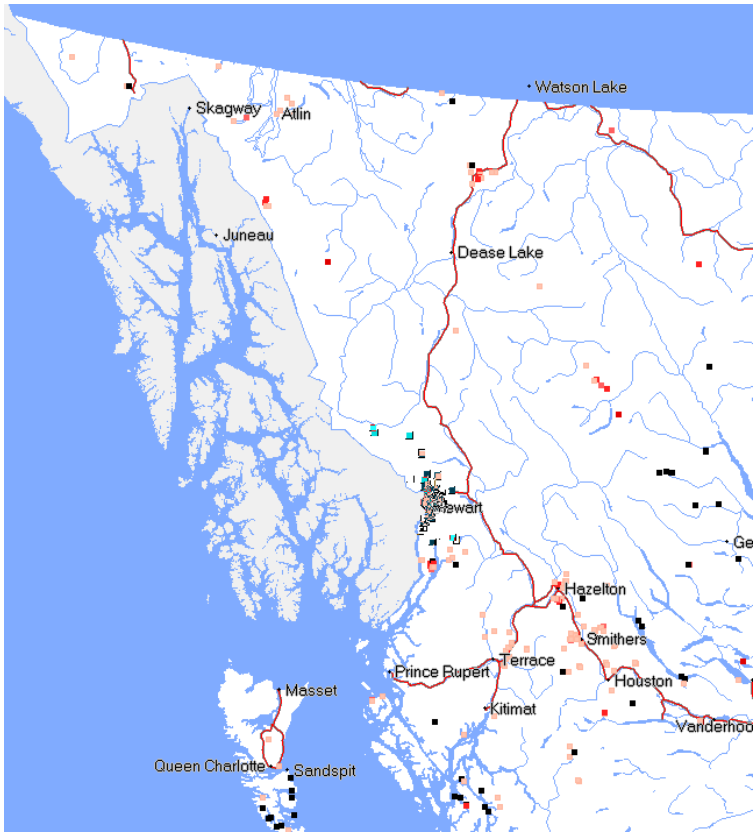

Figure 4. Known historic mines in the Skeena by production class.

Since 1969, mining companies have been required by law to reclaim all lands disturbed by mining, including land disturbed by exploration activities. In 2000, the Ministry of Energy, Mines, and Petroleum Resources (MEMPR) initiated a project to inventory historic mine sites in B.C.[5] and created a historic mines atlas based on a review of existing Ministry data (see example in figure 4) (http://webmap.em.gov.bc.ca/mapplace/HistoricMines/main.htm)

Within BC, 1887 unpermitted past mining sites were initially identified and 1171 were classified as having geo-environmental characteristics with potential for generating acid and/or leaching of metals into the environment. Based on the historic mine sites inventory, a Crown Contaminated Sites Branch was established to manage contamination on Crown lands to carry out environmental investigations and remediation programs at priority orphaned mine sites where environmental and health concerns exist, and no other party could be held accountable. While this agency has had some success in remediating some priority orphaned mine sites, more is required (remediation is underway at 58 historic mines sites across BC - approximately 42% of the area).

With respect to ecosystem restoration, SERNbc's interests may be centred around mines that are closed and under ownership but require monitoring or maintenance and abandoned sites (a mine for which all permit obligations have been satisfied and the mineral claims have reverted to the government) that require reclamation. The types of activities that could be required include monitoring, ensuring hydrological function is not impaired, work on acid rock drainage, erosion control, and vegetation re-establishment. Containment of materials (tailings) and discharge containment are higher priority but often much higher cost. Many sites are also remote, making any restoration intervention more difficult and

[4] Kyba, J., 2015. Exploration and mining in the Skeena Region, British Columbia. In: Provincial Overview of Exploration and Mining in British Columbia, 2015. British Columbia Ministry of Energy and Mines, British Columbia Geological Survey, Information Circular 2016-1, pp. 121-140

[5] http://www.empr.gov.bc.ca/Mining/Geoscience/MapPlace/thematicmaps/Pages/HistoricMines.aspx

more expensive. Any kind of activity undertaken by SERNbc on such sites should be done in collaboration with Crown Contaminated Lands.

THE ENERGY SECTOR (Transmission lines, Run of River Projects, Pipelines, Oil and Gas Exploration)

Major linear disturbances associated with mineral exploration include construction of CN railway grade (from Fort St. James to Dease Lake), and the Galore Creek access road along More and Spahler creeks just north of the lower Iskut river. Recent construction of the Northwest Transmission Line between Terrace and Bob Quinn Lake, and the Iskut connector, will lead to increased resource development in the region. Red Chris mine is connected to this power line. Pretivm's Brucejack mine gets power from the Long Lake transmission line near Stewart, and Galore Creek and Kutcho Creek mines are planning to acquire power from the Northwest Transmission line as well. Several run-of-the-river power projects in the Iskut watershed feed into the Northwest Transmission line.

Mineral processing at Rio Tinto Alcan's aluminum smelter in Kitimat has been the dominant employer in Kitimat and Terrace since the early 1950's. Construction of the Kenney Dam flooded 92,000 hectares of land within the upper Nechako watershed to create the Nechako Reservoir. The reservoir effectively reversed the natural flow – water that once drained southeast into the Fraser Basin was redirected west through an intake tunnel in the Coast Mountains to the Kemano Generating Station. The Nechako River was the largest coldwater tributary in the Fraser system and thus all salmon stocks in the Fraser were impacted. It is possible that eulachon stocks in Gardner Channel have also been impacted by this diversion (John Kelson, pers. comm, 2018). Creation of the Nechako Reservoir had significant and lasting impacts on the local Cheslatta Carrier Nation, who were forced from their homes, and destroyed salmon stocks in the Nechako River. Roughly 70 to 80% of the river water was diverted from its course, with the remaining released out of the Skins Lake spillway where it results in annual flooding of Cheslatta Lake before re-entering the Nechako downstream. Modified river flows altered the balance of sediment flows in the watershed. Although salmon stocks appear to be slowly recovering within the lower Nechako, low water flows and warm water temperatures are an ongoing threat to the system. Recent modernization projects to the power facility and to the smelter have improved the efficiency and lifetime of the operation.

FISH HABITAT AND WATER RESOURCES

The Skeena Watershed supports five salmon species: sockeye (*Oncorhynchus nerka*), pink (*O. gorbuscha*), chum (*O. keta*), chinook (*O. tshawytscha*), and coho (*O. kitsch*), and about 26 non-salmon species. Trout and char presence includes steelhead/rainbow trout and cutthroat trout, Dolly Varden, bull trout, and lake trout. Freshwater and salmonid fisheries in the Skeena Region are an extremely valuable resource. First Nations fish for food, societal and ceremonial purposes, as well as for economic purposes. The steelhead and inland salmon sport fishery alone is valued at 10's of millions of dollars per year. The commercial fishery in saltwater is worth millions of dollars annually. Processing sectors provide additional employment. The Skeena region sport fishery as well as the commercial fishery is considered to be world class. Forest harvesting, mineral exploration and mining, transportation and related infrastructure all have an impact on fisheries and water quality. Projected increased stream temperatures, accompanied by altered flow regimes, have the potential to substantially change fish population abundance and health and little is known about this potential impact. For example, there is considerable uncertainty that the ~93% of Skeena sockeye spawning and rearing in the upper Babine system will be able to migrate upstream in the Babine River given the increased temperatures and altered flows.

Forest Renewal BC and the Associated Watershed Restoration Program made a significant contribution to restoring riparian habitats and fish passage in the 90's. Since then, recent legislation and policy measures have shifted the onus onto industry. Ministry of Transportation, Environmental Programs is responsible for fish passage for highways and Ministry of Forests has a provincial Fish Passage program for forestry roads (not under industry obligation). The two agencies share a Protocol for Prioritizing Sites for Fish Passage Remediation. Both agencies do excellent work and annual reports are available. Their collective budget, however, falls far short of restoration priorities.

AGRICULTURE

Currently, the vast majority of agriculture practices in the Skeena region take place within the Bulkley, Lakes, and Morrice TSAs due to the more favorable climactic conditions and soil properties in these areas. Within the Smithers, Houston, and

Burns Lake areas, there are approximately 40,000 ha of land with designated farm status, with most agriculture activities pertaining to ranching and field crop production[6].

Extensive crop and cattle production across the region is supported by both private land and a variety of Crown land agreements dating back to the 1930s. Government policy of the day required land owners to clear and cultivate 80% of the arable land over a 20-year period in order to receive title to the land. This resulted in land clearing through streams and wetlands, often without proper stream crossings. Although there are a number of initiatives currently in place to assist in the restoration of stream crossings in these croplands[6], there is considerable room and need for additional restoration projects to be conducted within these areas.

TRANSPORTATION

The Skeena Region is the western terminus of Canada's Pacific Gateway Transportation Network. The network includes roads and rail lines, cargo facilities, and ports in Prince Rupert, Kitimat and Stewart. The Port of Prince Rupert has experienced significant expansion, including construction of the AltaGas Ridley Island Propane Export Terminal (RIPET), and Pinnacle Renewable Energy Group's Westview Wood Pellet Terminal. Site preparation and other construction related to the potential development of LNG projects and facilities has contributed to employment in the construction sector but there is uncertainty about the level of future development. Road development is extensive in the southern section of the Region (except in the Coast mountains) but limited to a single highway with relatively few secondary roads in the northern section of the region.

RELATED INITIATIVES

In addition to biophysical characteristics of the plan area, and patterns of land use, it is important to understand the management context for an Ecosystem Restoration Program. The management context for ecosystem restoration programming is changing rapidly due to a variety of factors. Many First Nations, for example, have a land management team, and some have departments specific to fisheries and wildlife. As described in this next section, some Nations are actively undertaking ecosystem restoration, often in collaboration with government. The potential for a substantial influx in funding through the Environmental Stewardship Initiative and other funders described below means there is renewed interest in ecosystem restoration from many sectors. Better coordination could improve the delivery of programs, increase efficiencies, and ensure that funds are spent effectively.

Forests, Lands, Natural Resource Operations And Rural Development

FLNRORD is a very broad organization with many functions that pertain to ecosystem restoration. Much of their programming is about resource development permitting and regulation, and while resource development can certainly affect ecosystem function, these operational programs are not within the scope of this report. There are, however, a number of programs that do directly affect an ER program and these are described below. Regional ecosystem restoration priorities are riparian restoration, moose habitat restoration, caribou habitat restoration, and placer mining restoration. All projects will need to be managed collaboratively with First Nations whose territories are affected.

The Provincial ER Program

The Ministry of Forests and Range, now FLNRORD, created a provincial Ecosystem Restoration Program in the fall of 2006 and, in 2009, produced a strategic plan with goals, strategic priorities, and methods to help guide the program. Initial efforts were focused in the Rocky Mountain Trench area of the province with emphasis on:

- maintaining open forest and grassland ecosystems to increase natural forage for wildlife and livestock, and to improve ecosystem resiliency.
- reducing excessive fuel loading to reduce the risk of catastrophic wildfires and the risk of infrastructure loss.

[6] Regional District of Bulkley-Nechako, 2012. Regional District of Bulkley-Nechako Agriculture Plan. Regional Farming Information and Statistics, pp19-25.

- improving long-term timber values and providing a fibre source for biofuels in the short term by thinning over-dense, stagnated stands.

The current mandate of the agency includes helping develop regional ecological restoration plans, helping coordinate and monitor restoration treatments, and providing advice on restoration activities. Over the last few years the Provincial Program has also been developing a system for tracking restoration activities that link with the Provincial Government database. The system includes two software applications – Estate Model and ER Pro, as well as a third application, for the iPad tablet, known as ER Pad that allows a field surveyor to collect plot data. Such a system was deemed to be necessary because ecosystem restoration activities such as surveying and monitoring, burning, manipulating stand structure, or undertaking habitat interventions, do not get captured in RESULTS or other types of provincial database. ER Pro is used to manage and summarize field data, including data validation. Estate Model imports data from ER Pro and is used in creating management units, plot compilation, reporting, and uploading information to RESULTS. Data is archived in the provincial government's central database. It is intended to be the main tool for tracking ecosystem changes over time and determining the effectiveness of treatments. The system shows promise, not just the ER program, but for any agency involved in data collection, monitoring, or treatment of a broad array of forest conditions.

Funding to date for the Provincial ER Program has come from the Land Based Investment Fund. Any ER program in the Skeena Region will need to coordinate with the Provincial Program, and it is likely that some funding from this source could be available to help ensure this happens.

SERNbc

The Omineca Ecosystem Restoration Program and South Peace Ecosystem Restoration Program are managed under the auspices of SERNbc (www.sernbc.ca) and within the Provincial ER program. In the Omineca, stakeholders formed a society with funds administered through a Board of Directors. Projects are delivered through contractors, some of which are administered through Price Waterhouse Coopers, or in-kind services of partners (e.g. BC Wildfire Services). Funding is provided through the Provincial ER Program and any other organizations with common interests (e.g. the Habitat Conservation Trust Foundation, BCHydro, BC Cattlemen, Environment Canada, Industry, and others). This type of sound societal governance structure provides funders and partners with confidence. The Provincial ER Program has not been active in the Skeena Region to date. In the Skeena Region ecosystem restoration activities have been delivered through a range of government initiatives, many in collaboration with First Nations, reflecting the New Relationship between government and indigenous communities. While there are likely lessons to be learned from the Ecosystem Restoration program in other Regions, the unique biophysical and socio-political characteristics of the Skeena region will necessitate different focus and approaches to ER programming.

The Forest Carbon Initiative and Integrated Investment Planning Branch

The Office of the Chief Forester is a Division within B.C.'s Ministry of Forests, Lands, Natural Resource Operations, and Rural Development (FLNRORD) and includes, amongst other things, the Forest Carbon Initiative and Integrated Investment Planning Branch. FLNRORD produced a Forest Carbon Strategy (2016-2020) which outlines current and planned initiatives to manage forest carbon and improve the sustainability of B.C. forests, communities, and industry while mitigating the effects of climate change. The forest carbon strategy is integral to the Provincial Government's Climate Leadership Plan. Forest carbon management strategies to increase carbon sinks or reduce emissions fall into six broad categories:

1. Increase (or maintain) forest area;
2. Increase stand-level carbon density;
3. Reduce emissions associated with forestry operations;
4. Increase landscape-level carbon density;
5. Increase the proportion of harvested wood that is used for long-lived products; and,
6. Create forests that are more resilient to changes in climate suitability, pathogens, invasive species, drought, and wildfire.

The Forest Carbon Initiative (FCI), is the operational arm that implements FLRNORD's provincial Forest Carbon Strategy and its objectives are to:

- Enhance the carbon storage potential of B.C.'s public forests by using intensive forest management practices (afforestation, high density planting, and fertilization).
- Improve fibre recovery and reduce emissions from burning slash.
- Increase the rate of replanting.

There are several areas of overlap in mandate between FCI and SERNbc in terms of mitigating climate impacts and improving the sustainability of forests in northern B.C. It is possible that SERNbc could help with developing implementation strategies, undertaking related research, technical extension and outreach, and project management. This work could be completed directly for the Forest Carbon Initiative and Integrated Investment Planning Branch or, more likely, through funding acquired under the Forest Enhancement Society (see the next section).

The Forest Enhancement Society

FESBC, formed in February 2016, is a legally established society but also has mandate to work as a Crown reporting entity. The Provincial Government provided the Society with an $85 million budget to invest over a five year period. The objective is to advance environmental and resource stewardship of BC's forests by preventing and mitigating the impact of wildfires, improving damaged forests, improving habitat for wildlife, supporting the use of fibre, and treating forests to improve the management of greenhouse gases. In February 2017, the Province provided the Society with an additional $150 million in a lump-sum payment. In June 2017 the Federal Government also launched a Low Carbon Economy Leadership Fund, with the objective of helping Provinces deliver on Canada's commitments under the Paris Agreement to reduce greenhouse gas emissions. The Province and Federal Government are working on the delivery of the program to enable $140 million of this funding to be recovered by the Province. B.C.'s Forest Carbon Initiative and Integrated Investment Planning Branch are assisting FESBC in investing in Carbon eligible projects through criteria on project eligibility and by providing guidance on the agreement between FESBC and the Federal Government in terms of utilization of the Low Carbon Economy Leadership fund.

SERNbc is well positioned to deliver project work directly in line with the FESBC mandate, particularly with respect to forest fire management planning, fuel management, habitat enhancement, research on alternatives to burning forest fuels, and carbon sequestration projects. In fact, SERNbc is already undertaking work on reforestation/forest augmentation across the Skeena, Omineca, and Peace Regions for FESBC. Additionally, because FESBC has an open call for proposals, any work that SERNbc identifies, which is in-line with the FESBC mandate, could potentially be funded by them. This agency could be an important partner in achieving SERNbc goals in the future, however, FLNRORD's Resource Management Section has a strong interest in ensuring that ecologically relevant practices for moose and caribou are considered with any ER work, and that silvicultural prescriptions mimick natural processes.

Cumulative Effects

Cumulative Effects (CE) are defined as "changes to environmental, social, and economic values caused by the combined effect of past, present, and proposed activities and events on the land base." BC Ministry of Environment provides provincial CE policy in the way of a framework – a set of policies, procedures and decision-support tools that helps identify and manage cumulative effects consistently and transparently across British Columbia's natural resource sector. The framework incorporates the combined effects of all activities and natural processes into decision-making to help avoid unintended consequences to identified economic, social and environmental values. Implementation of CE is carried out regionally by FLNRORD. The Skeena region is in the process of implementing a CE assessment for the 5 values recognized province-wide: Aquatic Ecosystems, Grizzly Bear, Old Growth Forest (seral stage distribution), Forest Biodiversity, and Moose. Two additional values are being assessed regionally: Wetlands and Medicinal Plants. Cumulative effects assessment, including consideration of climate change, will provide a powerful dataset that will help highlight where restoration is most needed on the landscape.

Caribou Recovery

Caribou habitat restoration within the region is driven by the federal Species at Risk Act (SARA) and by the Cheslatta Carrier Nation Reconciliation and Agreement process. FLNRORD Resource Management Section has several collaborative ecosystem restoration initiatives underway or in the planning and proposal stages aimed at restoring habitat for the Tweedsmuir-Entiako caribou herd. These include:

- removal of submerged snags and wood debris along the Whitesail Lake shoreline (a legacy of construction of the Kenney Dam) that inhibits caribou migration; the Cheslatta Carrier are fully equipped with barges, tugs, dozer boats and certified personnel and have active marine infrastructure and foreshore access in the vicinity of Whitesail Reach to implement the restoration.
- road deactivation and restoration aimed at reducing the proliferation of travel corridors and restoring landscape connectivity; the Cheslatta Carrier have an interest in maintaining some road access in the vicinity of their guide outfitting territory, but are otherwise supportive of the project; and,
- lichen-transplant seeding for accelerating the recovery of Pine-Lichen woodlands following the Chelaslie fire. An important consideration in habitat restoration is the spatial separation of caribou and moose habitat. The federal government has recently contributed $2,000,000 to the Habitat Conservation Trust Fund for caribou recovery.

Moose Enhancement

Moose management and associated habitat enhancement undertaken by FLNRORD includes a broad range of activities organized within a structured decision-making framework for making decisions more transparent and reflective of First Nations values, and within a broader landscape context. For example, it is important that moose habitat enhancement activities are spatially separated from caribou habitat. Ecosystem restoration activities include deactivation of unused supplemental and non-status roads; identifying and enforcing motorized vehicle closure areas; assessing and potentially restoring areas of high habitat capability affected by the willow-borer (***Cryptorhynchus lapathi)***; and planting browse species along S6 streams. Ecosystems Section is developing standards for moose habitat restoration that will effectively result in a form of “shelf-ready” ER plan that can be applied in areas of high moose habitat capability and that will be of interest to SERNbc, First Nations communities, and other stakeholders.

The Range Program

According to the FLNRO website (https://www.for.gov.bc.ca/hra/), the Range Program (including ecosystem restoration, range ecology, and invasive plants) allocates and administers hay cutting and grazing agreements and grazing leases on Crown range across the Province. Program activities focus on ensuring healthy and sustainably managed rangelands. Sustainable management is achieved through monitoring ecological conditions, controlling the establishment and spread of invasive plant species, advocating sustainable range management practices, developing legislation, policy, and extension services, and assisting in the restoration of degraded rangeland.

There are many range tenures in the Bulkley, Morice and Lakes TSAs for domestic livestock, primarily cattle, but there are also tenures and range use in other areas of the Region, particularly for pack animals. Key objectives with range management are:

- maintenance of healthy functioning riparian and upland systems.
- restoration and maintenance of desired plant communities.
- no net loss of native species.
- appropriate levels of use.

Open range treatments can include prescribed burning, cutting, fertilization, rangeland seeding, treatment of noxious plants, livestock control with fencing, salt licks, cattle guards, and exclosures, streambank stabilization, development of watering holes and water access points, scarification and tilling, and wildlife control, amongst others.

In the Skeena Region there are occasions where there are conflicts between range use and other resource uses. Examples include damage to riparian vegetation and water quality resulting from over grazing and trampling, wildlife conflicts, the spread of noxious weeds, and open range burning that results in timber supply losses. The Range Program has produced some excellent extension materials on treatments including brochures for making decisions about when to remediate, and a remediation toolkit.

There is a clear overlap in range objectives and ER objectives (hence the establishment of the Provincial ER program under Range Branch). An obvious way for an ER program to add value to the range initiative is in the coordination of treatments that will achieve both range objectives and other resource use objectives (e.g. habitat enhancement through prescribed burning) particularly in vulnerable or degraded ecosystems. Monitoring vegetation response to treatments and

associated data management is another area of potential collaboration, particularly on native grasslands, shrublands important for wildlife, and sensitive wetlands. An ER Program could also assist with research related to range response and assist with the development and distribution of extension materials.

Fish Habitat And Water Resources

The goal of the provincial Freshwater Fisheries Program is to conserve the natural diversity of fish and fish habitat and to sustainably manage freshwater sport fishing in B.C. The province exercises delegated authority, under the federal *Fisheries Act*, for the management of non-salmon freshwater fisheries. FLNRORD's Fisheries Section in the Skeena Region is tasked with managing recreational fisheries. Fish habitat management is recognized as another important priority, but the Section is not adequately resourced to address it, except on an ad hoc basis. For example, the Upper Bulkley River, above the Morice River confluence, is recognized as one of the most degraded watersheds in the region due to the cumulative impacts of forest harvesting, agriculture, associated road and rail networks, and changing climate. Fisheries section participates on the Upper Bulkley Round Table and shares monitoring and assessment work.

Other gaps in habitat restoration include concerns around the effects of recreational fisheries on isolated fish populations, such as lake trout (listed as a vulnerable species); and the effects of a changing climate on cold water thermocline habitat for cold water fish (trout and char, including Bull Trout and Dolly Varden).

Several staff pointed to the valuable legacy of restoration, assessment and planning work carried out by FRBC's Watershed Restoration Program (1994-2002). For example, industry and First Nation groups implemented projects to recontour roads and pull out, or replace, culverts to remove in-stream blockages to fish passage. Hillslope, gully and road stabilization projects from the WRP sought to prevent the introduction of fine sediments into streams and to prevent fish passage loss from landslide or road failure. Some first nations groups were trained in bioengineering practices, such as replanting unstable areas with willow whips and cottonwood live stakes. Off-channel salmonid rearing habitat projects restored habitat damaged by log driving on the Kitsumkalum River and created off-channel habitat on the Telkwa River.

Much of WRP's planning and assessment is still relevant today. Glen Buir, Stewardship Forester FLNRORD has kept documentation for a lot of this work. Other reports have been archived within FLNRORD Fish and Wildlife Section. The Skeena Knowledge Trust is another repository. Many of these reports contain methodologies for restoring riparian ecosystems. There are also a number of strategic reports such as Ralph Kossman's Listing and Preliminary Prioritization of Outstanding WRP Projects for Kispiox and Cranberry TSAs (2006) covering five major rivers. Further review of this body of work is required to prioritize outstanding projects, while recognizing that there are a number of well organized NGO's, described in the section on Other Stakeholders, who have a long history with fish and water related initiatives in the region.

The Department of Fisheries and Oceans also has a Habitat Restoration Biologist on staff who has been helping to plan and implement restoration priorities for the Upper Bulkley River, as well as a number of other projects across the region. Other hot spots for riparian restoration include the Kitimat watershed, the Kitwanga River Recovery Plan, Lakelse Lake, the Morice River, and Babine Lake sockeye tributaries.

Northern Wildlife Partnership

The northern portion of the Skeena region has very low road-density. Where roads exist, however, ecosystem impacts are concentrated so that wildlife populations such as moose may be impacted by habitat degradation, hunting pressure, and predation. To help address wildlife concerns in the northern portion of the Skeena region, FLNRORD has recently initiated a round table group called Northern Wildlife Partnerships. The Tahltan are participating at present and Taku River Tlingit and Kaska have been invited. Participating stakeholders include the BC Wildlife Association, the Tahltan Guide Outfitters Association, the BC Wildlife Federation, and a local resident hunter. This group is just in its formative stages. Wildlife issues include moose distribution and opportunities for habitat enhancement; management of caribou and sheep populations; and placer mining reclamation.

Ministry of Indigenous Relations and Reconciliation – The Environmental Stewardship Initiative

In 2015 the Province announced that it was allocating up to $30 million over three years to co-design environmental stewardship projects with First Nations and Industry. The goals of the ESI initiative are to develop a new, collaborative approach to establishing environmental legacies and to generate high quality, accessible and trusted environmental information. The scope of the ESI includes four key areas:

- ecosystem assessment and monitoring
- ecosystem restoration and enhancement
- ecosystem research and knowledge exchange
- stewardship education and training[7]

The program is organized sub-regionally and delivered through ESI Tables made up of First Nations resource specialists and government technical representatives from FLNRORD and MIRR, as well as industry representatives. Funding for ER activities is allocated by government to each table but can also be sought from other sources.

In the Skeena Region there are currently two ESI tables, the North Coast Table and the Skeena East Table. These tables are focused on five key values (grizzly, moose, wetlands, fish, and medicinal plants) and they are working toward understanding the current state of these values through assessments. The North Coast ESI Table is a partnership between Kitsumkalum, Kitselas, Metlakatla, Haisla, Gitxaala and Gitga'at First Nations and government representatives. They have developed an ecosystem restoration demonstration project that will identify and undertake restoration enhancement activities in the lower Nass, lower Skeena, and Kitimat watersheds and associated coastal marine areas. Activities include bank stabilization, fish passage remediation, watershed assessments, and gathering and improving baseline data. Riparian restoration assessments and prescriptions are in various stages of completion for Nalbeelah creek, Lone Wolf creek, Kumphry's creek, Wedeene River, Riordan River, and Kitkiata River. Live willow staking has been implemented on the Kitsumkalum River to protect fish spawning habitat; and fish passage has been restored through a wetland on the Exchamsiks River. Work is also underway to assess barriers to fish passage along the CN Rail ROW from Terrace to Prince Rupert.

The Skeena East ESI Table has focused on Nation-specific monitoring and assessment projects that will lead to the identification and prioritization of ecosystem restoration projects for the five key values mentioned above. Participants include Lake Babine Nation, Office of the Wet'suwet'en, Gitanyow, Gitxsan, Skin Tyee, Nee Tahi Buhn Band, Hagwilget village, and Wet'suwet'en First Nation. Skeena East stewardship initiatives already underway include:

- restoration priorities identified through the Fish Passage Culvert Inspection (FSCI) protocol – Wet'suwet'en First Nation and Lake Babine Nation;
- fish habitat restoration in the Upper Bulkley and Morice River systems – Wet'suwet'en
- site-specific ecosystem restoration priorities addressing the legacy of logging roads disrupting stream flow and fish habitat in the Hanna-Tintina Conservancy – Gitanyow.

There is significant overlap between the Environmental Stewardship Initiative and the proposed SERNbc Ecosystem Restoration Program including the focus on environmental function, assessments, technical outreach, and a governance structure that is multi-stakeholder. Any ER Program in the Skeena Region will need to consider ESI activities. Ideally, First Nations, Government, and SERN would work together to arrive at a consensus on priority areas, and funding from the initiative could be used to implement projects jointly deemed to be beneficial. It should be a priority for SERNbc, therefore, to position itself as a delivery agency that can assist with ESI project delivery.

[7] See - https://www2.gov.bc.ca/gov/content/environment/natural-resource-stewardship/consulting-with-first-nations/environmental-stewardship-initiative

The Ministry of Environment

The Provincial Government's website indicates that the key functions of the Ministry of Environment (MoE) include:

- leading action on climate change.
- managing discharges to the environment.
- responding to environmental risks.
- protecting biodiversity including ecosystems, habitats, and native species.
- managing the province's parks and protected areas.
- monitoring and enforcing compliance with environmental laws and regulations.

In other areas of the province, BC Parks has been a key partner in delivery of the ER program. Biologists within the Ministry have also helped guide ER programming as Board members or through project ideas and their management.

MoE initiatives of immediate interest for an ER program, aside from cumulative effects, include:

- Predictive Ecosystem Mapping (PEM) and Terrestrial Ecosystem Mapping (TEM) and derived products like the broad provincial habitat mapping for key wildlife species.
- Provincial data set for fisheries, wildlife, and ecosystems including web based applications like:
    - EcoCat (Ecological Catalogue): contains reports, data and maps.
    - FIDQ (Fish Inventory Data Query): search by waterbody name or ID for bathymetric maps, fish presence, chemical studies, obstacles, etc.
    - SIWE (Species Inventory Web Explorer): search for wildlife inventory, telemetry, plants and invertebrate reports and data.
    - The HabitatWizard (HabWiz) spatial database tool (http://www.env.gov.bc.ca/habwiz/).

The last product, HabitatWizard, is a map-based tool that spatially represents all the above mentioned MoE data sources, allowing users to view fish, wildlife and ecosystem information over the internet. This type of information is critical to decisions regarding ecosystem restoration interventions, and at some point, it may be useful to link Estate Model and ER Pro databases mentioned under the Provincial ER Program, to this system. In the Omineca Region, a need has been identified to develop a Stewardship Atlas that provides an ecologically based map and database tool, that will help decision makers determine the relative importance of any habitat or ecosystem restoration initiative based on the projects relative location with respect to existing habitat suitability and

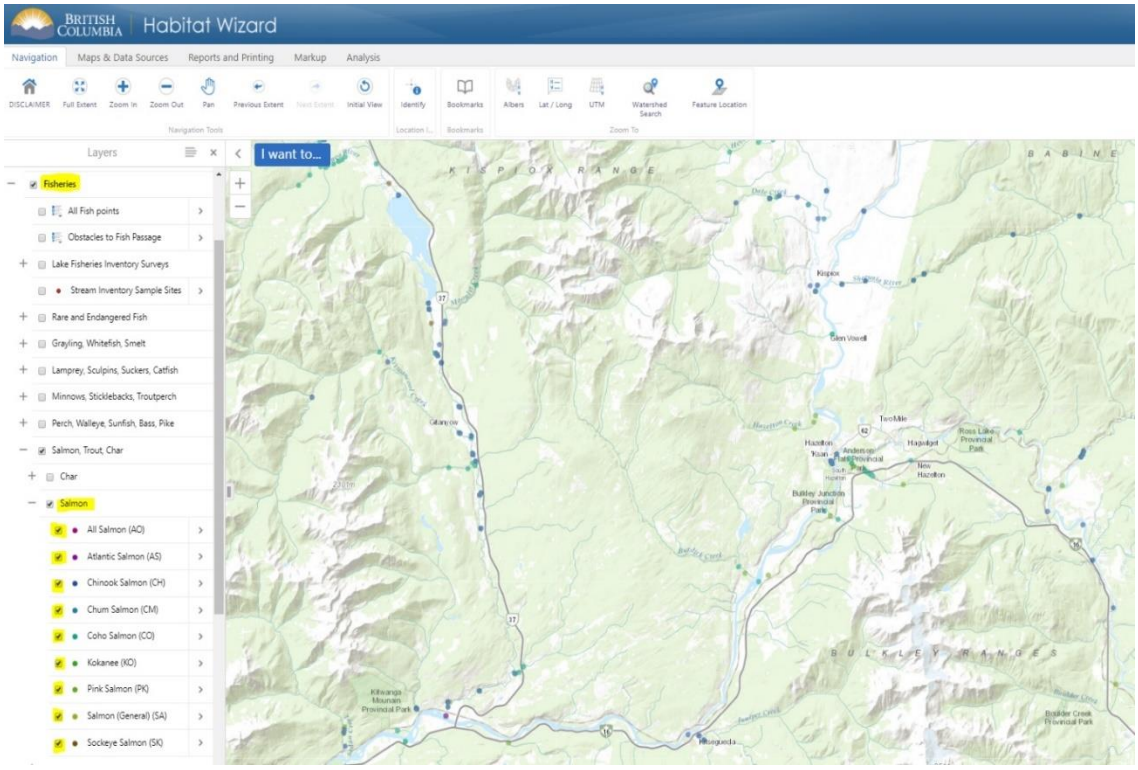

Figure 5. Salmon habitat in the Hazelton area depicted in Habitat Wizard.

capability, plant and wildlife population levels, enduring features (terrestrial or aquatic features that will endure in the face of climate change, and possibly act as refugia), known migration corridors, industrial development etc. It is probably that this type of Atlas will be useful in the Skeena as well, and HabWiz may be an appropriate mechanism for developing it.

First Nations

In total, there are 26 First Nations Located within the Skeena Region, affiliated with either the Gitxsan Nation, Carrier Sekani Tribal Council, Nisga'a Lisims Government, Office of the Wet'suwet'en Society, Tahltan Central council, or the Tsimshian First Nations Treaty Society. In addition, there are often many house groups within each First Nation, with unique values and goals, leading to the necessity to work with each house group on their own terms as a separate entity from the broader First Nation. Many First Nations have a land management team, with individual departments to focus on specific values, and many groups also have a recognized land management plan to further identify and work with resource values.

With the advent of ESI, the Entiako Caribou initiative, the Northern Wildlife Partnerships, and other programs such as Moose Enhancement, it seems clear that many of the ER priorities in the Skeena Region will flow from these collaborative government to government initiatives. SERNbc is well positioned to help coordinate and support these ER activities in a number of ways:

- ready access to additional professional capacity through resource consultants;
- contract management support;
- project monitoring standards;
- knowledge bank for completed reports, mapping, and data.

In other cases, First Nations and community conservation groups have their own ER priorities. In some cases they have done a lot of research and have well developed ER plans– the only thing lacking is sufficient funding to get the work done. This scoping exercise has identified many of the obvious community-based ER priorities across the region, however there are likely many others that have not been identified in this report.

BC Parks

One quarter of the Skeena Region land base is in parks or protected areas. BC Parks is responsible for the designation, management and conservation of ecological reserves, provincial parks, conservancies, protected areas and recreation areas. Their mission is to protect representative and special natural places within the Province's protected areas system for world class conservation, outdoor recreation, education and scientific study (http://www.env.gov.bc.ca/bcparks/). Their focus is generally on conservation and natural processes. All BC parks have a Park Management Plan and any ER activity within them needs to reflect this document.

In other Regions, SERNbc has worked closely with BC Parks to undertake some ecosystem restoration activities targeting habitat restoration and the re-introduction of fire. Interviews with Mark Parminter and Darren Fillier in the Skeena Region indicate that there may be opportunity for collaboration with Parks in such activities as management of forest fuels, whitebark pine conservation, protection of old Douglas-fir, and road deactivation.

Other Stakeholders

BC Wildlife Federation

The BC Wildlife Federation is a province-wide voluntary conservation organization representing British Columbians whose aims are to protect, enhance and promote the wise use of the environment for the benefit of present and future generations. Their goal is to ensure the sound, long-term management of British Columbia's fish, wildlife, park and outdoor recreation resources. They are also active in outdoor recreation education. The governing bodies of many of the other ER programs around the province, includes a representative from the BC Wildlife Federation.

The Guide Outfitters Association of BC

The Guide Outfitters Association of British Columbia (GOABC) was established in 1966 to create a voice with the provincial government for the guide outfitting industry and to advocate for science-based wildlife management. They are another group that commonly participates in ER programming around the province and come to the planning table with substantial practical experience respecting wildlife. GOABC recently established the Wildlife Stewardship Partner Program providing annual funding of $50,000 per year for community-based wildlife stewardship initiatives.

Northern Contaminated Sites Program

The Northern Contaminated Sites Program (NCSP) is a federally funded program, operating through Indigenous and Northern Affairs Canada, which aims to manage contaminated and abandoned mine sites throughout northern Canada. This program specifically focuses on reducing the potential risk to both human and environmental health by developing site remediation plans, implementing monitoring protocols, and creating risk management plans for these contaminated sites. There have been a number of potential reclamation sites identified within the Skeena region, requiring some level of monitoring and remediation to ensure that long lasting negative environmental and social consequences are prevented (see also **Mining** under Land Uses And Economic Development above).

World Wildlife Fund

The World Wildlife Fund (WWF) has been working with groups and communities in the Skeena for circa 10 years, to better enhance the capacity for the Skeena River to adapt to resource extraction, development, and climate change. In January 2018, WWF completed the Skeena Cumulative Effects Assessment, highlighting potential CE sources within the Skeena Watershed and Estuary. WWF assessed a number of ecological values within the region that are sensitive to ecosystem disruptions, including salmon, forage fish, habitat heterogeneity, sediment quality, and ecologically significant species such as eelgrass. This report also makes recommendations on potential mitigative actions that could be taken to ensure that the Skeena Estuary thrives for years to come. The organization is, however, is planning on ending its involvement in B.C in April of this year.

The Skeena Wild Conservation Trust

The Skeena Wild Conservation trust is an organization dedicated to ensuring ongoing social and environmental sustainability of the Skeena River, and works with numerous stakeholders to ensure the resilience of wild salmon in the region. Skeena Wild's main program areas are: habitat and species protection, science and research, sustainable fisheries management, and community engagement. Issues they are involved in include Skeena Estuary, Lelu Island, and Flora Bank, sustainable fisheries, mining, and air pollution.

Pacific Salmon Foundation

The Pacific Salmon Foundation takes a practical approach to salmon stewardship by leveraging and sharing resources within the community. The impact of every contribution is multiplied by community partnerships that can result in access to matching funds, and donations of additional goods and services for projects. The Salmon Watersheds Program, formerly known as the Skeena Salmon Program, is one initiative run by the Pacific Salmon Foundation that focuses on providing updated scientific data on pacific salmon populations, while facilitating communication between governing bodies, industry, and conservation groups within the Skeena. Some specific projects within the program include a synopsis on cumulative salmon habitat pressures in the Nass area, an assessment of the current status and condition of the Skeena River Estuary, and a report highlighting the state of specific conservation units within the Skeena Watershed. The foundation works closely with the Skeena Knowledge Trust (see below). The foundation also developed a tool call the Pacific Salmon Explorer which is an online data visualization tool that displays information on salmon populations and their habitats throughout British Columbia. This tool helps people interested in salmon conservation and management gain better access to baseline data relevant to Pacific salmon using interactive maps and figures, and identify key factors influencing the abundance and productivity of wild salmon populations.

The Skeena Watershed Conservation Coalition

Founded in 2004, the Skeena Watershed Conservation Coalition focuses on educating the public about proposed development plans in the region, while developing overarching stewardship plans for the Skeena. Specifically, the coalition focuses on engaging the public through a wide range of initiatives, such as the Youth on Water Program and the Sacred Headwaters Initiative, to further develop community based connections to the watershed itself. In terms of

ecosystem restoration value, the Skeena Watershed Conservation Coalition can assist in providing community based insight into potential restoration projects, with an emphasis on local values.

Skeena Knowledge Trust

The Skeena Knowledge trust (http://skeenatrust.ca/about) develops and maintains the Skeena Salmon data centre which is an on-line repository on fish habitat populations. The SKT's purpose is to provide a comprehensive source of information on wild Pacific salmonids in the Skeena Watershed, including water quality, habitat and population data. The data, available to all, will inform resource development proposals and government policy, including First Nations' land-use plans, provincial land-use plans, and the federal Wild Salmon Policy and is also useful in terms of public education. The Trust already has a substantial knowledge library for the Skeena watershed and they have created intuitive, functional tools that allow users to access spatial data as well. Johanna Pfalz, the program coordinator, was previously the Section Head for Information Management in the Skeena Region for the B.C. Ministry of Sustainable Resource Management and has a thorough understanding of government servers and data resources thus ensuring that Trust data is additive to that available from government. In terms of ecosystem restoration value, the information available on the site is a great resource and there may be potential for an organization like SERNbc to engage the Trust to manage data and spatial information pertinent to ER in the Skeena Region.

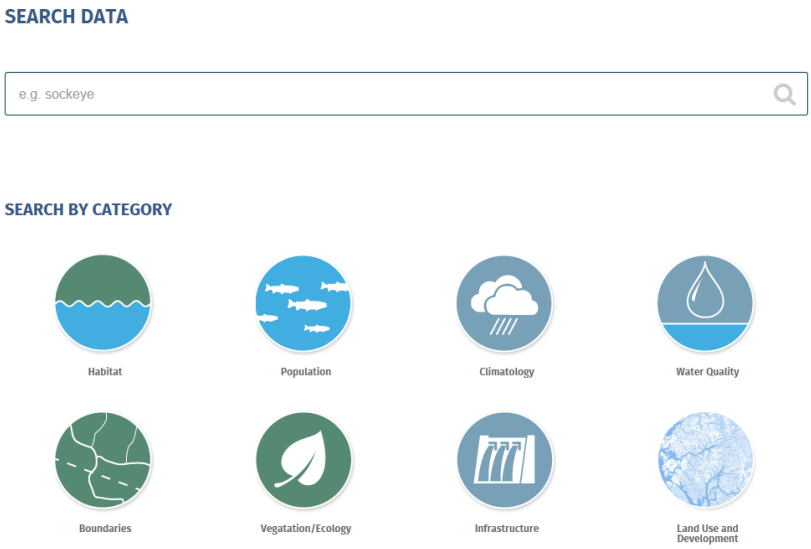

Figure 6. The Skeena Knowledge Trust search tool.

Skeena Fisheries Commission

The Skeena Fisheries Commission (SFC) is a group of First Nations including the Tsimshian, Gitxsan, Gitanyow, We'suwet'en, and the Lake Babine Nations that focuses on the science and management of fisheries within the Skeena watershed. They have developed a number of technical and peer reviewed reports on topics including watershed health, salmon abundance and health, and habitat usage of various salmonid species found within the watershed. These reports and presentations, combined with the traditional knowledge of the First Nation groups working within the SFC, could provide insight to potential restoration opportunities in the Skeena.

Gitxsan Watershed Authority

Comprised of biologists, fisheries experts, and community leaders, the Gitxsan Watershed Authority (GWA) is a fisheries management organization within the traditional territory of the Gitxsan First Nations and also advocates for science based research within the Skeena watershed. The GWA manages a number of projects including the Gitksan Fisheries Catch Monitor and Range Program which provides current figures on fish populations in the Skeena River, Bulkley River, and Babine River. With over 18 years of collected data, these scientific reports could be an important resource when trying to understand how the watershed has changed over time, and where to focus restoration efforts within the Skeena region.

Gitanyow Fisheries Authority

According to their website, the Gitanyow Fisheries Authority (GFA) is an arm of the Gitanyow Hereditary Chiefs office, that specializes in monitoring fisheries and wildlife within the Nass River Watershed. Since 1997, the GFA has worked extensively on recovery of the Kitwanga River sockeye salmon, leading to the construction of the Kitwanga River Salmon Enumeration Facility and the Kitwanga River Sockeye Smolt Enumeration Facility. Each year, the GFA conducts stock assessments within the Gitanyow Traditional Territory, providing insight into the health of the Nass River Watershed. Specific areas of expertise and services offered by the GFA include habitat restoration and enhancement, environmental monitoring, and environmental impact assessment.

Upper Bulkley Stream Keepers

This group, led by local resident Cindy Verbeek, has set up a round table group made up of local First Nations, residents, DFO representatives, and FLNRORD staff, to find ways of supporting fish values in the upper Bulkley River (upstream of the Morice River confluence). One of the group's major achievements has been the construction of the Buck Creek CANFOR hatchery for conservation, education and restoration of the Upper Bulkley river watershed. Verbeek has a long list of restoration activities that she would like to see funded. The highest priorities are:

- Expansion of the fish habitat and erosion control work that has been funded by DFO's (soon to end) Fish Habitat Development Initiative that was coordinated by the Yinka Dene Development corporation. In the past, LGL Environmental Research and Consulting led the work and hired Wet'suwet'en field technicians to place in-stream tree structures and plant willow. The projects took place on private land. This type of activity could be carried out on other private lands within the upper Bulkley.
- Barren Creek Hwy 16 culvert replacement to restore fish passage to one of the (formerly) most productive tributaries in the upper Bulkley.
- Habitat restoration along the Bulkley River and Buck creek dikes to improve instream and overhead cover while continuing to protect the town of Houston from potential flood events.
- Johnny David Creek Hwy 16 culvert replacement. This hanging culvert has recently been retrofitted with a weir system, financed by MOTI, but a more permanent solution is sought.

Seymour Lake Conservation Society

The purpose of this society is to raise awareness and access funds to finance eradication of the yellow floating heart (*Nymphoides peltata*), a potentially highly invasive non-native variety of pond lilly that "escaped" from a land owner's private water garden some time in the 90's. The lily has now spread to 20% of the lakeshore. The plant develops dense floating mats that reduce light penetration, lower oxygen levels, increase organic matter input, alter nutrient cycling, and displaces indigenous vegetation. The society has had a small amount of funding from HCTF and Wet'sinkwa Community Forest to help control spread by cutting and harvesting stems, and installing weed mats. The society has applied to use FLNRORD Invasive Plant Program's vacuum dredger to eradicate the weed, which could cost about $50,000. The Invasive Plant Program has limited funding and Seymour Lake may not make its list of top priorities this year. There is concern that if the plant spreads to larger motorized water bodies, the spread could become exponential.

BC Environmental Farms Program

BC Environmental Farm Program runs a voluntary cost-shared program so that farmers can develop Environmental Farm Plans. The plans include ecosystem restoration activities for which farmers can apply for matching funds to carry out Beneficial Management Practices on private land. The program is always over-subscribed, and runs out of funds within first month of intake each year.

POTENTIAL ECOSYSTEM RESTORATION OPPORTUNITIES

Summary Of Potential Ecosystem Restoration Activities In The Skeena Region

In developing this plan, more than 60 individuals representing nearly 40 different organizations were interviewed and more than 130 different ER opportunities were identified, some of which involved multiple sites (for example, 49 riparian management area encroachments that would benefit from some form of intervention were identified on the upper Bulkley alone). This data has been provided under separate cover in an excel spreadsheet. Some opportunities were spatially identified and others were descriptions without specific geographic locations. The different ER opportunities were classified under nine different project categories (table 2). As part of this project, an ArcGIS project map was created to show the location of spatially explicit projects. Thirty-five different shp files were captured in ArcGIS as point, line, or polygon features, some of which have multiple points or polygons. These are shown in figures 7 and 8 below. Different project categories are represented with different symbology (different shapes, colours, or sizes). The maps in the figures below are included to provide a general sense of where these projects occur within the region and are not suitable for detailed project planning. At the project level, the shp files for the project, provided under separate cover, will, in some cases, be useful in creating project maps.

Table 2. Summary of Skeena Region ecosystem restoration opportunities.

Stream/Watershed Restoration	**Prescribed Fire**
Upper Bulkley Rail Hwy Encroachments	Kispiox 33 Mile Ck Berries
Bulkley Remediation Temp Sens. Streams	Suskwa Babine Berries
Bulkley Cumming Creek	Nadina Red Hills Prov Park Forage
Bukley Jonas Creek	Cassiar Gun Lake Forage
Buck Creek Habitat Restoration/Erosion Control	Cassiar Telegraph Ck Forage
Bulkley Johnny David Creek Fish Passage	Cassiar Tuyo/Stikine Confl Forage
Restoration of Fish Habitat - Houston Town Dike	Cassiar Alsek/Tatshenshini Forage
Hubert Creek (near Telkwa)	Cassiar Todagin South Park Forage
Morice River	Bulkley Col Lake Shrub Ecosystems
(Kispiox Strone and Surprise creeks)	Nadina Shrub/Grassland Ecosystems
Kitimat Rv Estuary Foreshore Restoration	Burn Impact Analysis/Monitoring
Deep Creek, Spring Ck, Leanto Ck	
Habitat And Fish Stock Monitoring	**Species Conservation/Enhancement**
Impacted Watershed Monitoring	Nadina Caribou Habitat Enhancement
	Cheslaslie Fire Lichen Establishment
Fish Passage	Whitesail Caribou Migration Corridor Restoration
Upper Bulkley Rv	Bulkley Nadina Moose Habitat Enhancement
Upper Skeena Rv Approx	Kispiox Birch Inventory/Restoration
Kispiox River 20 very	Kispiox Cedar Inventory/Establishment
Cranberry Rv high	Skeena Old Sitka Spruce Restoration
Kitseguecla Rv priority	Lower Skeena Old Sitka Spruce
Kitwanga Rv sites	Lower Skeena Red Cedar Establishment
Suskwa Rv	Old Growth Conservation/Recruitment in the SBSdk
	Nadina Douglas-fir research/deployment
Road Deactivation	Whitebark Pine Nadina/Bulkley Seed Acquisition
Kispiox West Itzul	Whitebark Pine Planting
Kispiox Dennison	Whitebark Pine WTP Establishment
Kispiox Hanna Tintina	Bulkley Deciduous Restoration at the WUI
Nadina Road Rehabilitation	Hardwood Mgmt Strategy And Establishment
Nadina Road Legacy Structures	Willow establishment/restoration
South Ootsa	Nadina Pine Lichen Ecosystems Cons/Restoration
	Noxious Weed Control Seymour Lake
Stand Rehabilitation/ Habitat Enhancement	Kispiox Mushroom Habitat Enhancement
Nadina Boar Mtn Old Growth Attributes	Coast Mountain Khyex or Exchamsiks Canopy Walkway
Nadina MPB Restoration	Coast Mountain Eulachon Research
TerraceKitimat Stand Structure Restoration	Bulkley Wetland Restoration (where affected by ATVs)
	Todagin Mountain Thinhorn Sheep Habitat Monitoring
Carbon Conservation/Sequestration	Goshawk Conservation Habitat Enhancement
Afforestation to Capture Carbon	
Timber Waste Utilization	**Industrial Site Reclamation**
	Cassiar Placer Mining Site Reclamation
Data Management/Planning	Contaminated Site Reclamation
ER Database Establishment and Maintenance	Cassiar Railgrade to Dease Lk North of Minaret
Enduring Features Analysis	Restoration of Abandoned Gravel Pits
Reassessment of HLP Objectives	

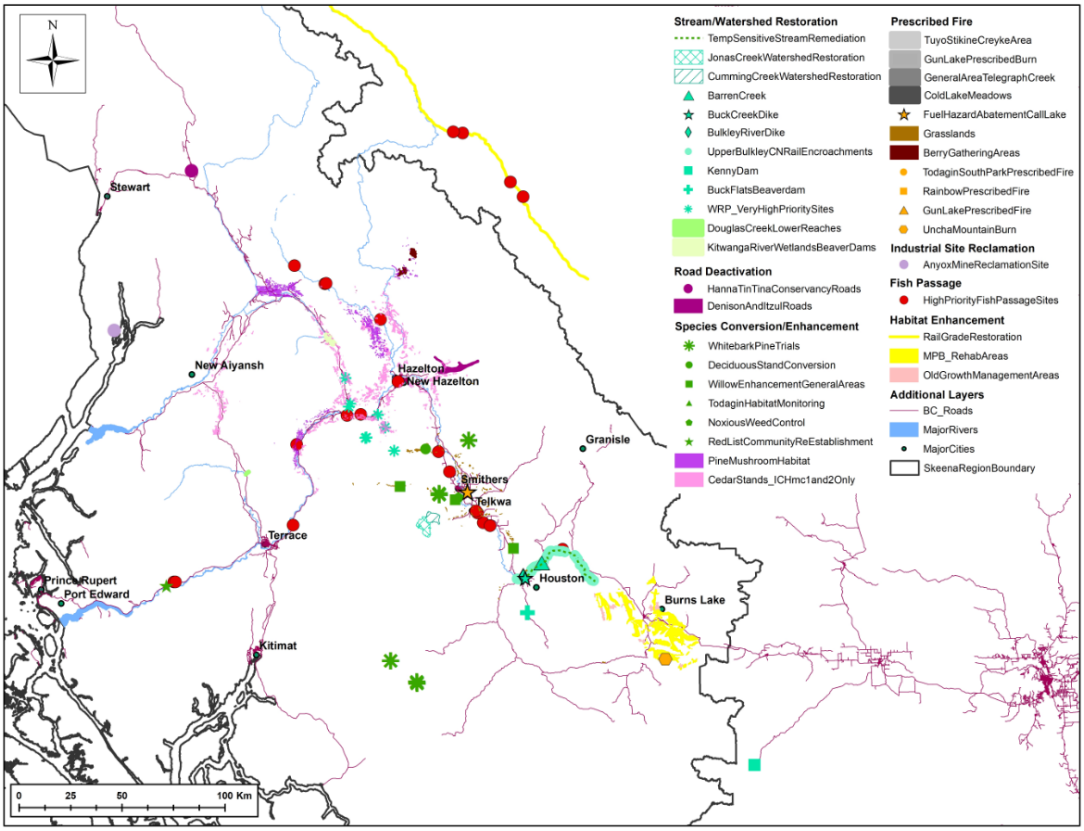

Figure 7. General locations of potential ER sites in the southern section of the Skeena Region.

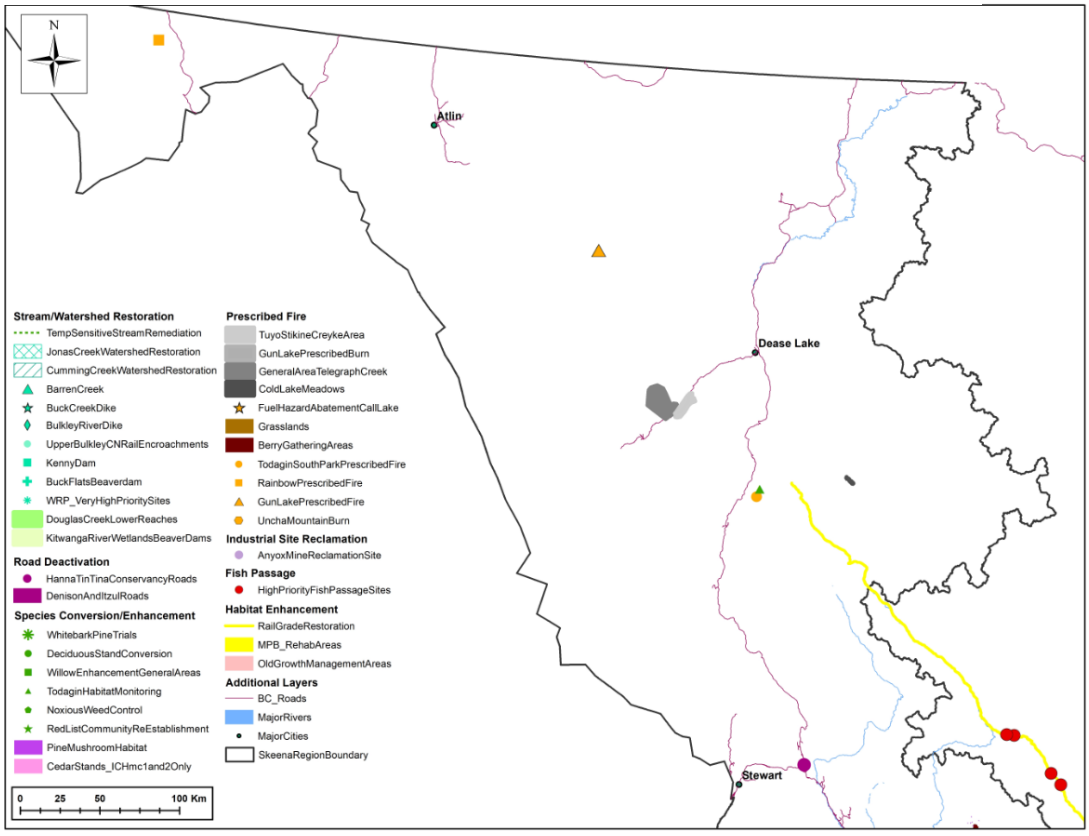

Figure 8. General locations of potential ER sites in the northern section of the Skeena Region.

Preliminary Priorities For Ecosystem Restoration in the Skeena Region

Ecosystem restoration programming in the Skeena Region is relatively new within most organizations and stakeholder perceptions on the highest priority ecosystems are still emerging. In the following sections, a process that might help with prioritizing ER opportunities is outlined followed by a description of priority restoration activities based on this process and the experience of the authors of this report. It should be noted that no attempt was made to numerically rank the project opportunities obtained from stakeholder interviews. It is also important to note that the descriptions are strategic in nature, designed to help the SERNbc Board or partner organizations choose broad areas of initial focus. Project level planning will still be required for all potential projects.

A Process For Prioritizing ER Opportunities In The Skeena Region

Choosing amongst the many restoration suggestions that stakeholders have provided to develop an ecosystem restoration program, requires careful consideration of a number of legal and policy questions as well as tactical and operational questions. Legal and policy questions that might be used as a preliminary filter, could include:

1. Does the existing policy and regulatory framework support treatment?
2. Is the proposed area on crown land or on encumbered land under an agreement with the crown that will ensure that proposed treatment outcomes will endure?
3. Is there an existing obligation to treat the area by an agency with the capacity to do it and is there opportunity for SERNbc to be involved?
4. Will proposed treatment conflict with future development or other values/objectives?
5. Does the proposed project involve ecosystems that are vulnerable or degraded?
6. Are there significant adverse consequences if no action is taken?

If a proposed project meets the requirements implied in the legal and policy questions, one might ask:

1. Is the project technologically feasible?
2. Is the benefit of treatment substantive, who benefits, and are costs, including re-entries, reasonable in relation to benefits?
3. Is there a reasonable opportunity to obtain funding for the project?
4. Is the area of interest reasonably accessible?
5. Is there reasonable assurance that the investment will not be compromised by natural catastrophe, land re-zoning, or industrial development?
6. Are there significant adverse or unintended consequences with treatment?

In many cases, a carefully considered answer to each of the questions above could, on its own, result in proposal rejection. If a proposal passes these preliminary questions, there may be a need to further rank projects in a more robust way. The numerical ranking approach depicted in table 3 is an example of how this might be done. Both the criteria and scale will need to be further fleshed out and tested over time to ensure they are suitable for the types of conditions encountered in the Skeena Region. In some cases a single factor will trump all other decision criteria.

Table 3. A numerical approach to ranking ecosystem restoration opportunities.

Criterion	Scale	Rating	Considerations
Ecosystem Functional Importance	5 to 15		Consider rarity, link to other communities, level of biodiversity, keystone species, level of consumptive use
Treatment Impact on Ecosystem/Spp at Risk	-10 to 10		A negative number if there are species at risk and treatment is detrimental, positive if it is beneficial
Departure from Desired Conditions/Degradation	0 to 10		Rate higher if existing or pending degradation, or departure from desired future condition is higher
Vulnerability	0 to 5		5 if vulnerable, 0 if resistant/resilient
Perceived Habitat/Forage Availability	0 to 5		Higher where there is evidence that habitat or forage opportunities in the area are in critical short supply
Size Of Unit	0 to 3		Larger units often mean economies of scale and reduced unit costs
Treatment Cost	0 to -30		Consider unit cost versus total cost as well as budget avail - higher costs mean a larger negative number
Previous Investment	0 to 5		Rate higher where benefits from sunk costs will not be realized if there is no follow-up treatment
Technical Difficulty Of Treatment	0 to -10		Difficult treatments get a higher neg number. Consider access, control measures, equip availability, etc
Conflicting Interest/Tenure	0 to -8		Consider competing land uses, land status, and whether there agencies/groups in opposition
Proximity To Infrastructure	0 to -10		Consider distance to infrastructure, suppression response time, infrastructure hazard, response zone etc
Climate Impacts/Treatment Uncertainty	0 to -8		How will climate change affect treatment results? Are there uncertainties about treatment outcomes?
Managed Under Other Programs	0 to -10		Higher negative number if the unit is already being managed for the same values by another agency
	Total	0	

Descriptions For Priority Ecosytem Restoration Opportunities In The Skeena Region

The following tables outline potential ER opportunities identified during stakeholder interviews for specific projects or ER categories including details about the nature of the work, potential partners, and an approximate timeline for program delivery. Tables are not presented in order of preference.

Activity:	***Bulkley Watershed Restoration***	**Timeline:**	2018 to 2023
Potential Partners:	Upper Bulkley River Stream Keepers, Yinka Dene Development Corp, Office of the Wetsu'weten, FLNRORD, the Department of Fisheries and Oceans, the Ministry of Environment, Water Quality Section, Skeena Wild, Suskwa Research, BC Cattleman's Association, and the BC Environmental Farm Program		
Description			
There are many projects along the upper Bulkley that are a high priority. Most project opportunities are associated with highly degraded riparian habitat impacted by agricultural activities, mostly on private lands or stream crossings. Some projects have discrete locations and are small enough that they align well with the SERN mission. The highest priority examples are as follows: 1) The Yinka Dene Dev Corp undertook fish habitat restoration and erosion control work, placing dead trees with roots intact to direct water away from erodable bank and planted willow on private lands. Several projects have been implemented on private lands including those of the Strimbolds, Maints, and Groot's. Many more projects could be carried out with the same and other landowners if more funding were available. 2) Fish passage work (primarily culvert replacement) on the following tributaries: Station Creek, Moan Creek, Johnny David Creek, Glass Creek, McDowell Creek, Barren Creek (needs a bridge), McQuarrie Creek, Byman Creek (Site 6), Richfield Creek (Site B4), Ailport Creek (Site C), Taman Creek, Cesfore Creek (Site C), Tyhee Creek, and Coffin Creek. 3) Restoration of fish habitat along the Houston town dike (long shallow straight stretch with little shade) such as better stream cover, boulder placements, beaver dam mitigation, and a comprehensive study on hydrology of the area due to public safety concerns around flooding. 4) Erosion control at McKilligan Road (Knockholt creek) bridge. 5) Water temperature mitigation studies/measures along the upper Bulkley targetting increasing seasonal water storage, and shading the riparian zone to keep water temperatures cooler. UAV-based infrared imagery may be used to provide maps of stream and riparian temperatures. 6) Fencing off riparian areas from cattle. The Bulkley Round table is generally trying to coordinate this work and it is possible that they could use some assistance from SERN in terms of coordination and funding. Patty Hirshfield is also interested and Mark Fisher of the Regional District could be interested in participating as well.			

Activity:	***Hanna Tintina Watershed Restoration***	**Timeline:**	2018 to 2023
Potential Partners:	Gitanyow Fisheries Authority, BC Parks, FLNRORD		
Description			
There is a legacy of logging roads and forest management practices in the area that have disrupted stream flow and fish habitat. Poorly stocked stands and poor road management have led to poor riparian vegetation and erratic peak flows. With the pending closure of all fishing on the Skeena this year, a shift in pressure to the Nass may occur, exacerbating the situation. The area is now a Conservancy. Over the past 5 years the Gitanyow Fisheries Authority has developed a number of restoration plans and carried out studies in support of these plans. Treatments are contingent on finding funding however. Costs in the area could run into the 100s of thousands of dollars over a period of years.			

Activity:	***Watershed Restoration in the Kispiox and Cranberry TSAs***	**Timeline:**	2018 to 2023
Potential Partners:	Gitanyow Fisheries Authority, the Environmental Stewardship Initiative, Suskwa Research, FLNRORD Land And Water Section (Sam Pitman)		
Description			
In 2006, Ralph Kossman completed a review of the WRP Studies in the Kispiox and Cranberry TSAs. Glen Buhr has a paper copy of this report and tables of restoration opportunities. Per Glen Buhr and Kenny Rabnett, there are many areas for which preliminary surveys have been completed but no site restoration was completed. The report identified 10 very high priority sites most of which would be good candidates for restoration work (and 102 high priority sites). Shp files for these 10 sites have been provided as part of this report. The Expert Watershed Panel, led by Glen Buhr, with assistance from Dave Wilford, worked with the Gitxsan and Gitanyow Fisheries Authorities to identify a lot of areas. Preliminary surveys or documentation exists for them but further detailed planning will be required for all these sites. Work involves restoring in-stream and riparian function, restoring water quality, floodplain species conversion, and stream channel stability. Costs may be prohibitive in some cases.			

Activity:	*Fish Passage in the Sustut*	Timeline:	2019
Potential Partners:	The Fish Passage Technical Working Group, FLNRORD, Suskwa Research, the Environmental Enhancement Fund, the Fish Habitat Restoration Initiative, and the Pacific Salmon Foundation.		

Description

Ken Rabnett and Tim Wilson produced 5 project reports on fish passage for the Upper Skeena, Kispiox, and Bulkley watersheds. They produced 24 project maps and identified hundreds of sites (most with geographic coordinates) of which 23 were identified as the highest priority sites for fish passage remediation. Proposed activities include activities such as removing culverts, installing a bridge, stream morphology work such as creating step pools or backwater steps, etc. Some works have already been completed. There are still 18 locations that have not been treated (shp files for these sites have been provided as part of this report). Costs are high at many of these sites but, per Ken Rabett, there are three fish passage sites in the Bear drainage (Sustut - which is technically in the Omineca Region), that are at a scale and cost that would be manageable by SERN and are already surveyed and identified as high priority. All 3 sites require work on culverts.

Activity:	*Road Restoration/Remediation in the Lakes, Morice, Bulkley TSAs*	Timeline:	2019 to 2023
Potential Partners:	FLNRORD Skeena at the Regional and District levels, the Forest Enhancement Society, the Forest Carbon Initiative, the Environmental Stewardship Initiative, Cheslatta Carrier Nation		

Description

Many stakeholders identified road density, especially in caribou habitat, and in pine beetle affected areas, as a key concern. Road density is also part of a broader concern about cumulative impacts and is an indicator in the LRMPs. At the landscape level there are issues with timber flow, loop roads, and legacy structures. While roads will often recover naturally over time, there are still access issues, and legacy structures are often left. Activities such as deactivation and water management, recontouring, afforestation, and gating, amongst others, will be necessary. A comprehensive overview of issues and opportunities, potentially as part of a cumulative impacts assessment or risk assessment needs to be completed for priority areas (South Ootsa, Babine Lake, Canfor/WF roads in the East Thautil (Telkwa herd area), the Telkwa River Landscape Corridor, other MPB affected areas in the Morice and Lakes TSAs, and the Itzul Dennison areas in the Kispiox). Road deactivation work should be prioritized for areas of greatest wildlife value, wildlife sensitivity, and where it is needed most in terms of road density. With roads in the south Oosta area, there may be potential opportunity to work jointly with the Cheslatta Carrier Nation. The overarching objective is to recreate large areas of unroaded habitat. Where possible, an attempt should be made to ensure these activities meet multiple objectives (timber supply, carbon sequestration, aquatic function, habitat protection).

Activity:	*Prescribed Fire For Forage Production*	Timeline:	2019 to 2023
Potential Partners:	FLNRORD Tenures, FLNRORD Ecosystems, FLNRORD Wildfire Services, BC Parks, Red Chris Mine, NW Invasive Plant Council, Local Guide Outfitters		

Description

There are several projects proposed for prescribed fire with the objective of improving forage for wild or domestic ungulates, and maintaining open forest, including Red Hills Park, Todagin South Park, Gun Lake, and the Tuyo-Stikine Confluence. In all cases some preliminary planning and or survey work has been completed. Shp files for all these sites have been produced as part of this report.

In **Red Hills Park** (Nadina) Scott MacMillan and Adrian DeGroot are working on a plan for prescribed fire in the area and Brad Martin has been involved. The intention is to undertake a 4 ha trial burn followed by a 108 ha burn. The objective is to maintain an open forest condition. The opportunity for SERN involvement at this point may be limited.

In **Todagin South Park**, an area with relatively pristine natural grasslands, some vegetation monitoring plots have been installed and assessed by Adrian DeGroot. Per Anne Hetherington, more baseline monitoring of vegetation, soils, and wildlife in this grassland ecosystem is required to establish benchmark conditions and determine benefits if treatment is undertaken - she has some limited funding to assist with this. The Tahltan and a wildlife working group led by Eric Smith (FLNRORD) are interested in creating a tactical plan (with a focus on thin horn sheep) and further monitoring before any treatment interventions. The Tahltan are interested in capacity building through monitoring (Christine Creyke and Jarod Quack could be contacted regarding this idea). There may be an opportunity to partner with Red Chris mine and the Invasive Plant Council as well regarding the prevention of invasive plants. Treatment would involve small scale broadcast burns as a trial followed by larger burn if appropriate.

The area between **Tuyo and Stikine** Rivers at their confluence was used historically for range for horses and has some pristine grasslands on the steeper banks down to the rivers. The area was burned many years ago (40 to 50 or so years ago) but has not been maintained and is becoming overgrown. The area overlaps with the Stikine River Park. There is good access to the area. Bob Drinkwater (ex MoF Range Officer) did establish some monitoring trials in the area in the past. Treatment in this area would be a broadcast burn to promote open forest conditions and grassland restoration.

Adjacent to **Gun Lake** (NW of the town of Dease Lake) an area of about 200 ha has been proposed for burning with the objective of creating forage for wildlife habitat. Unlike other sites, this area is not in a park. Bruce Hutchinson has produced a preliminary burn plan for the area and Brad Martin is aware of the plan.
There is limited or no funding for all these projects.

Activity:	***Caribou Migration Mitigation***	**Timeline:**	2019-2024
Potential Partners:	The Federal Gov't, the Caribou Recovery Fund, FLNRORD, HCTF, the Nechako Environmental Enhancement Fund, Rio Tinto Alcan		
Description			
Caribou recovery is a high priority for FLNRORD and significant funding is being allocated by the Federal government. Mitigating the impeded passage of caribou across Whitesail Lake to spring and summer habitat in Tweedsmuir Park caused by driftwood and rafting of wood on the lake aligns with priorities set by three levels of government (Federal, Provincial, and FN) and SERN's mission. Some radio collar data is available showing that this material does prevent habitat access. Additionally, the Cheslatta Carrier Nation is very interested in getting some of this work done and has some experience with removal of driftwood and submerged snags, and they are equipped with barges, tugs, and dozer boats. They also have certified operators, active marine infrastructure, and foreshore access.			

Activity:	***Moose Habitat Enhancement***	**Timeline:**	2019-2023
Potential Partners:	FLNRORD Resource Management, FLNRORD Ecosystems, Babine Outfitters, the Habitat Conservation Trust Foundation, BC Wildfire Service NW Fire Centre.		
Description			
Moose habitat enhancement is a major initiative that has been identified as a key concern by a number of stakeholders. A related concern is the willow borer outbreak, which has killed a considerable proportion of large willows in a number of areas in many locations in the Skeena. In addition to being a valuable browse species for moose, willow ecosystems are important for breeding birds (especially warblers), herpetofauna, pollinating insects, and many small mammals, soil organisms, bacteria and fungi. There is potential conflict between conserving large old willow and creating young willow shoots for moose browsing. FLNRORD is producing a report (due in April 2018) that describes some of the important moose habitat issues and mitigation techniques, and, at the Regional level, a document that highlights standard operating procedures for moose habitat enhancement (funded by HCTF). Per Len Vanderstar, there are also numerous reports from FRBC days, including Seymour Moose Enhancement Sites (MES) proposal, Tchesinkut Lake MES, Tatlow-Telkwa MES, Owen Lake ME proposal, Nadina River Moose Enhancement Report, Maxan Lake and Morice River ME report, Lakes District Potential Sites, Kitsumkalum Lake MES (150 sites), Decker Lake ME, Coffin Lake ME, Chapman Lake ME. Potential projects for SERN to consider include: 1) willow cutting and hinging to accelerate moose habitat recovery, possibly by involving FLNRORD Wildfire Services crews – two areas that have already had cutting and hinging trials carried out include Babine Lake and Chapman Lake; 2) Use prescribed fire to promote re-sprouting of willow, especially with upland species such as Scouler and Bebb; 3) Undertake inventory work to document known locations of moose habitat, while also collecting data on the current health of willow species across the Skeena - Tobi Anaka of FLNRORD Ecosystems is in the process of identifying potential willow enhancement areas near Smithers; 4) Mechanical knockdown with or without piling and burning in some areas (but not if there are old, large, healthy willow); and 5) monitoring of willow health and habitat enhancement treatments (possibly through ESI funding). Some areas suggested for habitat enhancement include Kitsequekla, Houston tommy, Morice River, Knockholt, Byman Creek, Bulkley Lake, Maxan Lake, Rose Lake, Ailport Creek, Gilmore Lake, Elwin Lake, Tagetochlain Lake, Francois Lake, Mt. Colley, Decker Lake, Southbank, Tchesinkut, Uncha Mountain, Haney Lake, Takysie Lake, Cheslatta Lake, Nilkitkwa Rd km 37 and km 85, to name a few. One of FLNRO's goals will be to bring stakeholders together in achieving willow management goals that are common (relationship building).			

Activity:	***Whitebark Pine***	**Timeline:**	2018 and 2023
Potential Partners:	FLNRORD, the BV Research Centre, the Whitebark Pine Foundation, Pacific Inland Resources Ltd, Canfor Houston, BCTS, the Smithers Community Forest, BC Parks		
Description			
Whitebark pine is a keystone tree species in sub-alpine forests that is declining throughout its range because of white pine blister rust, mountain pine beetle, and increased competition from shade tolerant trees caused by fire suppression. Whitebark pine grows at treeline and it shades the snowpack, prolonging snowmelt which helps in regulating stream flow, it stabilizes exposed soil in areas where other species don't survive, and its exceptionally large seeds are an important food source for at least 13 species of birds and 8 species of mammals including the Clarke's nutcracker, grizzly bears, and squirrels. It also provides shelter and nest sites for many other wildlife			

species, including deer, elk, grouse, neotropical migrants, snowshoe hares, and birds of prey. Considerable effort has been spent already in the Bulkley and Morice TSAs by Sybille Haeussler, Alana Clason, Pacific Inland Resources, and Canfor Houston in mapping whitebark locations, collecting some seeds, screening for rust resistance, growing nursery stock, and planting, albeit all on a small scale, as trials. Further work on all phases is required including seed collection and screening, site selection, nursery work, possibly site preparation, and planting. Although there are likely many others, the Atna Bay fire and Kid Price Lake have large areas that might be suitable. Planting burn scars is also a good option and may achieve carbon sequestration objectives (Forest Carbon Initiative) as well.

Activity:	***Seymour Lake Vacuum Dredging Of Yellow Floating Heart***	**Timeline:**	2018-20
Potential Partners:	FLNRORD Invasive Plants Section, Seymour Lake Conservation Society, Wetzin'kwa Community Forest, HCTF, Environment and Climate Change Canada		
Description			
Eradication of yellow floating heart (Nymphoides peltata) invasive plant from lake perimeter using the vacuum dredger owned by FLNRORD Invasive Plants Section. The plant was introduced to the lake from a private water garden in the 90's. Over time the plant develops dense floating mats that reduce light penetration, lower oxygen levels, increase organic matter input, alter nutrient cycling, displace indigenous vegetation. 20% of the lake margin is now impacted to depths of up to 3 meters. Measures have been taken to control the spread of the plant but the dredger could eradicate it and eliminate the risk of spread to other lakes (which would have profound impacts across the region). Cost estimated at $50,000. This project is effectively shelf-ready.			

Activity:	***Development Of An Integrated Data Management System***	**Timeline:**	2018 and 2019
Potential Partners:	FLNRORD Prov ER Program, FLNRORD Integrated Investments Initiative (Robyn VanIderstine), Skeena Knowledge Trust, the Ministry of the Environment, the Environmental Stewardship Initiative, Skeena Fisheries and Water NGOs		
Description			
There is a demonstrated need for a data management system that focuses on ecosystem restoration. The provincial ER program has initiated a way to track ER projects through the Provincial ER Program Estate Model and ER Pro. There are also other data management systems such as the Skeena Knowledge Trust, iMap, MoE's HabWiz (Habitat Wizard: a webapp that allows you to query the various databases, EcoCat (Ecological Catalogue: contains fisheries reports, data and maps, and ecosystem mapping reports, data, and maps), FIDQ (Fish Inventory Data Query: search by waterbody name or ID for bathy maps, fish presence, chemical studies, obstacles, etc), SIWE (Species Inventory Web Explorer: search for wildlife inventory, telemetry, plants and invertebrate reports), Habitat Capability Suitability Mapping, the Terrestrial Ecosystems Information website (where you can download ecosystem mapping data from specific projects), Provincial Mining History data and mapping, a great deal of data and many reports by many organizations (such as the WRP reports), and novel tools being explored using platforms such as ArcGIS on-line to ensure non-technical people can access both documents and spatial data. All these systems have their strengths and weaknesses but there is no one resource or portal that can be used. A potentially useful service that SERNbc could provide would be develop (or add on to) a portal that serves as a single repository for ER information for the Skeena Region or even all three SERNbc regions. Steps involved in this project would be to solicit input on an Integrated Data Management System with from key stakeholders, develop systems that build on an existing portal, develop methods to integrate the database and spatial mapping service with government portals such as iMap and RESULTS, and eventually, develop an ER Ecosystem Restoration Atlas. The portal developed by the Skeena Knowledge Trust seems well positioned to serve this role. This project would be initially expensive and require maintenance funding.			

Activity:	***Deciduous Regeneration In MPB Affected Areas***	**Timeline:**	2019-2024
Potential Partners:	The Burns Lake Community Forest, FLNRORD Nadina, the Forest Enhancement Society, the University of Alberta (deciduous management), UNBC, and HCTF		
Description			
There are areas within the Burns Lake Community Forest that have been heavily affected by mountain pine beetle which are largely uneconomical to harvest and which are a risky in terms of fuel for wildfire. Some sections, including around the community bike trails, are within an established VQO. Shp files for these areas have been provided as part of this report. The project involves salvaging any merchantable timber or biofibre, piling and burning to remove fuels, and deciduous regeneration to reduce fuel hazard, advance carbon sequestration, and improve visual quality. A number of birds and mammals make extensive use of deciduous stands and cattle make use of older aspen stands with low slash levels, a sparse shrub layer, and lush herb and grass layer. Per Sybille Haeussler, aspen may not be regenerating at a rate that was historically evident and, in some areas, vigor is poor possibly because of lack			

of soil disturbance, lack of fire, moose browse, Venturia fungus, etc. There is already some funding in place for preliminary phases but none for the regeneration phase. Reforesting with deciduous trees is somewhat experimental and will require special fire management stocking standard but results from this project will help inform similar opportunities elsewhere.

Activity:	***Landscape Analysis of Ecosystem Function***	**Timeline:**	2019-2020
Potential Partners:	FLNRORD, HCTF, ESI		
Description			
There is the need for a project to create a broader biogeoclimatic, ecosystem-based mapping/planning product that identifies where it is important to conserve biophysical conditions, and where other types of interventions aimed at restoration will be most helpful, based on habitat suitability projections, enduring features, and opportunities for connectivity. Per Jim Pojar, land use planning must consider not only the current environment, and contemporary plant and animal communities, but also the different types of bedrock geology, physiography, landforms, lakes and streams - enduring features that will not change as much as climate changes, as species sort themselves out and as biological communities undergo upheaval and reassembly. Such information will be useful in filtering project opportunities at both the coarse and fine filter level. Long-term environmental planning should focus on enduring features, in addition to scenarios of individual species and their habitat - conserve the stage (geophysical settings) not just the actors. In the near term, focus as well on at-risk species and ecosystems; habitat connectivity based on species biology and present-day land cover and patterns of productivity; restore degraded areas; minimize habitat fragmentation; secure core sanctuaries with buffers; and provide a nature-friendly matrix with functional migration spaces and connectivity on land and in the water. But we also need to re-examine the roles of protected areas, buffer zones, connectivity, 'special' management zones, and matrix management and begin enabling ecosystems to self-adapt and reorganise, and maintain ecological and evolutionary processes. This will lead to resilient ecosystems that will sometimes have a novel composition but will continue to deliver ecosystem services. Planning will need to be focused in large part on physical enduring features that will not change as much as climate changes, as species sort themselves out and as biological communities reassemble. The mountains, rivers and big lakes will remain, the plateaus will persist, morainal blankets and outwash terraces will stay as they are, even as the life they support changes. The assumption in this approach is that habitat heterogeneity drives species richness, that biodiversity is in large part a consequence of geophysical diversity, and that conserving physical diversity should conserve biological diversity under present and future climates. To the extent that biodiversity hotspots are a function of physiography, topography, geology, sharp climatic gradients and complex local climates, as well as of moisture, nutrients and primary productivity, they will persist. The type of plan foreseen in this project is critical to decisions about ecosystem restoration efforts (and land management in general) but will be moderately expensive (>$100,000) to produce.			

Activity:	***Old Growth Stand Structure***	**Timeline:**	2019-2024
Potential Partners:	Terrace Community Forest, the Haisla First Nation, the Kitsumkalum First Nation, the Environmental Stewardship Initiative, the Forest Enhancement Society.		
Description			
In many areas around Terrace there is a legacy of densely stocked, uniform second growth stands, resulting from logging 30 to 60 years ago. There are several hundred ha of these types of stands in the Terrace community Forest and many more in other parts of the Kitimat valley. A number of stakeholders raised the idea of reintroducing habitat functionality in these uniform second growth forests, by attempting to advance, or recreate, stand structure more typical of old growth. Treatments might include gap creation, installing CWD, snag creation, planting cedar and/or spruce in some gaps (or at least favoring them during gap creation), spacing to a variety of densities, and even possibly fertilization (based on foliar screening trials). Frank Doyle is working with Kitsumkalum FN and the Regional District to try some of these treatments in the Forceman Ridge area. Kim Haworth, manager of the Terrace Community forest, has applied for FES funding to create an incremental silviculture plan to better identify scope out some of these treatments.			

Activity:	***Gravel Pit Rehabilitation***	**Timeline:**	2018-2019
Potential Partners:	FLNRORD Ecosystems, Crown Lands Contaminated Sites, the Forest Carbon Initiative, FLNRORD Skeena Stikine District		
Description			
There are many abandoned and inactive gravel pits along Highway 16, and on Crown Land throughout the Skeena Region that would benefit from reclamation work. A project to remediate and afforest these gravel pits, and other			

land that has been exposed, would align well with SERN's mission and the objectives of the Forest Carbon Initiative. Potential remediation actions could include, grading and re-contouring sites, afforestation, and possibly legume seeding and/or planting shrubs to control erosion and restore wildlife habitat. SERN is already in the process of undertaking a study across northern BC to identify potential areas that could be used to help meet FCI carbon sequestration goals and gravel pits will be amongst these. That project will serve as a starting point in identifying potential sites and planning restoration activities within the Skeena. There is also a gravel pit layer in the BCGW database.

Activity:	***Berry Species Enhancement***	**Timeline:**	2019-2023
Potential Partners:	Gitxsan First Nations, Suskwa Research, FLNRORD Skeena Sitkine, UNBC, Northwest Fire Centre.		
Description			
There are several potential areas that would benefit from berry management activities such as prescribed fire, harvesting, or brushing as a means to stimulate berry production for human consumption, and potentially increase habitat capacity for some wildlife species. Some potential locations have been described by Burton et al - Exploring Options for the Management of Wild Berries in the Kispiox Forest District; McCulloch - Non-Timber Forest Resource Monitoring in the Babine Watershed; and Buhdwa - The Importance, Traditional Use and Locations of Various Berry Species within the Gitxsan Traditional Territory. Nine-mile mountain and 33 mile creek locations in the Kispiox district have been identified in the past. Another potential source of information, if berry production for bears is an objective, would be the Fort Babine grizzly habitat mapping that was completed by Grant MCutcheon and Tony Button. It should be noted that berry patches for human consumption and for bear habitat are not necessarily in same location. The former is accessible but the later should be beyond road access. Prior to any implementation activity, survey work and planning will be required as well as working with local First Nations to explore their interest in becoming involved and with Wildfire Services to ensure they are directly involved if prescribed fire is contemplated. There is good potential to involve multiple stakeholders and build relationships with First Nations with a project of this nature.			

While the ecosystems described above have been selected as initial candidates for potential restoration, because they are perceived by stakeholders to be relatively high priority and have a high chance of success, it does not preclude including other ecosystems or activities, or changing relative priorities in the future as more is learned about degradation, treatment options, and stakeholders values. The process is iterative and as the program evolves, and early successes generate credibility, other options will need to be considered. The fundamental program driver in the first two years, is to ensure a credible, functional organization is established.

GOVERNANCE

Organizational Structure

It has been implicit in this report that an ER program for the region should fall under the existing SERNbc program. The Board already has a representative from the Region on it (the FLNRORD Ecosystems Section Head) and the current SERNbc program coordinator has also been working in the Skeena Region for many years. SERNbc and its members have been developing and implementing ER programming in northern B.C. since 2007 and have garnered considerable experience in the north during this time and an increasingly broad membership. There are a number of advantages in having an ER umbrella organization like SERNbc for the north, including:

- that SERNbc is a legal entity (a Society) with the authority to act on behalf of its members and enter into contractual arrangements with other agencies.
- SERNbc as a northern organization could leverage its geographic size to generate more profile for the program, possibly attracting more funding.
- the program has paid staff who can work on behalf of all Regions.
- SERNbc can coordinate data management and extension activities for all areas.
- SERNbc already has a body of work on policy and governance that other areas can utilize.
- SERNbc has well established links with government agencies and other stakeholders.

- An umbrella organization can provide expertise and efficiencies in reporting (for example, to the Provincial ER program, funding agencies, the investment manager – PWC, and the provincial government).

The diagram in figure 9 depicts the general organizational structure that is envisioned[8].

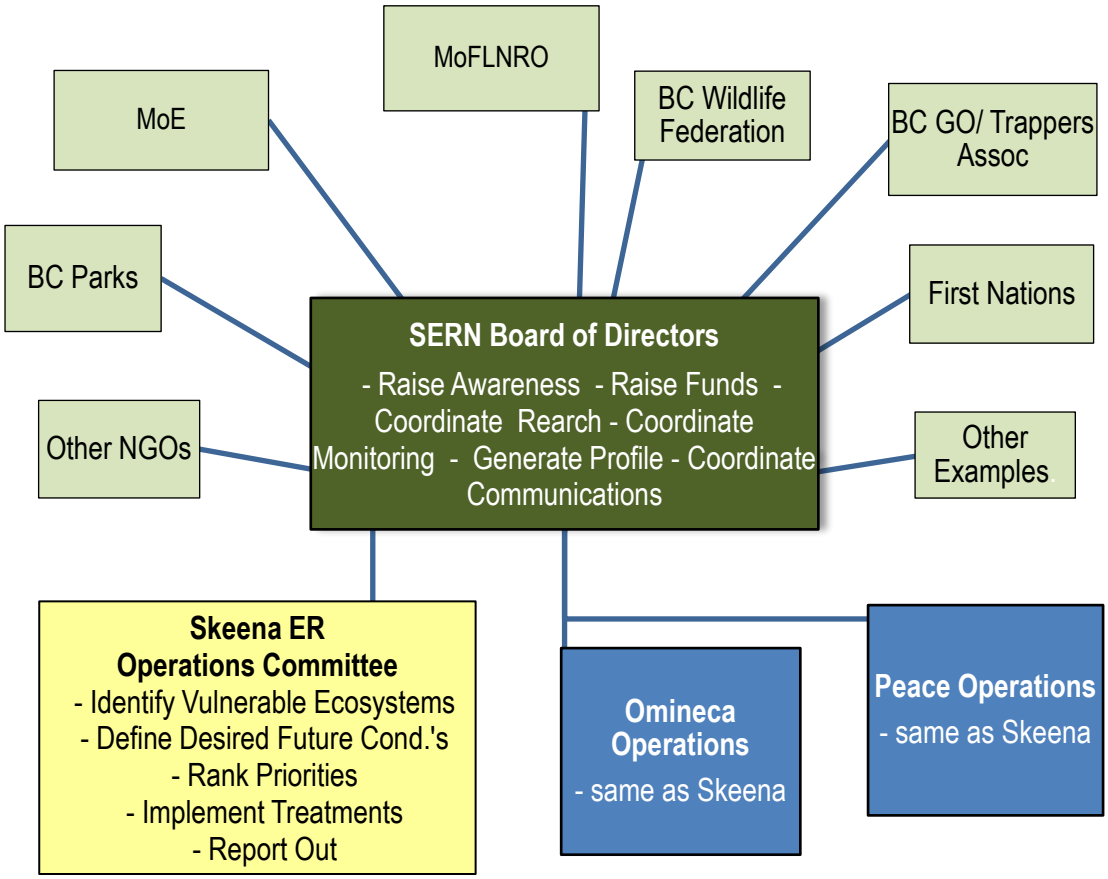

Figure 9. Hypothetical organizational structure for an ER program in Northern BC.

With respect to the Skeena ER Program, SERNbc's role would be to raise awareness and funding for the program, identify strategic allocation of funds based on proposals from Regions, coordinate research and monitoring, and report out to stakeholders, funders, and agencies building profile for the program in collaboration with the Provincial ER program. SERN_Skeena's role might be to hire a part time coordinator, form an implementation committee to identify vulnerable ecosystems, determine desired future conditions, rank treatment priorities, identify and implement treatments, and report out on accomplishments.

While the model described above seems like the most logical approach to governing ER in the Skeena Region, it will ultimately depend on what stakeholders in the area want. Questions like how a project will be delivered, who manages the financial aspects, and who leads technical implementation will need to be answered. While the answer to such questions will depend in part on the nature of the project and stakeholders involved, there are a number of principles that will help stakeholders answer these questions.

[8] More detail on the structure of the governing body for SERNbc can be found on the SERNbc website (http://sernbc.ca/pdf/SERNbcStrategicPlan.pdf) under Society Vision and Strategies.

Operating Principles

One of the most important aspects of any organizations governance, is having a clear purpose. A mission statement describes an organization's purpose and helps ensure that current and future initiatives are appropriate. It should be informative and inspire members and funders alike. It is like a lighthouse that keeps one on course. A formal mission statement has not yet been developed for the Skeena program but the existing SERNbc mission seems well suited:

To identify, treat, and monitor vulnerable or degraded ecosystems to achieve a desired future condition that will sustain ecological services and human soci-economic needs.

This statement will need to be revisited and refined in the future to accurately capture what stakeholders believe to be the purpose of the organization.

Some general principles that will help in creating effective ER programming in the Skeena include:

- The program will need to be founded on partnerships. Constructive partnerships with individuals and agencies that can bring skills, human or financial capital, and/or influential connections to the initiative are paramount. This type of thinking aligns well with the Province's approach to similar recent initiatives like the Forest Enhancement Program (formed as a society with government support), and the Environmental Stewardship Initiative, both of which are multi-party organizations.
- A culture of inquiry, mutual respect, constructive debate, and transparency will need to be cultivated.
- The board and steering committees will need to maintain their independence.
- Building sustainability into the governance structure (both economic and social) is paramount.
- Operations will need to be results-oriented and opportunities for learning and adaptation must be incorporated into the management framework.
- A process for renewal (in particular, of organization policy, membership, Board members, and management practices) will need to be established.

Additionally, there are some principles that an ER organization within the Skeena Region will need to adopt that are more specific to ecosystem restoration. Ideally these would be incorporated into the organization's policies by elected officials. Some recommendations include:

- Projects and activities should be **incremental** to operational activities that are required under a current license or permit obligation or which are being effectively addressed by other programming. Where another organization wishes to partner in the delivery of ER programming, involvement could be considered based on consistency with the organizations mission and project evaluation protocols. An objective of the organization should be to **add value** to current initiatives.
- Building **partnerships** amongst stakeholders (government, First Nations, NGOs, academia and private or individual development proponents) is key in developing an effective, balanced approach to ecosystem restoration.
- **Land ownership** should not be a barrier to undertaking ecosystem restoration projects provided that there is some assurance that investments will persist long enough to be effective. Covenants could be used on private land, for example, to help ensure the longevity of restoration efforts.
- Program **priorities should be stakeholder driven and ecosystem-based** rather than based on the priorities of external funding sources. In circumstances where an external funding source has explicit end uses for funding, the decision to accept it, should be based on alignment with program mission, program objectives, and project evaluation protocols, including maintaining a functioning organization.
- The program should be forward looking and **scalable** so that it can be expanded as capacity grows to include for example, all of the Peace region.
- The role of the organization in **advocating** for political change should be minimal. Membership of the organization, and on the board of directors, should include individuals that are also involved in provincial level associations (Watershed Quality organizations, Cattleman, Guide Outfitters, Trappers, Wildlife Federation, etc.), where an advocacy role is better suited. The organization should, however, strive to provide information to

government and NGOs to foster an improved understanding of ecosystem dynamics and vulnerabilities across the region.

- The organization will have no direct **authority for land management** and can only undertake restoration activities by virtue of stakeholder agreement, and legal authority granted by government agencies or land owners. For this reason, it is essential that government agencies are directly involved in the affairs of the organization.
- There are often **competing interests** in land management decisions. The organization will need to **balance ecological, social and economic values** when considering involvement in restoration activities. Members of the organization should have a broad range of backgrounds allowing the organization to serve as an effective place for collaborative discussion regarding multiple values.

FUNDING

An ER program can only exist by virtue of the services it provides, and the profile it brings to its member organizations. It appears that there is significant opportunity for such a body to supply a suite of services (identified in this document) to a number of stakeholders, in particular FLNRORD, the Ministry of the Environment, the Environmental Stewardship Initiative, the Forest Ecosystem Society, the Forest Enhancement Program, many First Nation initiatives, the Habitat Conservation Trust Foundation, the Mining Sector, and a number of fish and wildlife habitat initiatives. Core funding from one of more of these agencies will provide immediate impetus for the formation of an effective agency and will jump start delivery of on-the-ground action. The following core funding levels are recommended for the first five years of operation:

Year One (2018) - $100,000
Year Two - $250,000
Year Three - $400,000
Year Four - $400,000
Year Five - $400,000

These amounts are not based on a detailed analysis but are representative of other ER programming in the province with a similar list of potential ecosystem restoration functions.

In addition to its core funding, the Skeena ER Program will need to attract other sources of funding. Having a diversity of funding sources will be provide resiliency and demonstrate broader acceptance of the program, something that is important to many agencies. Opportunities for revenue generation within a project (e.g. removal of merchantable timber through a thinning treatment) will need to be used where possible to offset project specific costs.

Some examples of possible funding sources include:

- The Provincial Ecosystem Restoration Program (Ministry of Forests, Lands, and Natural Resources) - http://www.for.gov.bc.ca/hra/Restoration/index.htm
- The Habitat Conservation Trust Foundation - http://www.hctf.ca/
- The Forest Enhancement Society - https://news.gov.bc.ca/releases/2016FLNR0018-000284
- The Environmental Stewardship Initiative - http://www2.gov.bc.ca/gov/content/environment/natural-resource-stewardship/consulting-with-first-nations/liquefied-natural-gas-environmental-stewardship-initiative
- The Moose Recovery Program - https://news.gov.bc.ca/releases/2016FLNR0026-000343
- BC Oil and Gas Innovation Society (OGRIS) - http://www.bcogris.ca/
- The Union of BC Muncipalities Strategic Wildfire Prevention Initiative – http://ubcm.ca /EN/main/funding.html
- Fisheries habitat compensation projects (FHCPs) coming from the Fisheries Act HADDs (Harmful alteration, disruption or destruction of fish habitat) determined by Federal and Provincial Environmental Impact Assessments - http://www.pac.dfo-mpo.gc.ca/habitat/steps/authorization/ additional-auth-eng.htm
- Ducks Unlimited - http://www.ducks.ca/province/bc/index.html
- The BC Gaming Commission - http://www.pssg.gov.bc.ca/gaming/grants/community-gaming.htm
- Beef Cattle Industry Development Fund - http://www.cattlefund.net/bcidf.htm
- The Wilburforce Foundation - http://www.wilburforce.org/funding_areas/priority_regions. cfm?region=bccentral
- TIDES Canada - http://www.tidescanada.org
- Corporate contributions (e.g. oil and gas, forests, Rio Tinto Alcan, and the mining sector)

- Other private donations
- Project management fees (fees paid by agencies that engage the Society to undertake ecosystem restoration work).
- Provision of consulting services (like habitat evaluation for government, research work, or community outreach)

Although Board members may have been appointed because of their contribution to operating capital or because they have important connections or contacts and are, therefore, in a good position to undertake some fund raising, it is often left to the Program Coordinator (or executive director) to take on the important task of fund raising. In the absence of an identified Coordinator, it is expected that in the early stages of developing an effective ER program, a champion for the program will need to emerge and build a strong investment case. This work would be the basis for attracting core funding from potential funders and ensure the economic sustainability of the program.

Next Steps

The most critical next step for the Skeena ER Program is to establish a formal presence and governance structure that will provide funders and agencies with confidence that the program can act effectively as a delivery body. In this regard it seems like the most effective, least costly, and least time consuming way to do this would be through SERNbc which already has a broad spectrum of members which provide balanced representation. The next SERNbc AGM will be held in May, 2018 and at that venue it is recommended that two new members from the Skeena Region run for election to the Board of Directors.

Other critical next steps include:

- Outreach to stakeholders to build awareness and solicit commitment to undertaking activities.
- Better engagement of key stakeholders, especially First Nations, regarding the program through individual meetings and presentations, and potentially, building an on-line presence.
- A meeting with each individual potential funder to explore the possibility of investing in the ER Program.
- Hire a part time program coordinator to assist the SERNbc coordinator (contract management and get project plans together)
- Development of a project intake process by SERNbc
- Selection and development of initial projects to fund
- Beginning implementation of the projects identified in this document that have the greatest chance of success.

Individuals, agencies, and organizations with an interest in restoring function in vulnerable or degraded ecosystems in the Skeena Region, must find representatives to lead the way forward and galvanize commitment. In the Skeena, there are many highly skilled individuals that can offer this type of leadership and provide opportunities for synergies with many diverse, highly motivated organizations with similar values. While initial phases of ER programming in the Region will need to start with less costly, smaller scale, easier to complete projects involving key stakeholders, the Directors should have an eye to the future ensuring that the program is scalable so that it can become competent across the broader area, building on the experience and successes achieved at a more local scale.

APPENDICES

I - Glossary

Abiotic: Pertaining to the non-living parts of an ecosystem, such as soil particles bedrock, air, and water.
Adaptive Management: managing forests and incorporating into decisions the experience gained from the results of previous actions. Adaptive management rigorously combines management, research, monitoring, and means of changing practices so that credible information is gained and management activities are modified by experience.
Allowable Annual Cut (AAC): The allowable rate of timber harvest from a specified area of land. The Chief Forester sets specific AACs for Timber Supply Areas and Tree Farm Licences in accordance with Section 8 of the *Forest Act*.
Articles of Incorporation: The Articles of Incorporation are a legal document filed with a provincial or territorial government, or the federal government, which sets out a corporation's purpose and regulations.
Best Management Practice (BMP): A forestry practice or combination of practices determined to be the most practicable means of protecting and conserving forest resources and forest land productivity, now and into the future. BMP are often developed for Forest Roads, Stream Crossings, Riparian Management Zones, handling fuels, lubricants and trash, and other practices.
Biogeoclimatic Ecosystem Classification (BEC): A hierarchical system of ecosystems that integrates regional, local and chronological factors and combines climatic, vegetation and site factors. Subzones further refine the zones and are based on precipitation and temperature. Examples include: mc – moist, cold; mv – moist, very cold; dk – dry, cool; dw – dry, warm; xv – very dry, very cold.
Each subzone can be furthered refined by variants. A variant reflects further difference in regional climate. Also see Site Series.
Biological Richness (species richness): Species presence, distribution, and abundance in a given area.
Carbon Cycle: The storage and cyclic movement of organic and inorganic forms of carbon between the biosphere, lithosphere, hydrosphere, and atmosphere.
Bylaws: Refers to the internal rules of a company or organization. Bylaws vary widely but generally cover topics such as how directors are elected, how meetings of directors are conducted, what officers the organization will have, and a description of their duties.
Carbon Sink: Forests and other ecosystems that absorb carbon, thereby removing it from the atmosphere and offsetting CO2 emissions.
Coarse Woody Debris (CWD): Downed woody material of a minimum diameter or greater, either resting on the forest floor or at an angle to the ground of 45 degrees or less. Coarse woody debris consists of sound and rotting logs and branches, and may include stumps when specified. Generally a log is considered as being a minimum of 2 m in length and 7.5 cm in diameter at one end. CWD
provides habitat for plants, animals and insects, and a source of nutrients for soil development.
Conserve: Keep from harm or damage.
Cultural Feature: Unique or significant places and features of social, cultural or spiritual importance, such as an archaeological site, recreational site or trail, cultural heritage site or trail, historic site, or protected area.
Desired Future Condition: In the context of the Ecosystem Restoration program, means the target set of structural attributes necessary to maintain ecosystem function and provide the ecological services and forest products considered to be important by stakeholders.
Ecosystem: A dynamic complex of plants, animals and micro-organisms and their non-living environment interacting as a functioning unit. Ecosystems can be defined at any scale.
Ecosystem Degradation: In the ER program, which is focussed on managing vulnerable ecosystems, an ecosystem is considered to be degraded or vulnerable when it is missing structural elements and ecological processes that are important for achieving a future condition that will sustain ecological function and human socio-economic needs.

Ecosystem Resistance: is an ecosystem's ability to maintain its structural and functional attributes in the face of such stresses/disturbances. Examples of resistant ecosystems might include those with low fuel loads, diverse species mixes, and/or multiple ecological processes.
Ecosystem Resilience: There are many definitions of resilience but most are about the capacity of an ecosystem to regain structural and functional attributes that have changed because of a disturbance.
Ecosystem Restoration: A commonly used definition is *the process of assisting with the recovery of an ecosystem that has been degraded, damaged or destroyed by re-establishing its structural characteristics and ecological processes*. In the proposed South Peace ER Program, ecosystem restoration is defined as managing the structure and function of vulnerable ecosystems to achieve a desired future condition that will sustain ecological services and human socio-economic needs.
Ecosystem Stability: An ecosystem that is stable retains its functional and structural characteristics and successional trajectory in spite of stress/disturbance. Stable ecosystems are often in a state of dynamic equilibrium rather than a steady state. Disturbances of sufficient magnitude and duration may force an ecosystem to reach a threshold beyond which a different regime of processes and structures predominates (a different system state).
Ecosystem Vulnerability, the counterpart of resilience, vulnerability is the lack of capacity to cope with, resist, and recover from a disturbance. The ER Program focuses on vulnerable ecosystems.
Edge Habitat: Habitat conditions, such as degree of humidity and exposure to light or wind, created at or near the boundary dividing ecosystems, for example, between open areas and adjacent forest.
Environmentally Sensitive Area (ESA): An area requiring special management attention to protect important scenic values, fish and wildlife resources, historical and cultural values, or other natural systems or processes. ESAs for forestry include potentially fragile, unstable soils that may deteriorate unacceptably after forest harvesting, and areas of high value to non-timber resources such as fisheries, wildlife, water,and recreation.
Forage: Grasses, herbs, and small shrubs that can be used as feed for livestock or wildlife.
Forest: A complex community of plants and animals in which trees are the most conspicuous members and where the tree crown density—the amount of compactness of foliage in the tree tops—is greater than 10 percent."
Forest Health Factors: Biotic and abiotic influences on a forest that have an adverse effect on the health of trees and other plants." "Biotic influences include fungi, insects, plants, animals, bacteria, and nematodes. Abiotic influences include frost, snow, fire, wind, sun, drought, nutrients, and human-caused injury.
Global Ecological Cycles: The complex of self-regulating processes responsible for recycling the Earth's limited supplies of water, carbon, nitrogen, and other life-sustaining elements.
Inoperable: Lands that are unsuited for timber production now and in the foreseeable future because of a range of factors including: elevation; topography; inaccessible location; low value of timber; small size of timber stands; and steep or unstable soils that cannot be harvested without serious and irreversible damage to the soil or water resources. Inoperable lands may also be designated as parks, wilderness areas, or other uses incompatible with timber production.
Interior Forest: Forest that is far enough away from a natural or harvested edge that the edge does not influence its environmental conditions, such as light intensity, temperature, wind, relative humidity, and snow accumulation and melt.
Managed Forest Land: Forest land that is managed under a forest management plan, utilizing the science of forestry.
Merchantable Timber: a tree or stand that has attained sufficient size, quality and/or volume to make it suitable for harvesting.
Natural Disturbance: Events such fire, insect or disease infestations, wind, landslides, and other natural events not caused by humans that damage or destroy stands of trees.
Natural Disturbance Unit (NDU): Large geographic areas that have similar topography, climate, disturbance dynamics (e.g., fire cycle, patch size), stand development and successional patterns.
Nitrogen Cycle: The movement of nitrogen in its many forms between the hydrosphere, lithosphere, atmosphere and biosphere.
Patch: A particular unit with identifiable boundaries and different vegetation from its surroundings.
Permanent Access: A structure, including a road, bridge, landing, gravel pit or other similar structure that provides access for timber harvesting and is shown on a forest development plan, access management plan, logging plan, road permit or silviculture prescription / site plan as remaining operational after timber harvesting activities on the area are complete.
Predictive Ecosystem Mapping (PEM): A computer-GIS, and knowledge-based method that divides

landscapes into ecologically oriented map units for management purposes. PEM is a new and evolving inventory approach designed to use available spatial data and knowledge of ecological-landscape relationships to automate the computer generation of ecosystem maps.
Productive Capability: The current and future ability of forest ecosystems to produce biomass.
Productivity: The natural ability of a forest ecosystem to capture energy, support life forms, and produce goods and services.
Provincial Forest: Forest land designated under Section 5 of the [Forest] Act as provincial forest. Designation as "provincial forest" restricts land use activities and alienation for other purposes, which can occur more easily on vacant Crown land. This ensures that activities on, or any removal of land from, the provincial forest undergoes due process and consideration.
Public: The people as a whole within a defined area (i.e. community, forest district). At its broadest sense public means everyone anyone in the world and to narrowest sense public might be considered as the people living on your street.
Riparian: An area of land adjacent to a stream, river, lake or wetland that contains vegetation that, due to the presence of water, is distinctly different from the vegetation of adjacent upland areas.
Riparian Habitat: Vegetation growing close to a watercourse, lake, swamp, or spring that is generally critical for wildlife cover, fish food organisms, stream nutrients and large organic debris, and for streambank stability.
Resolutions: A decision made by the directors of an organization and recorded in the organizations meeting minutes.
Stakeholder: A person with an interest or concern with resource management within a defined area (i.e. community, forest district, defined forest area).
Seral Stage: Any stage of development of an ecosystem, from a disturbed, non-vegetated state (early seral) to a mature plant community (late seral).
Site Index: The height of a tree at 50 years of age (age is measured at 1.3m above the ground) In managed forest stands site index may be predicted using either (1) the biogeoclimatic ecosystem classification for the site or (2) the Site Index Curve which uses the height and age of sample trees over 30 years old.
Site Plan: A site level plan that supports the strategic (and legal) results and strategies contained within a proponents Forest Stewardship Plan (FSP). The site plan identifies the appropriate standards for specific cutblocks, including: stand-level biodiversity, permanent access, soil disturbance limits, stocking requirements, regeneration date, and free-growing date at the standards unit level.
Site Series: A landscape position consisting of a unique combination of soil edaphic features, primarily soil nutrient and moisture regimes within a biogeoclimatic subzone or variant. Soil nutrient and moisture regimes define a site series, which can produce various plant associations (see definition of "plant association"). In the BEC system, site series is identified as a number (e.g., 01, 02, 03,).
Soil Disturbance: Disturbance caused by a forest practice on an area. This includes areas occupied by excavated or bladed trails of a temporary nature, areas occupied by corduroyed trails, compacted areas, and areas of dispersed disturbance.
Stocking Standard: The required range of healthy, well-spaced, acceptable trees growing on an area to achieve a free-growing stand.
Stream Class: A stream is a watercourse, having an alluvial sediment bed, formed when water flows on a perennial or intermittent basis between continual definable streambanks. There are six riparian stream classes designated S1 to S6 that are based on presence of fish, occurrence in a community watershed and average channel width. S1 to S4 streams are fish streams or streams in a community watershed. S5 and S6 streams are not fish streams and are not within a community watershed.
Snag: A standing dead tree, or part of a dead tree, found in various stages of decay—from recently dead to very decomposed.
Species at Risk: A list of wildlife species at risk maintained by the Government of Canada. Addition of species is done annually by the Minister of the Environment, based on a report from the Committee on the Status of Endangered Wildlife in Canada (COSEWIC), an independent committee of wildlife experts and scientists. The list contains five categories for species: special concern, threatened, endangered, extirpated, and extinct. The goal of the Species At Risk Act is to protect endangered or threatened organisms and their habitats.
Timber Harvesting Land Base (THLB): The portion of the total area of the Defined Forest Area considered to contribute to, and to be available for, long-term timber supply. The harvesting land base is

defined by reducing the total land base according to specified management assumptions and tends to change slightly over time.
Visual Landscape Inventory: the identification, classification, and recording of the location and quality of visual resources and values.
Unmerchantable: of a tree or stand that has not attained sufficient size, quality and/or volume to make it suitable for harvesting.
Unsalvaged Losses: the volume of timber destroyed by natural causes such as fire, insect, disease or blowdown and not harvested, including the timber actually killed plus any residual volume rendered nonmerchantable.
Utilization Standards: the dimensions (stump height, top diameter, base diameter, and length) and quality of trees that must be cut and removed from Crown land during harvesting operations. For detailed standards see the Provincial Logging Residue and Waste Measurement Procedures Manual.
Waste: the volume of timber left on the harvested area that should have been removed in accordance with the minimum utilization standards in the cutting authority. It forms part of the allowable annual cut for cu tcontrol purposes. For detailed standards see the Provincial Logging Residue and Waste Measurement Procedures Manual.
Water Cycle (also known as the hydrologic cycle): The journey water takes as it circulates from the land to the sky and back again.
Wetland Ecosystems:

- Organic sedge fen - sedge dominated fen, organic soils
- Marsh - semi-permanently to seasonally flooded mineral wetland dominated by emergent vegetation
- Wet meadow - herbaceous meadow
- Organic open bog - shrub dominated organic bog (tree canopy cover less than 10%)
- Organic treed fen - treed fen on organic soils (tree canopy cover greater than 10%)
- Organic shrub fen - shrub dominated fen on organic soils
- Organic treed bog - treed dominated organic bog (tree canopy cover less than 10%)
- Lowbench shrub floodplain - shrub dominated floodplain
- Lowbench sedge/herb - floodplain herb dominated floodplain
- Shrub swamp - shrub dominated mineral swamp
- Treed swamp - treed mineral swamp

II - Defining Ecosystem Restoration And How Success Is Measured

Given the high potential for a climate-induced state shift and associated changes to external stressors like summer drought, higher temperatures, more frequent fires, changes in peak flow, increased stream temperatures, more frequent/severe forest health issues, etc., it is unlikely that it will be appropriate for land managers to restore ecosystems to some historic state. A more effective scenario may be one in which managers base land management practices on expected future conditions and fundamental ecological principles, to create new conditions that provide reasonable assurance of resource availability, and ecosystem function, now and in the future. Some of the basic ecological concepts underlying this approach are discussed below.

Ecosystem Stability And Resilience

Disturbances such as fire, wind, drought, flooding, epidemic insects and disease outbreaks, avalanches, and pollution can be thought of as external (to the ecosystem of interest) ecological processes that drive change. **Resistance** is an ecosystem's ability to maintain its structural and functional attributes in the face of such stresses/disturbances. Examples of resistant ecosystems might include those with low fuel loads, diverse species mixes, and/or multiple ecological processes. An ecosystem that is **stable** retains its functional and structural characteristics and successional trajectory in spite of stress/disturbance. Stable ecosystems are often in a state of dynamic equilibrium rather than a steady state. Disturbances of sufficient magnitude and duration may force an ecosystem to reach a threshold beyond which a different regime of processes and structures predominates (a different system state).

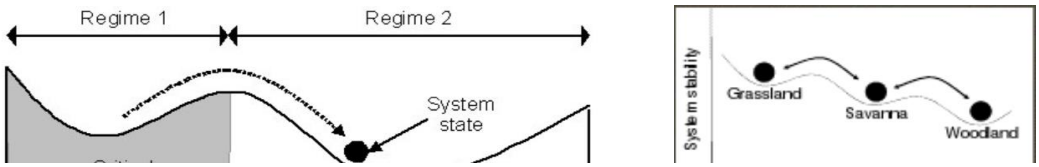

Figure 6. Examples in which a disturbance has changed an ecosystem to such an extent that it has shifted it to a new state with different structure and processes (adapted from Beisner et al, 2003).

There is much discussion in the climate adaptation literature about creating resilient ecosystems. There are many definitions of **resilience** but most are about the capacity of an ecosystem to regain structural and functional attributes that have changed because of a disturbance. In the **provincial** program, **ecological restoration**, is defined as the process of assisting with the recovery of an ecosystem that has been degraded, damaged or destroyed by re-establishing its structural characteristics and ecological processes. This definition might be thought of as *human-assisted resilience*. However, as noted in preceding sections, restoring an ecosystem to an earlier state may not be the right solution in the face of climate change. **Vulnerability**, the counterpart of resilience, is the lack of capacity to cope with, resist, and recover from a disturbance. It is recommended that a South Peace ER Program focus on vulnerable ecosystems rather than ecosystem resilience. As a starting point, it is recommended that ecosystem restoration be defined as:

"managing the structure and function of vulnerable ecosystems to achieve a desired future condition that will sustain ecological services and human socio-economic needs".

Desired Future Condition

The term **desired future condition** is anthropocentric, and in the context of an ecosystem restoration program means the *target set of structural attributes necessary to maintain ecosystem function and provide the ecological services and forest products considered to be important by stakeholders*. A desired future condition for a particular ecosystem should reflect the best available information on ecological systems, climate change, and forest management systems, and be

established with a specific time scale in mind. Determining a desired future condition for a vulnerable ecosystem requires expert knowledge but, because of the complexity of ecosystems, and uncertainties about driving forces in the future, it will also involve experimentation, adaptation, and revision.

Ecosystem Degradation

Most definitions of degradation include the concept that an ecosystem is degraded when structural elements or functional processes are lost or impeded. In the South Peace then, **an ecosystem would be considered to be degraded or vulnerable when it is missing structural elements and ecological processes that are important for achieving a future condition that will sustain ecological function and human socio-economic needs**. Examples of vulnerable ecosystems include those with:

- excessively uniform species distribution (a lack of diversity).
- introduced species whose growth and spread is not constrained by ecological processes characteristic of the ecosystem.
- a low number of individuals that cannot sustain the population.
- isolated populations which are not integrated into a larger ecological matrix (no opportunity for migration and biotic and abiotic flow).
- unnatural levels of one or more structural elements because of past human activity (e.g. high slash loads because of fire suppression).
- epidemic levels of a forest pest.
- lack of a critical structural element for a given stage of development (e.g. coarse woody debris, berry producing shrubs, large organic debris in a stream, riparian vegetation, old large trees, an important browse species, vegetative cover on erodible soils, etc).
- impeded ecological function (e.g. impeded or excessive above ground or sub-surface water flow, insufficient photosynthesis, impeded carbon fixation, lack of connectivity, disrupted mating or calving, disconnected functional link, etc).
- impaired hydrological regimes that result in loss of function or productivity.

This definition will, of course, evolve as ecosystem knowledge and experience are obtained.

Measuring Success

Part of strategic planning is ensuring that program success is defined. Success can be measured at many levels and, at the most fundamental level, in the South Peace, it is measured by the establishment and persistence of an ER organization, and the willingness of stakeholders to participate. Assuming that this occurs, the next level may be to define when activities or treatments are successful. In general, ecosystem restoration interventions are considered to be successful when:

- further degradation is halted.
- the rate of recovery increases.
- key components are present (e.g. characteristic assemblage of species, key structural elements, necessary ecosystem processes, critical habitat types).
- the ecosystem is capable of sustaining reproducing populations of the species necessary for its continued stability or development along a desired trajectory.
- the ecosystem is integrated into a larger ecological matrix or landscape and there is abiotic and biotic flow and exchange.
- potential threats to the health and integrity of the restored ecosystem, and to human values, from the surrounding landscape have been eliminated or reduced as much as possible.
- there is improved engagement by stakeholders.
- planning amongst stakeholders and agencies is integrated and accounts for cumulative impacts.
- land managers learn and adapt to improve future interventions.

Desired Future Condition

In most ER programming, the objective of an ecosystem intervention is to create a desired future condition - a target set of structural attributes and ecological processes necessary to maintain ecosystem function and provide the ecological services and forest products considered to be important by stakeholders. This definition is anthropocentric in the sense it is about what people think is important in an ecosystem and what they want in terms of ecosystem products or services (for example, productive range land, good furbearer habitat, good ungulate habitat, productive, functional hyrdoriparian ecosystems, berry habitat, ecosystems that will continue to provide ecological services into the future even with different disturbance regimes including climate impacts, safe communities). Management interventions typically attempt to change one or more structural elements in a stand or landscape.

Some examples of structural elements and ecological processes that could be used in describing a desired future condition have been provided in the tables below for four different ecosystems (figure 9). These tables simply provide information that helps structure thinking about treatment objectives. It is useful to think about which ecological processes are affected as well. Coloured cells in the tables indicate that an element or process is of particular importance for that ecosystem.

An example of how the tables could be used to describe a desired future condition for ungulate winter range for deer and elk, that includes thinking about structural elements, might look like the following:

- > 50% of the unit is in conifer patches that are primarily mature and old forest.
- More than 30% of patches are greater than 5 ha in size.
- More than 75% of the area in conifer patches has a crown closure that exceeds 50%.
- Aspen cover is less than 5%.
- Fuel loading (coarse woody debris) is less than 10 m^3/ha and occurs in dispersed patches.
- Fuel loading within 500 m of infrastructure is less than 5 m^3/ha.
- Bark beetles affect less than 5% of conifer stems.
- Browse cover exceeds 30% and is comprised primarily of saskatoon, Douglas maple, willows, red osier dogwood, soopolallie, snowberry, or other favored browse species, and herb cover in canopy gaps exceeds 60%.

Examples of Structural Elements	Fd Sites	Grass lands	Wet lands	Berries
Patch Size Distribut				
Connectivity				
Seral Stage Distribut				
Species Diversity				
Area In Old Forest				
Road Density				
Tree Species				
Crown Closure/Gaps				
Coarse Woody Debris				
Snags and Decay Cl				
Shrub Species/Cover				
Grass/Herb Cover				
Berry Species Cover				
Alien Species Cover				
Proportion Open H_2O				
Proportion Rock				
Lichen Cover				
Pest Incidence				
Infrastructure Proxim				

Exampes of Ecological Process[1]	Fd Sites	Grass lands	Wet lands	Berries
Hydrologic Regime[2]				
Thermal Regime[3]				
Soil Erosion/Stability				
Nutrient Cycling[4]				
Eutraphication				
Anoxia				
Photosynthesis				
Evapotranspiration				
Pollination				
Carbon Sequestratn				
Species Migration				
Wildlife Interactions[5]				
Colonization/Success				
Cell Division/Growth				
Plant Mortality				
Tree Recruitment				

1. Normally assessed indirectly because data collection and required research often exceed the capabilities and budgets of most restoration projects.
2. Refers to water levels, peak flow, ground water recharge/storage, runoff, percolation, salination, eutrophication, connectivity, etc.
3. Soil, water, air heating.
4. Soil organic matter accumulation and decomposition, nitrogen fixation, etc.
5. Breeding, foraging/predation, hiding, escape, etc. behaviors.

Figure 9. Structural elements and processes that could be included in a description of a desired future condition – source: Vanderhoof ER Strategic Plan

Incorporating targets and indicators into a desired future condition, will add strength to a treatment prescription. These terms can mean different things to different people but, in B.C., they are commonly defined as follows:

- Resource value - a characteristic or feature of an ecosystem that is considered to be important by stakeholders. Stakeholders may have one or more objectives for a resource value.
- Objectives - broad statements describing a desired future state or condition for a particular geographic location.
- Indicators - variables used to measure or describe the state or condition - they should be relevant, measureable, feasible, understandable, and acceptable to stakeholders.
- Targets - a specific statement describing a desired future state or condition for an indicator. They should be time-limited and quantifiable if possible.

Program objectives, indicators, and targets can be set at the landscape level and at the site level. Site level objectives are subordinate to landscape level objectives and should be consistent with them. Following is an example of how objectives, indicators, and targets can be built into a desired future condition for grasslands at the site level.

Value: Grassland Forage
Existing Condition: Grasslands (including palatable forbs) occur in small pockets or strips within a complex of aspen copses, shrub pockets, and scattered conifers, and represent less than 50% of the unit. They are predominated by introduced species such as timothy, brome, and Kentucky blue grass.
Treatment Objective: Improved grass abundance and composition.
***Indicator** 1:* Kg forage/ha and stock capacity
***Target** 1:* 600 kg forage/ha/year with a stocking rate of 2.4 ha/AUM.
***Indicator** 2:* Proportion of grasses that are native species.
***Target** 2:* 25% of grass cover is comprised of native species within five years of treatment.

Data supporting specific indicators must be collected before and after treatment during program monitoring. Obtaining this type of information is part of the adaptive management process and allows treatment success to be evaluated and results to be communicated. The overall intent is to ensure that management strategies are meeting stakeholder expectations for ecosystem restoration.

Incorporating Desired Future Condition Into Treatment Prescriptions

Once desired future conditions for a particular ecosystem have been described, a treatment prescription must be developed to achieve the desired condition. Some principles that should be considered in designing treatment prescriptions for ecosystem restoration in the South Peace District include:

- Ensure treatments reflect driving forces and future conditions.
- Promote techniques that create biologically diverse and functionally complex ecosystems.
- Avoid setting treatment targets that are based on historical conditions unless historical drivers of ecosystem function will be the same in the future.
- Ensure that treatments result in ecosystems that function well under existing conditions (precipitation, temperature, hours of sunlight, edaphic and physiographic conditions, disturbance regimes, etc.) and under expected future conditions.
- Avoid treatments that require repeated interventions unless there is some assurance that these future interventions can be supported.
- Ensure that a framework for learning through monitoring is incorporated in treatment planning.

The table below provides a more complete example of how a prescription can be built, in this case, for a grassland ecosystem. The table describes general treatment methods, expected outcomes, and rationale for the ecosystem, but does not provide operational details on things like location, equipment, treatment area, costs, and protection concerns for specific units. These types of concerns would also normally be incorporate into an operational plan.

Grassland Ecosystems	
	Prescribed Burning
Treatment Description	- prepare a treatment prescription and burning plan 1 to 2 years in advance of burning - engage stakeholder involvement (particularly cattlemen and local residents) prior to treatment implementation - delineate treatment boundaries based on natural fire breaks, location of infrastructure, and access - develop fire guards as necessary near infrastructure, reserves (including areas with high potential for red listed species), or areas with thin duff and rocky outcrops - burn in the spring when the fire is more easily controlled, when dead grass stalks and herbaceous vegetation are dry and flammable, and when soils are still frozen or moist (to avoid loss of humus horizons) - burn intensity should be light so that the seed bank and rhizomes are not destroyed and humus horizons are conserved (note that burn intensity is not well correlated with aspen mortality and that slender wheatgrass - *Elymus trachycaulus* is sensitive to spring burning) - manually cut and spread brush as required before burning treatments to improve fuel continuity - consider cutting and hinging (on stems up to 15cm at the root collar) aspen taller than 3 m prior to burning (to increase mortality and reduce suckering) - consider repeating burning 2 years after the initial treatment to kill aspen suckers (this approach could reduce soil productivity and will not eliminate aspen – i.e. it will not shift the ecosystem to a new regime state unless it is frequently repeated - but will provide a window of opportunity for better grass, forb, and shrub production until aspen and conifers reestablish). - consider manual cutting of aspen and undesirable shrubs each year for 2 to 3 years after treatment to extend the period of good grass and herb production - consider undertaking controlled grazing in August, in the year of burning (to kill aspen or make any resprouting shoots more susceptible to winter kill). - consider leaving sections with high indigenous species diversity untreated (since introduced species such as Timothy, Kentucky bluegrass, and Brome resist fire well and may tend to occupy a site more effectively) - in high use areas, consider mechanized thinning (or harvesting) of conifer forests to open the stand and improve light conditions for forbs and grasses - on areas that are primarily used by domestic livestock and are not targeted for restoration to a natural state, consider grass seeding of roadsides and landings using a range mix that includes slender wheatgrass (this treatment could also be considered in thinned conifer forests if there is enough mineral soil exposure) - avoid burning in areas where livestock grazing already provides sufficient disturbance to stimulate robust shrub and herb cover (the combination of burning and grazing can reduce site productivity to a point where recovery is prolonged)
Associated Vulnerability/ Degradation	- grassland areas occur in small, dispersed pockets - aspen and conifer encroachment - the prevalence of introduced species such as dandelion and agronomic grasses - the prevalence of undesirable shrub species such as snow berry or birch leaved spirea - low species diversity (less than a dozen or so grass and herb species for example) - low grass and herb production - compacted or eroded soils - soil organic horizons that are thin and do not adequately hold soil moisture, provide soil nitrogen, protect seed banks, and prevent erosion - extirpation of wildlife resulting from overuse by domestic animals or human activities
Desired Future Condition	- rare or endangered species are protected - grassland patches exceed 2 ha and are well connected - aspen and conifer cover is less than 5% within defined units - shrub cover is less than 50% and 75% of shrub species are browse and/or berry species - grass cover, outside of shrub and aspen sections, exceeds 80% and is 25% native species - on rangeland areas that are not considered to be natural grasslands, grass production exceeds 400kg/ha.
Treatment Rationale	Treating grassland ecosystems may be necessary because they are rare and provide important forage opportunities for a different array of species than is found in most forest ecosystems. For example, grasslands are very important for a variety of bird species and host a variety of small mammals like the chipmunk, the jumping mouse, packrats and other mice and voles, garter snakes, and species of prey like the red-tailed hawk, fox, and even cougar. Most of the natural grassland sites in the District provide important spring range and, in high-snow years could be critical to the survival of wild ungulates following a harsh winter. Such sites may also be beneficial in diverting wild ungulates away from the hay and grain crops available on ranches and farms. In other areas where the focus is on rangeland for cattle, burning can also be beneficial in terms of creating pasture land and improving carrying capacity and could have a direct economic benefit for the cattle industry now that it is beginning to improve. Site specific objectives for undertaking this treatment could include: improving grass nutrient quality, enhancing flowering and seed production, removing unpalatable dead plant matter, creating suitable seedbeds, reducing fuel build-up, and top killing aspen and shrubs.

III - List Of Ecosystem Restoration Needs Identified By Stakeholders

Provided under separate cover in a spreadsheet entitled *Interview Information*.