CEF Cumulative Effects Framework

BRITISH COLUMBIA

INTERIM CURRENT CONDITIONS REPORT FOR FIRST NATIONS ENVIRONMENTAL LIVELIHOODS IN NORTHEAST BRITISH COLUMBIA (2018 ANALYSIS)

PREPARED BY THE RSEA ENVIRONMENTAL LIVELIHOODS WORKING GROUP

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CURRENT CONDITION REPORT

Current condition reports (CCR) provide an overview of the current state of individual values in relation to selected indicators and their respective reporting units. The CCR generated by the RSEA Project Team contains information pertaining to the indicators and methods used to assess current conditions of valued components, results for each indicator, descriptive maps, and a summary of the assessment results.

This CCR provides an overview of the current state (2018) of First Nations Environmental Livelihoods in the RSEA Project Area. This CCR describes the methodology that was used to collect and analyze relevant indicators for First Nations Environmental Livelihoods, including wildlife harvesting participation rates, the number and types of wildlife species harvested, the food weight procured for consumption, the directional orientation of First Nations land use, and the extent to which traditional foods are shared between First Nation communities and households. Furthermore, this CCR also describes the procedures used to identify potential industry-livelihood conflicts/thresholds that may trigger management actions, as well as impact scenarios that can be used to inform dialogue and shared decision-making by First Nations and Provincial agencies. Lastly, this CCR describes the data management system that was developed and is now being used by First Nation Governments to respond to industrial referrals and other public land use interests.

ENVIRONMENTAL LIVELIHOODS

This study used a household-level survey to elicit comprehensive data about the environmental livelihoods of the Saulteau First Nations (SFN), McLeod Lake Indian Band (MLIB), and West Moberly First Nations (WMFN). Environmental livelihoods include the provisioning of environmental resources (e.g., wildlife, plants) from ecosystems such as forests, wetlands, lakes, rivers, and grasslands. Because environmental resources are most often procured for non-commercial subsistence purposes, and are shared through informal social networks, their importance within First Nations communities has too often gone unaccounted for in previous impact assessment processes. For this reason, environmental livelihoods were identified as one of five RSEA valued components that would be used to inform the management recommendations contemplated by First Nations and Provincial agencies.

LIMITATIONS

Representation: This study elicited responses from on-reserve households only. While the on-reserve response rates are highly representational (SFN=90%; MLIB=88%; WMFN=81%), our results do nonetheless represent only 27% of the total registered First Nations population. The results presented here should therefore be considered an accurate yet conservative estimate of the environmental livelihoods of each First Nations.

Temporality: This study asked First Nations members to recall the number and types of wildlife species harvested during the preceding 12-month period (2018). This survey approach therefore captures only a snapshot in an otherwise lifetime of land use experiences. First Nations' uses of the land vary over time due to ecological disturbances (e.g., wildfire) and the various social and economic constraints that may be experienced by First Nations harvesters. The results presented here therefore represent a single point in time and should not be misinterpreted as static or unchanging.

Cultural Significances: The data presented in this CCR provide a quantitative assessment of the environmental livelihoods of First Nations. However, these data do not capture the cultural values that inform these harvesting practices. Whereas environmental livelihoods include a range of food procurement activities (harvesting, processing, sharing, consuming), these activities are embedded within a cultural system that includes norms, social relationships, worldviews, identities, and environmental knowledge that give environmental livelihoods meaning. It is the potential loss of these cultural values that has motivated First Nations to participate in this RSEA process.

DATA SOVEREIGNTY

The collection and use of First Nations Environmental Livelihoods data are premised on the CARE Principles for Indigenous Data Governance[1] (Carroll et al., 2020):

- The right to **Collectively Benefit** from the collection, analysis, and use of First Nations data.
- First Nations **Authority to Control** access to data in accordance with First Nations' governance and collective interests.
- The **Responsibility** of those proposing to work with First Nations' data to disclose how those data will be used and how those uses will support First Nations rights and interests.
- An **Ethical Commitment** to minimize harm and maximize benefits for First Nations in the use, integration, and translation of data.

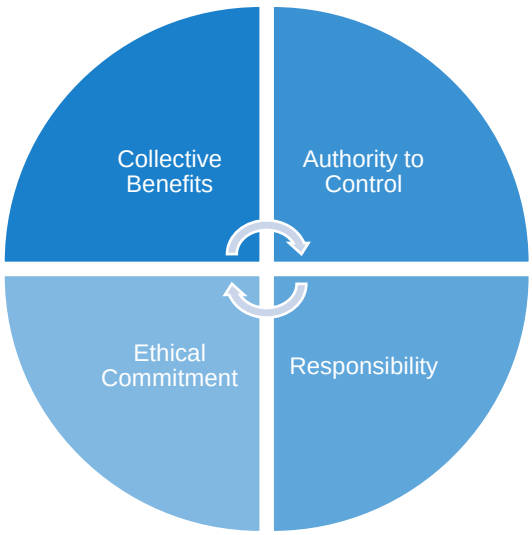

Figure 1. CARE Principles for Indigenous Data Governance

[1] Carroll, S.R., Garba, I., Figueroa-Rodríguez, O.L., Holbrook, J., Lovett, R., Materechera, S., Parsons, M., Raseroka, K., Rodriguez-Lonebear, D., Rowe, R., Sara, R., Walker, J.D., Anderson, J. and Hudson, M., 2020. The CARE Principles for Indigenous Data Governance. *Data Science Journal*, 19(1), p.43. DOI: http://doi.org/10.5334/dsj-2020-043

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1.0 INTRODUCTION

In 2015, the Regional Strategic Environmental Assessment (RSEA) Enabling Agreement (Enabling Agreement) was finalized between the Government of British Columbia and Treaty 8 First Nations. A principal objective of the Enabling Agreement is to credibly assess the effects of natural resource development on the rights of the participating First Nations as adherents to Treaty No. 8 and as recognized and affirmed by section 35(1) of the Constitution Act, 1982 (Treaty 8 Rights). Through the Enabling Agreement, the Province and Treaty 8 Nations agreed to collaborate on the design and implementation of a RSEA through the Environmental Stewardship Initiative (ESI). To advance the Enabling Agreement, a RSEA Project Team was established with provincial and First Nations representation. The mandate of the RSEA Project Team is to collaborate in the development and implementation of approaches to assess the cumulative effects of natural resource development activities. This included the identification of valued components associated with the practice of Treaty 8 rights. The RSEA valued components selected by the RSEA Project team include Moose, Biodiversity, Water, Peaceful Enjoyment, and Environmental Livelihoods. Based on these valued components, the RSEA Project Team set out to assess the current condition of each valued component to inform draft management recommendations and other decisions contemplated by First Nations and Provincial agencies.

In this Current Conditions Report (CCR), we present the results from the environmental livelihoods assessment. Environmental livelihoods include the provisioning of environmental resources (e.g., wildlife, plants) from non-cultivated ecosystems such as forests, wetlands, lakes, rivers, and grasslands. The First Nations that led this assessment include the Saulteau First Nations (SFN), McLeod Lake Indian Band (MLIB), and West Moberly First Nations (WMFN). The environmental livelihoods assessment documented the extent to which First Nation livelihoods are derived from environmental resources. More specifically, the objectives were to:

- Collect and organize a body of information and relevant indicators that can be used to quantify the extent to which First Nations members utilize environmental resources.

- Identify and establish management thresholds or benchmarks that can be used to trigger management actions.

- Develop scenarios that favor desired outcomes and best safeguard the environmentally based livelihoods of First Nations.

- Develop an integrated 2D & 3D Web GIS Platform for the continual monitoring of First Nations Environmental Livelihood Value in the northeastern British Columbia.

This CCR provides a summary of key findings from the environmental livelihoods assessment, with illustrative examples of the livelihood indicators that were documented. These results serve as a baseline of livelihood data - albeit based on a single year of data collection and having already been significantly influenced by a legacy of colonial interference. Due to the sensitive nature of these findings, some results have been generalized for confidentiality. Further, the results from the WMFN assessment are not included in this CRR.

The information collected through this assessment provides the necessary information to evaluate how various land uses, be they industrial or conservationist in intent, might affect the environmentally-based livelihoods of First Nations. The results of this assessment represent an opportunity for First Nations to protect vital aspects of their land-based culture and economy, and to work with the Government of British Columbia in a more meaningful and informed manner concerning future planning decisions.

2.0 STUDY AREA

The ancestral territories of the SFN, WMFN, and MLIB extend throughout the Peace River basin of British Columbia and Alberta. The study area for this assessment covers 101,400 km^2 of northeast British Columbia that has been used historically by the SFN, MLIB, and WMFN for hunting and other traditional land use activities (Figure 2). Within this territory, First Nations follow a seasonal round of harvesting activities. The locations and timing of seasonal land uses are adjusted based on the accumulation of environmental knowledge of where resources could be most readily found. This knowledge informs a subsistence pattern that enables First Nations to thrive in the face of change.

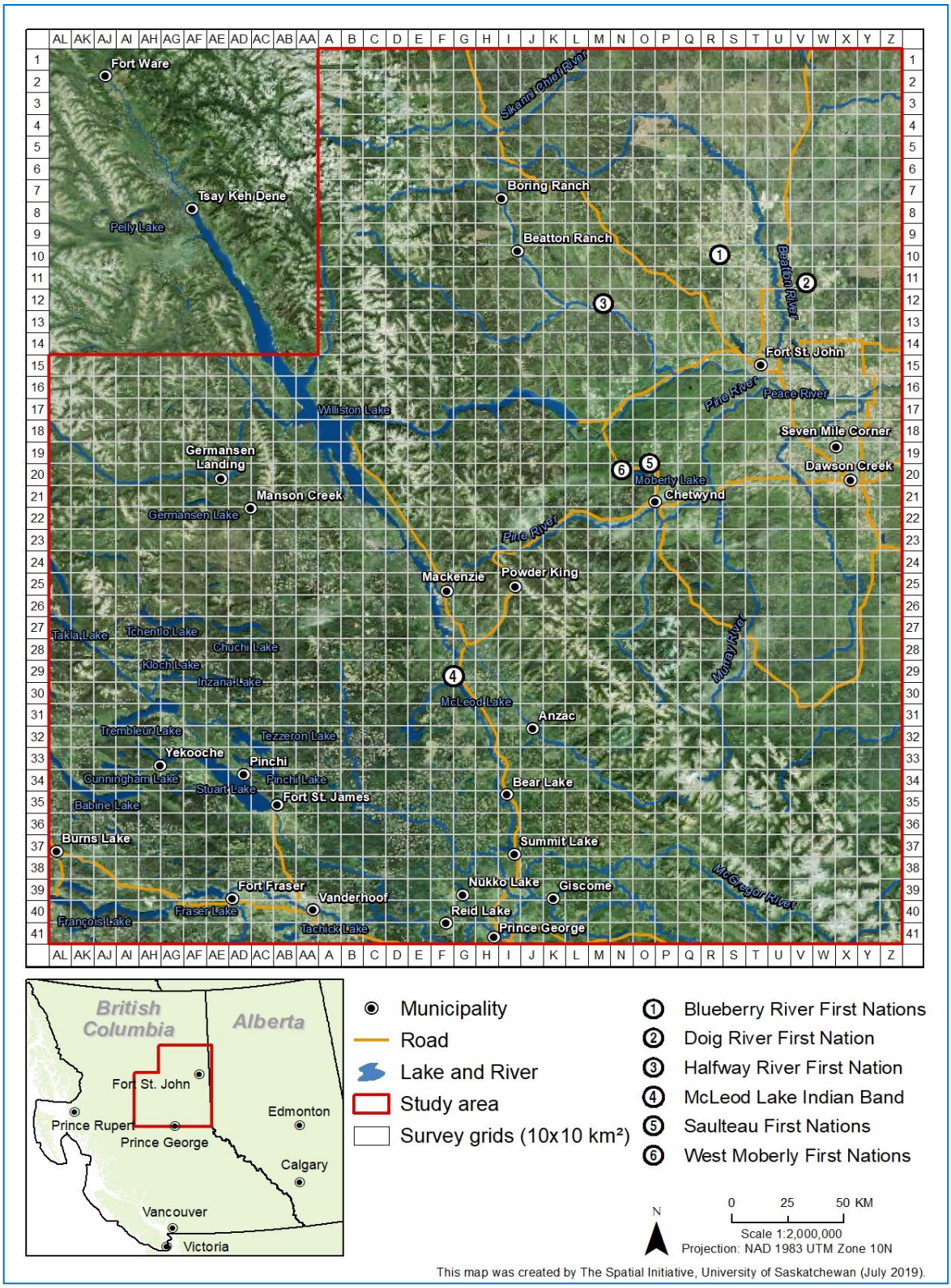


Figure 2. Environmental Livelihoods Study Area

2.1 McLeod Lake Indian Band (MLIB)

The traditional territory of the Tse'Khene Nation, or the McLeod Lake Indian Band (MLIB), extends 108,000 km^2 through the Parsnip, Finley, and Peace River drainages in British Columbia. In 2000, the McLeod Lake Indian Band ratified an agreement with the Government of Canada and the Government of British Columbia that brought the MLIB into Treaty 8. The main residential reserves of the MLIB (IR 1 and 5) are located near the unincorporated village of McLeod Lake, approximately 150 kilometers north of Prince George on Highway 97 (Figure 3). As of 2018, the total registered population of MLIB is 496, of which 131 reside on reserve (26%), living in 48 households.

Figure 3. Location of MLIB Reserves (I.R. 1 and 5)

2.2 Saulteau First Nations (SFN)

The Saulteau First Nations (SFN) are of Cree, Saulteau, and Dane-zaa descent, and its members are speakers of the Algonquian and Athabaskan linguistic families. Ancestors (Anishnaubemowin) of the present day SFN migrated from Manitoba to Moberly Lake between 1888 and 1908. Over time Saulteau members married the Dene-zaa and Cree inhabitants of the area and together formed what was later labeled by Treaty Commissioners as the East Moberly Band No. 169. The leaders of the East Moberly Band signed Treaty 8 in 1899 and in 1914 received a 3,026 ha reserve on the northeast end of Moberly Lake (Figure 4). The current population of SFN is 1,115, of which 320 reside on reserve, living in 107 households.

2.3 West Moberly First Nation (WMFN)

West Moberly First Nations (WMFN) are of Dane-zaa (Beaver) descent and speakers of the Northern Athapaskan language group. Citizens of the WMFN entered into Treaty 8 in 1914, and in 1916 a 2,034 ha

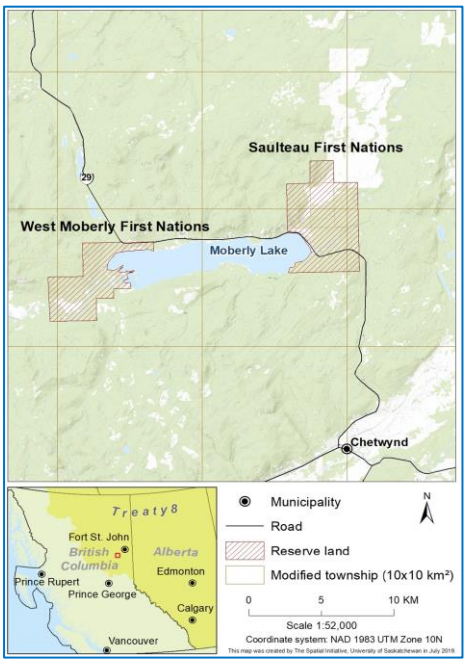


Figure 4. Location of SFN and WMFN Reserves

reserve was established on the west end of Moberly Lake (I.R. No. 168A). The current population of WMFN is 359, of which 85 members reside on reserve, living in 43 households (Figure 4).

3.0 METHODOLOGY

Our research involved a mixed methodology that employed both qualitative and quantitative strategies (Figure 5).

3.1 Wildlife Harvesting Survey

Environmental livelihoods data were collected through the delivery of a household survey. While a common survey instrument was used, its delivery varied by each First Nations. For example, in the case of SFN, the leadership chose to include students from their summer youth program in the delivery of household surveys. In total, 14 high school students were hired as research assistants who then set out to survey all on-reserve households (N = 107). These students worked under the supervision of the SFN Lands Manager and a SFN Elder. In the case of MLIB and WMFN, staff from each First Nations Land Office were hired to administered surveys, who were supervised by their respective Lands Manager.

Section One of the survey collected household demographic information. These data included the number of household members, along with their age, gender, and employment patterns. Section Two of the survey recorded wildlife harvesting data. First Nations researchers asked the head(s) of households to recall the number and types of animals harvested by household members during the preceding 12 months. A predetermined list of animal species was used to aid informant recall. In addition to identifying the number and types of animals harvested, respondents were asked to locate on an accompanying map the zones (10x10 km^2) where harvesting activities occurred (Fig. 2 above). Mapping at this scale was done to capture the spatial distribution and concentration of land use and harvesting activities, while protecting the confidential nature of specific sites. Section Three of the survey focused on food sharing. Household-heads were asked to identify who in the past year they had given or received food from. Researchers recorded the types of food shared (e.g., moose, rabbits), the relationships between giving and receiving households (e.g., son to mother, brother to sister), and the corresponding household numbers that were coded for confidentiality. The food sharing component of the

survey highlights the harvest and subsequent flow of wild foods between households, and identified households that are either at the core, periphery, or isolated from food-sharing networks. These network data were then linked spatially to harvest locations to demonstrate how changes on the landscape might affect the harvest and subsequent distribution of wildlife resources, and the impact these changes have on environmental livelihoods of First Nations members. Data sources and analyses for the social network analysis are listed in Table 1.

Table 1. Data sources and analyses for Social Network Analysis (SNA).

Data Types	Analytical Tools	Outcome of Analysis
Food sharing and kinship data	UCINet and Netdraw	Food sharing connections between households
Spatial and social proximity data	UCINet, SPSS, R Studio	Linking of social network data with spatial data to determine the influence of disturbance on harvesting and food sharing

3.2 Data Processing and Geodatabase Development

For non-spatial harvesting data, simple descriptive summary statistics were compiled. Household socio-demographic characteristics were manually entered to support the generation of descriptive summary tables and figures. Harvested animal counts were converted to edible food weight (i.e., the amount of consumable meat left after processing). These weights were calculated at species, household, and community levels and mapped according to the harvest locations on the 10x10 km^2 map. Plant and berry species were analysed separately as they were associated with harvest location only and not by weight or quantity.

Catalys Consulting provided for disturbance layers (2018), which included transportation, oil, gas, power, mining, forestry, agricultural, fire, pests, and recreation sites. These layers were used to identify associations between landscape disturbances and First Nations land use. Other geospatial data (e.g., provincial boundary, road network, water bodies, and base map) were also collected from open-source database and government website. Table 2 lists the spatial data features and sources.

Table 2. Spatial layers used for geodatabase development.

Data Feature	Data Source
RSEA disturbance dataset	Catalys Consulting Ltd.
Water bodies	ESRI and Open Government Access
Base map	ESRI
First Nation community profiles	SFN, WMFN, and MLIB; Indigenous and Northern Affairs Canada
Study area	RSEA Project Team
Moose sport hunting dataset	BC Ministry of Forest, Land, Natural Resource Operations and Rural Development
Harvesting information	Environmental Livelihoods Survey
Harvesting barriers	Environmental Livelihoods Survey
Food sharing information	Environmental Livelihoods Survey
Camps and cabin	Environmental Livelihoods Survey
Road network	Statistics Canada
Province boundary	Statistics Canada
BC Parks, Ecological Reserves, and Protected Areas	The Ministry of Environment and Climate Change Strategy, BC government
Recreational, reserve site, dams	The Ministry of Forest, Land, Natural Resource Operations and Rural Development, BC government
Survey grid	USask Spatial Institute
Coastal GasLink Pipeline	BC Oil and Gas Commission
Westcoast Connector Gas Transmission	Spectra Energy Corp
Prince Rupert Gas Transmission	BC Oil and Gas Commission

3.3 Spatial Analysis and Mapping

Geographic information systems (GIS) were used to manage the geographic datasets and to investigate the spatial patterns of First Nations land use. The main tool used for mapping and spatial analyses was ESRI ArcGIS version 10.6. Thematic maps were generated to show the total harvest by number and types of species harvested, the converted food weight, and the frequency of use by First Nations hunters. Hotspot analyses were performed to identify areas of high use and harvesting concentration. Hotspot analyses utilized the geographic location, data frequency, and the weights of discrete zones to derive a data layer covering the entire study area. Hotspot maps were then created by calculating the density of the zones for a certain data theme (i.e., number of moose killed). Hotspot analysis was performed in ArcGIS using the Kernel Density tool, at a cell resolution of 1 × 1 km^2. In the output layer, each raster cell is assigned a density value (kg/km^2) and the output layer is

visualized using a gradient from green to red – with red indicating areas of higher harvested concentration and green indicating more dispersed use.

Directional maps for harvesting were generated by calculating the spatial orientation of the data points to reveal the directional tendencies of First Nations harvesting. The Euclidean distance was first calculated between the center of each First Nations community to the calculated centroid of the harvest zones. Standard deviational ellipses (1 standard deviation) were created by using the directional distribution tool in ArcGIS to summarize central tendencies and directional trends.

3.4 Threshold and Scenario Analysis

Threshold maps we developed to measure the sensitivity of First Nations' harvesting to industrial presence throughout the study area. The intensity of harvesting activities is measured by a Harvest Utility Index (HUI) that was calculated by combining three harvesting metrics (food weight, number of animals harvested, and frequency of use). The intensity of industrial development is quantified by the Industrial Disturbance Index (IDI). The IDI considers the impact of all known industrial projects (e.g., pipelines, mining, logging) in the study area. The HUI and IDI were created by normalizing, weighting, and summarizing respective input data and executed in ArcGIS' model builder. To examine the interactions between the First Nations harvesting activities and industrial disturbances, the HUI and the IDI maps were overlaid and combined into a comprehensive threshold map to show the current conflicts between the land uses of First Nations and industrial disturbances in the study area.

Based on the compiled data, a series of scenarios were developed to assess how resource development and supporting infrastructure might affect the environmental livelihoods of First Nations in the future. The scenario analysis accounts for First Nations harvesting patterns in relation to existing and proposed industrial disturbances (i.e., well sites, road development, pipelines). To do so, a series of simulations were run based on predetermined industrial setbacks—in this case, the absolute minimum distance that must be maintained between any energy facility (e.g., pipeline or gas plant) and proximal harvesting areas. Within these setback areas, certain land use activities are prohibited, such as the discharge of firearms. Scenarios were then developed to explore the potential impact on First Nations land use, wild food harvest, and subsequent sharing of food. Figure 5 below captures the methodological stages of this assessment.

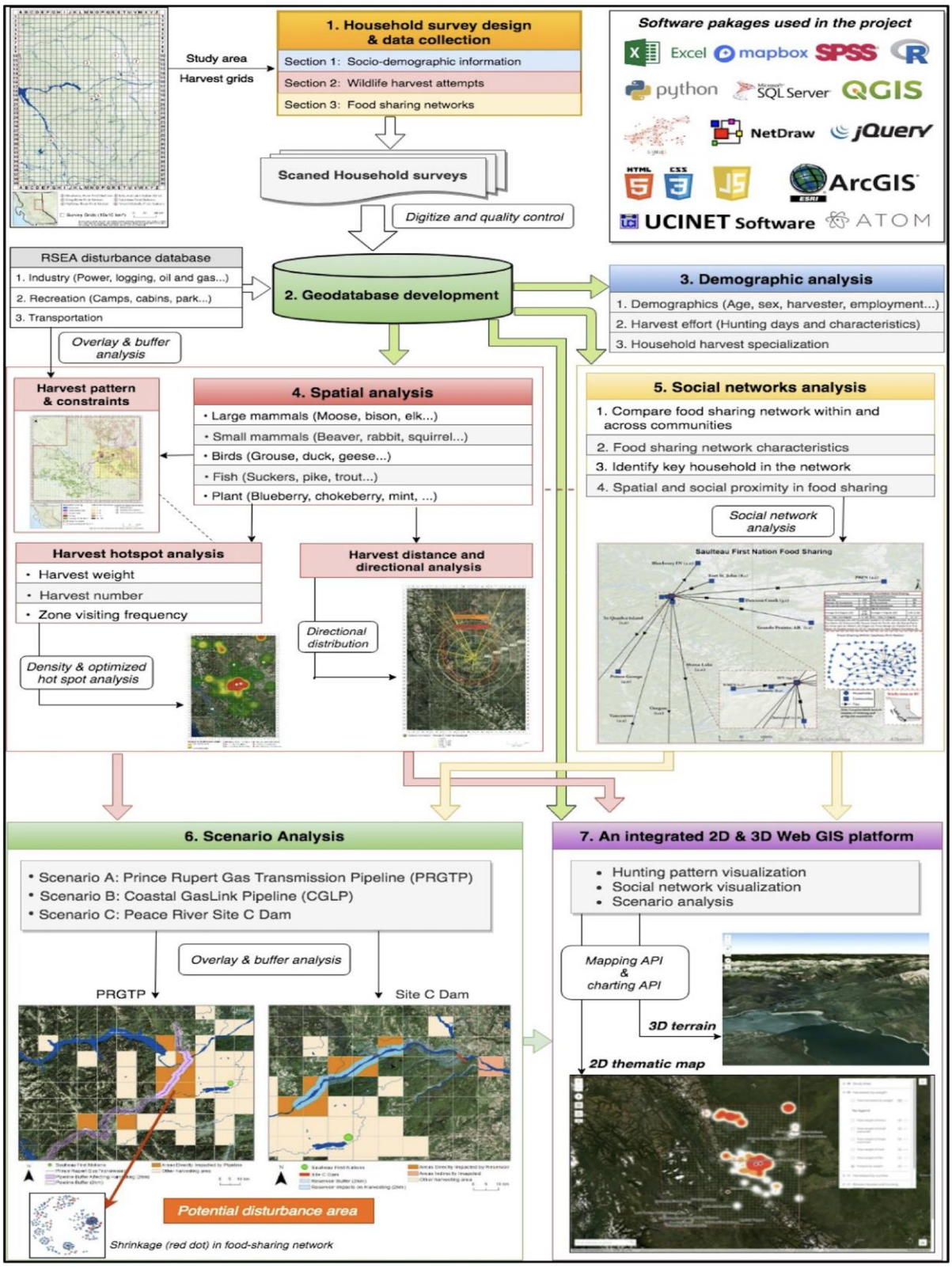


Figure 5. Environmental Livelihoods Methodology

4.0 RESULTS

4.1 Household Survey Coverage

This section provides a summary of results for the MLIB, SFN and WMFN. More detailed results have been compiled in the Environmental Livelihood Reports of each participating First Nations.

MLIB researchers surveyed 88% of all on-reserve households (N=42). In addition, 41 households were surveyed in Prince George, and 10 households in other communities, including Bear Lake and Fort St James. In total, MLIB researchers surveyed 93 households, with a survey population of 232 residents (Figure 6).

Among the SFN, surveys were completed in 96 of the 107 (90%) SFN on-reserve households. This represents a survey population of 255 SFN members.

WMFN researchers surveyed 35 out of the 43 on-reserve households (81%). This represents a survey population of 71 members (see Table 3).

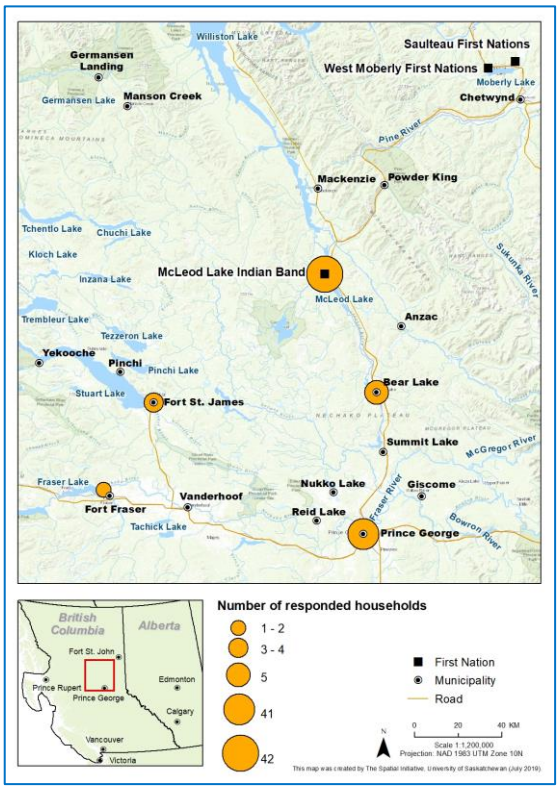


Figure 6. MLIB Survey Coverage

Table 3. Environmental Livelihoods Survey Summary

First Nation	Total Population	On-Reserve Population (%)	On-Reserve Households	Surveyed Households (%)
MLIB	496	131 (26%)	48	42 (88%) (+51 off-reserve)
SFN	1,115	320 (29%)	107	96 (90%)
WMFN	359	85 (24%)	43	35 (81%)
Total	1,970	536 (27%	198	224 (87%)

4.1 Harvest Summaries

Our findings indicate that wildlife resources make an important contribution to nearly all First Nations households. Among the 224 households that were surveyed, 84% (N=187) participated in wildlife harvesting during the 2018 survey period. Excluding the totals from WMFN, the total food weight that was harvest by MLIB and SFN households is estimated to be 85,615 kg. If distributed evenly among MLIB and SFN households, this equates to an estimated 453 kg/household.

On average, SFN households devoted 55 days/year to harvesting activities (e.g., hunting, fishing, gathering). This effort resulted in an estimated total harvest of 56,027 kg of wild food. Large mammals (e.g., moose, bison, deer, elk, bear, and caribou) accounted for 53,370 kg, or 95% of SFN's food harvest, with moose accounting for 56% (31,176 kg) of the total. Other harvested foods include small mammals (e.g., muskrat and squirrel), fish (e.g., pike, lake trout, and whitefish), and birds (e.g., geese, ducks, and grouse).

MLIB households spent an average of 39 days engaged in harvesting activities. This harvesting effort resulted in estimated harvest of 29,588 kg. Moose accounted for 42.2% (12,495 kg) of all harvested food. Other large mammals (elk, deer, and bison) accounted for 46.2% (13,659 kg). Small mammals, fish, and birds also made important contributions (11.6%). Estimates of household harvesting effort should be used cautiously in that they do not account for opportunistic encounters wildlife that may be harvested. Harvesting effort also fails to capture the multiple harvesting activities that may occur during a single day of effort, for example collecting plants or berries during a moose hunt (Table 4).

Table 4. First Nations Harvest Summary

First Nation	No. of Harvesting Households (%)	Harvesting Effort/Household (days/yr.)	Total Food Weight Harvested (kg)
MLIB	74 (80%)	39 days/yr.	29,588
SFN	78 (81%)	55 days/yr.	56,027
WMFN	NA	NA	NA

Total Harvest by Species Category (kg of food weight)					
	Moose	**Lg. Mammal**	**Sm. Mammal**	**Fish**	**Birds**
MLIB	12,495	13,659	1,477	1,638	319
SFN	31,176	22,194	1,307	1,174	186
WMFN	NA	NA	NA	NA	NA
Total	43,671	35,853	2,784	2,812	505

Whereas household harvesting effort ranged between 39-55 days/year, a smaller number of super-harvesting households engaged on a full-time basis. For example, among SFN households, 20% (N=19) accounted for 71% (39,779 kg) of the total food harvest, with one super-harvesting household procuring in excess of 9,000 kg, or 16% of the SFN total wild food harvest (Figure 7). Similar patterns were found among MLIB households. In this case, 20% (N=19) accounted for 64% (19,002 kg) of the total harvest.

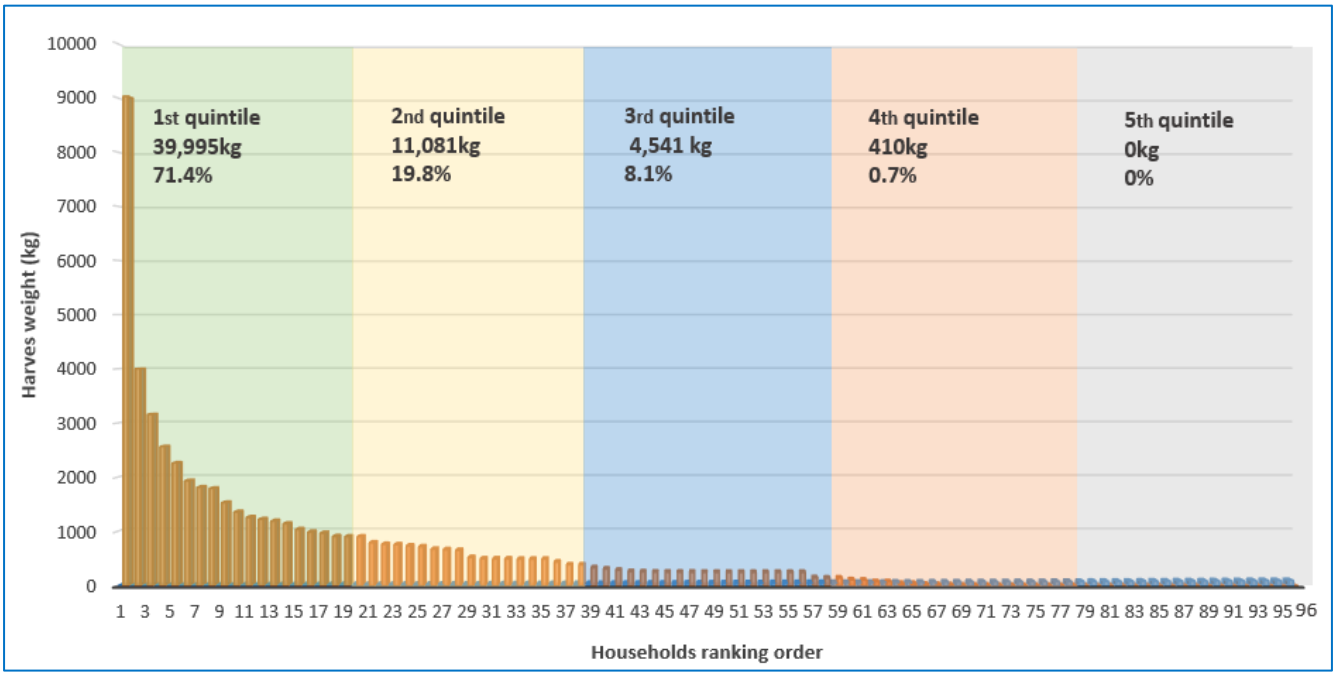


Figure 7. SFN Household harvest distribution (quintiles, N=96)

4.3 Food Sharing

Food sharing was found to be pervasive among nearly all SFN and MLIB households. For example, of the 96 SFN households that were surveyed, 86 households (90%) shared food with other households in the community. SFN households also reported sharing food with 74 other households from 13 other communities. In the 12-month survey period, SFN members shared food 245 times. This is a conservative estimate and does not include shared meals or the customary norm of sharing food with guests and visitors. Moose meat was most frequently shared but all other species, including plants and berries, were also exchanged. Food sharing occurred predominately between kin, most often between members of immediate families. For example, 29% of all exchanges take place between siblings, whereas 16% of food exchanges occur between non-related friends and hunting partners (Table 5, Figure 8).

Table 5: SFN Food Sharing Summary.

Tie Summary		Household Summary	
Total ties	245	Total Households	160
Between SFN Households	171	SFN Households	86
With non-SFN Households	74	Non-SFN Households	74[a]
Households Degree Summary			
Average Out Degree (SD)	2.63 (3.05)	Average In Degree (SD)	1.53 (2.28)
Min. - Max. Out Degree	0 - 18	Min. - Max. In Degree	0 - 17

[a] These exchanges are with households located in 13 other communities: Blueberry First Nation (2); Chetwynd (28); Dawson Creek (4); Fort St. John (9); Grande Prairie (2); Horse Lake (2); Moberly (8); Oregon (1); Prince George (2); Prophet River First Nation (3); Quadra Island (1); Unknown (3); Vancouver (1); West Moberly First Nation (8).

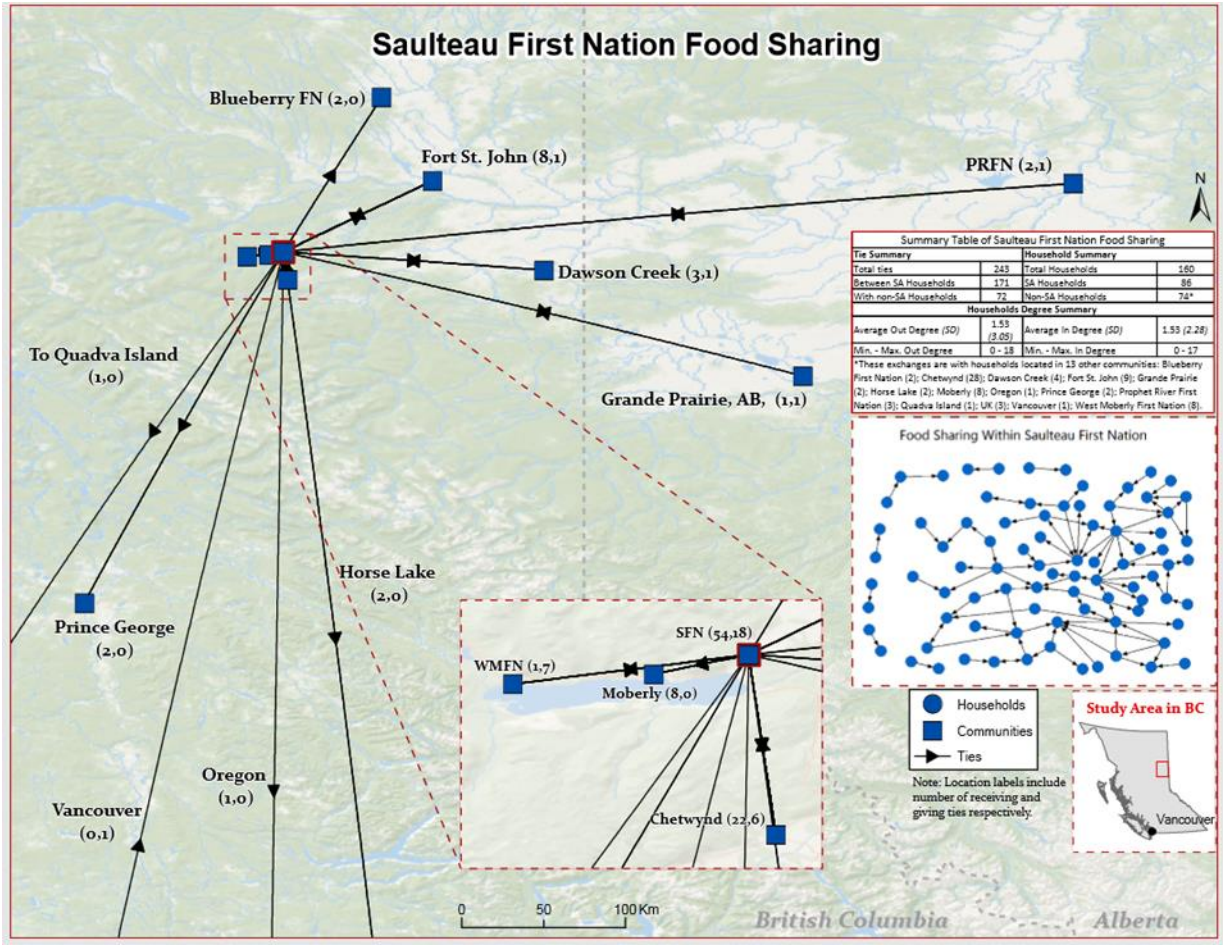


Figure 8. SFN Regional Food Sharing

MLIB households are similarly involved in an extensive network of food sharing. The MLIB food sharing network is comprised of 257 households; 99 (38.5%) MLIB households and 158 (61.5%) other households located in 24 other communities (Table 6).

Table 6. MLIB Food Sharing Summary

Tie Summary		**Household summary**	
Total Ties	440	Total households	257
Between MLIB Ties	269	MLIB Households	99
With non-MLIB Households	171	Non – MLIB Households	158*
Household Degree Summary			
Average Out Degree *(SD)*	1.70 (1.02)	Average In Degree *(SD)*	1.70 (1.027)
Min. - Max. Out Degree	0 – 7	Min. - Max. In Degree	0 - 23
*These exchanges are with households located in 28 other communities: Moberly Lake (1 HH), Bear Lake (7 HH), Chetwynd (6 HH), Dawson Creek (1 HH), Fort St John (2 HH), Fort Saint James (37), Gitanmaax BC (1 HH), Halfway River First Nations (1 HH), Hazelton BC (4 HH), Inzana Lake 12 (1 HH), Kamloops (1 HH), Lheidli Tenneh Band (8 HH), Lilloet BC (1 HH), Mackenzie BC (9 HH), Nadleh Whut'en First Nation (5 HH), Prince George (48 HH), Saulteau First Nation (2 HH), Smithers BC (1 HH), Sooke BC (1 HH),) Summit Lake (1 HH), Tachie (4 HH), Tacla Lake BC (2 HH), Victoria (1 HH), West Bank First Nation (1 HH), Unknown (3 HH)			

4.2 Spatial Distribution of Harvesting Activities

Harvest data that were extracted from the surveys were mapped on discrete grids to convey the spatial concentration and distribution of harvest locations. For example, Figure 9 reflects the spatial distribution of the MLIB harvest. Darker brown grids indicate areas where greater weights of food were harvested. Similar maps have been created that reflect the number of animals harvest (i.e., number of moose or fish harvest in each grid) as well as the number of households that utilize grid areas. Hotspot analysis further revealed the spatial distribution of food harvest across the entire study area (Figure 10). Similar patterns can be observed for the SFN in Figure 11.

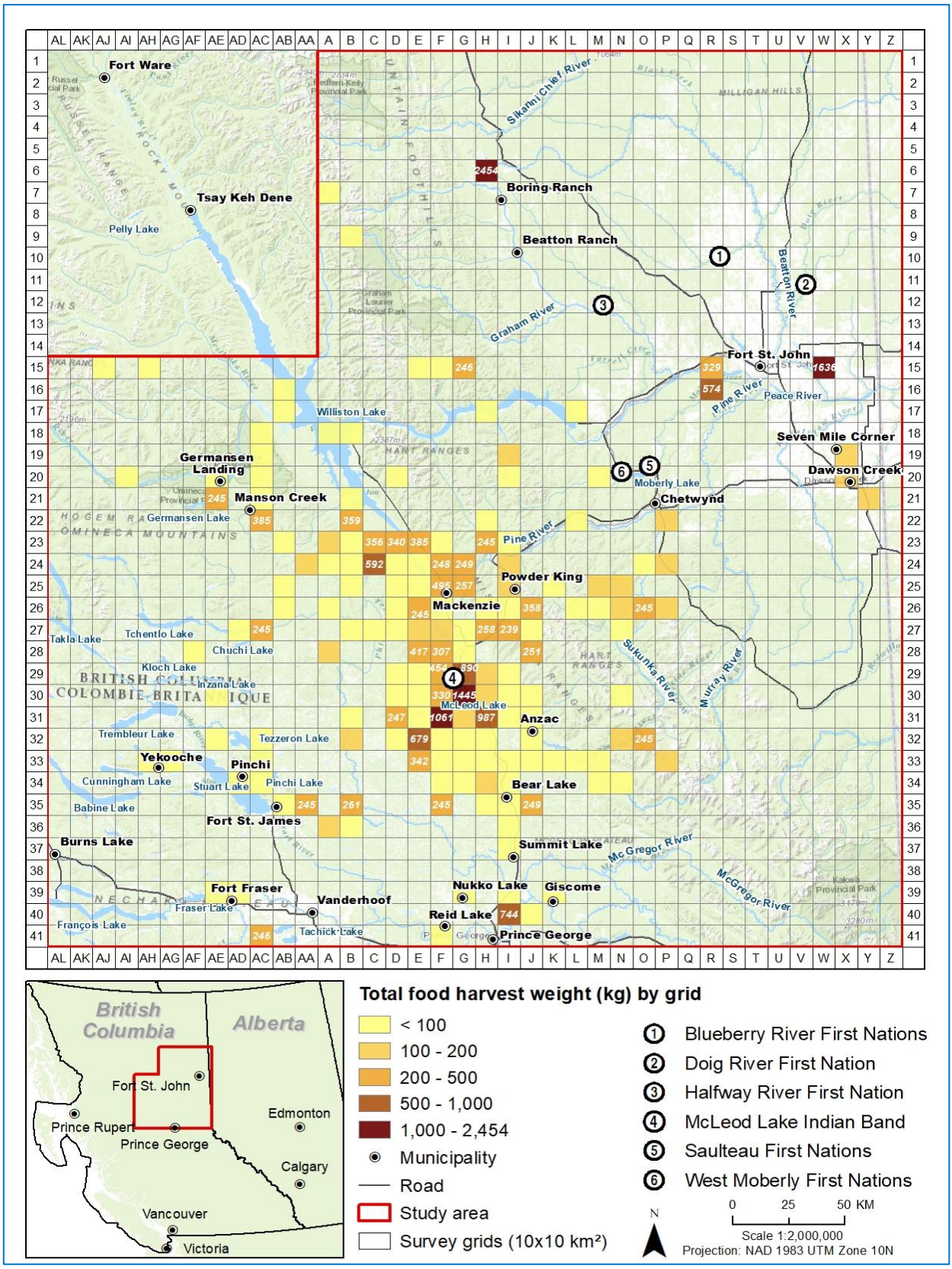


Figure 9. Spatial Distribution of MLIB Harvest

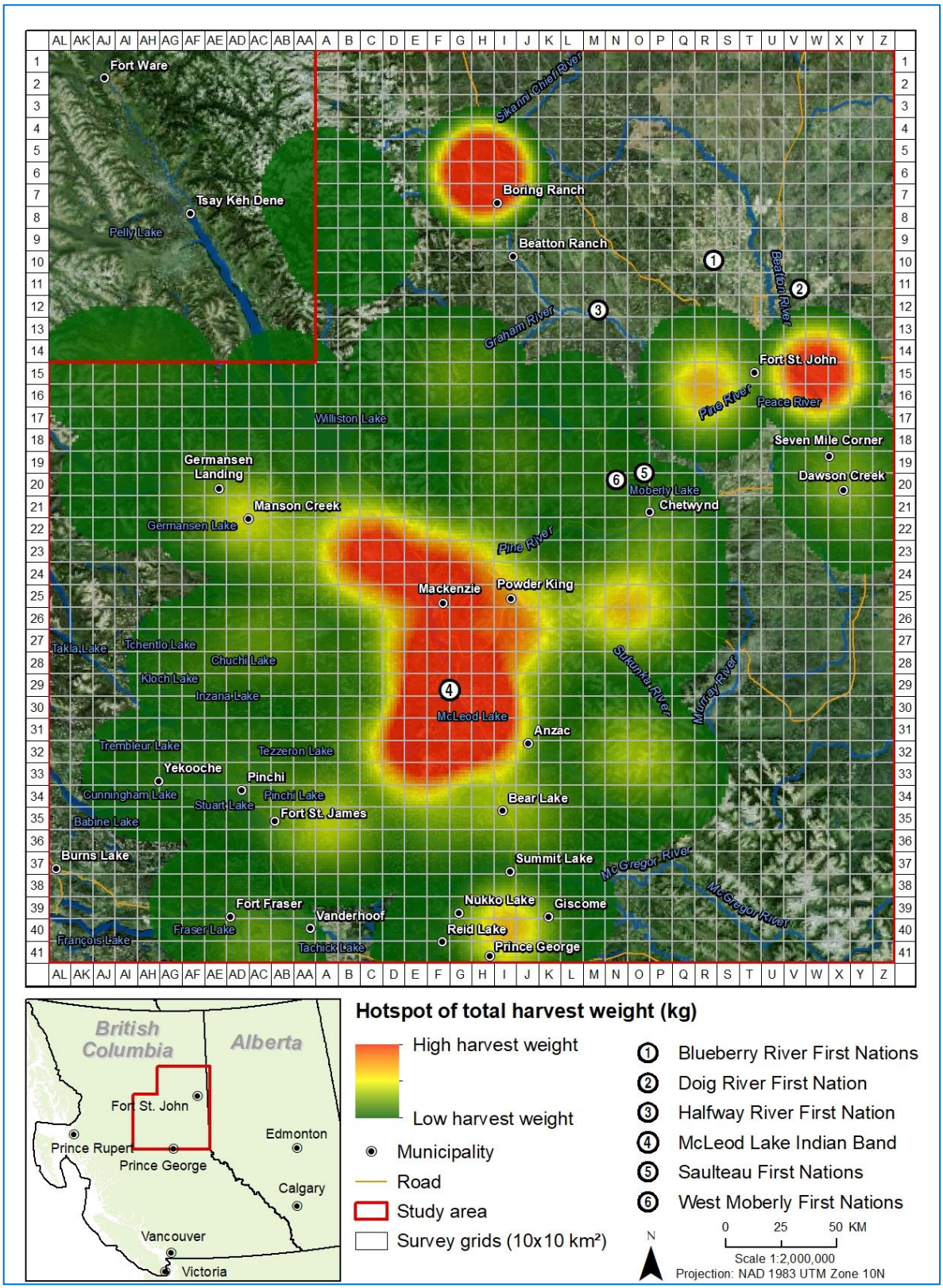


Figure 10. MLIB Hotspot Map of Harvesting Concentration and Distribution

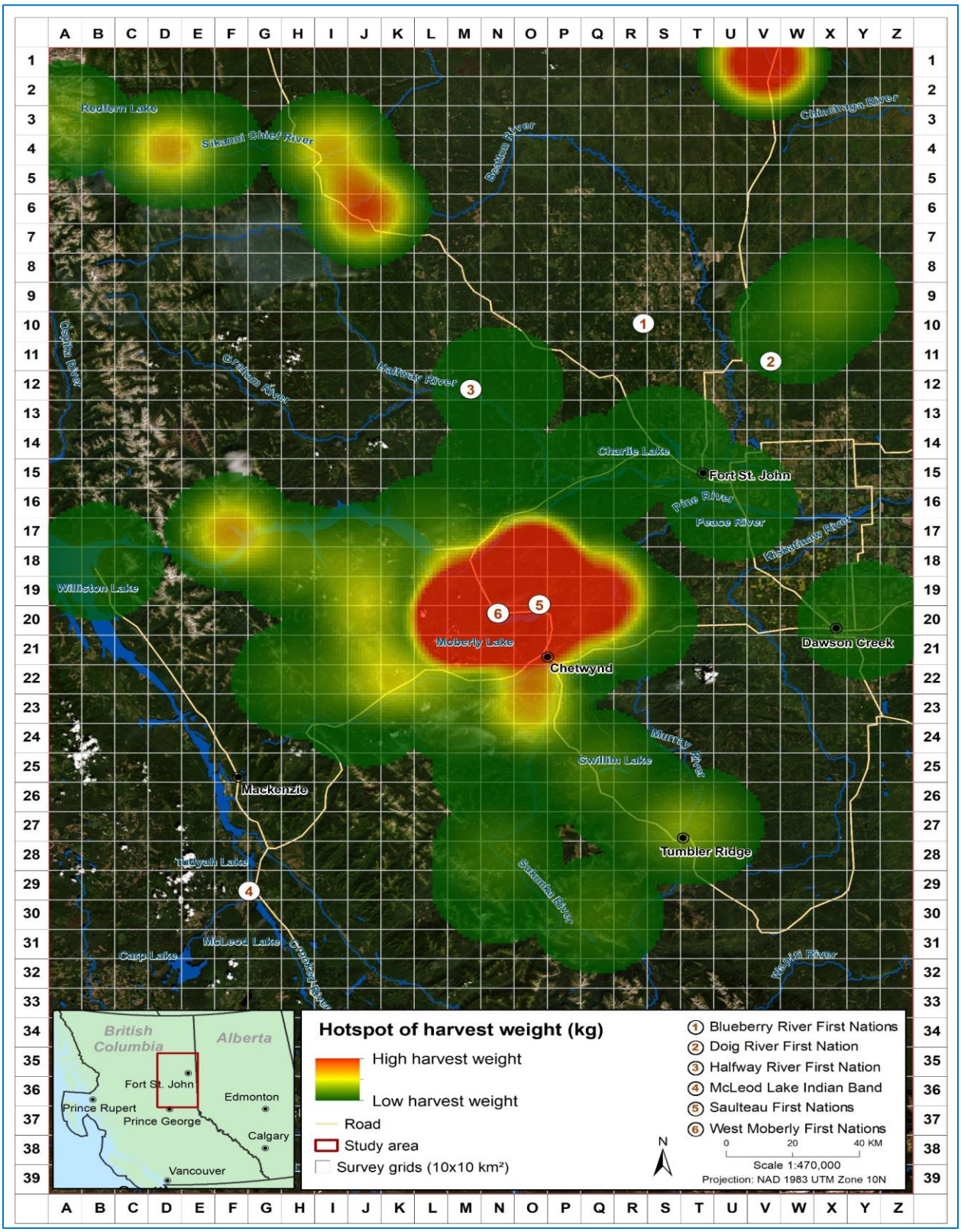


Figure 11. SFN Hotspot Map of Harvesting Concentration and Distribution.

As can be observed, there are anomalies (deviation from the conceptual homogeneous model) in First Nations land use. At a conceptual level, with no constraints or preferences, the harvest zone distribution would be homogeneous. However, in practice the directional orientation of SFN harvesting shows considerable heterogeneity. This directional orientation is captured in Figures 12 and 13 below. In the case of SFN (Figure 12) there is no directional preference in land use within 20 km, with more or less even spatial distribution Within 40 km, the directional orientation of SFN harvesting begins to orient towards the west and northwest. This orientation is influenced by existing industrial and agricultural development to the east of the SFN reserve, which has restricted SFN access and regular use. The spatial distribution of harvesting patterns also indicates that during the survey year roughly two-thirds of SFN harvesting occurred within a 100 km radius of the SFN community. However, more distant locations were also used, in some cases, to target specific species (i.e., bison hunting that occurred 220 km to the northwest) and in other cases to affirm cultural connections with specific places on the land. Similar distributional patterns can be observed in Figure 13 for MLIB.

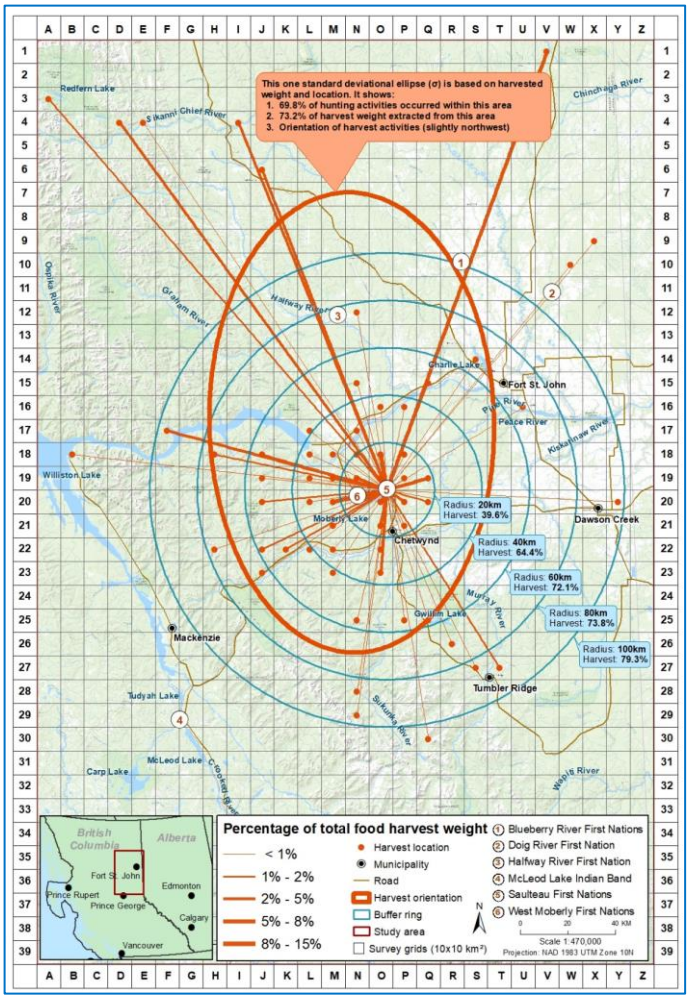


Figure 12. Directional Orientation of SFN Harvesting

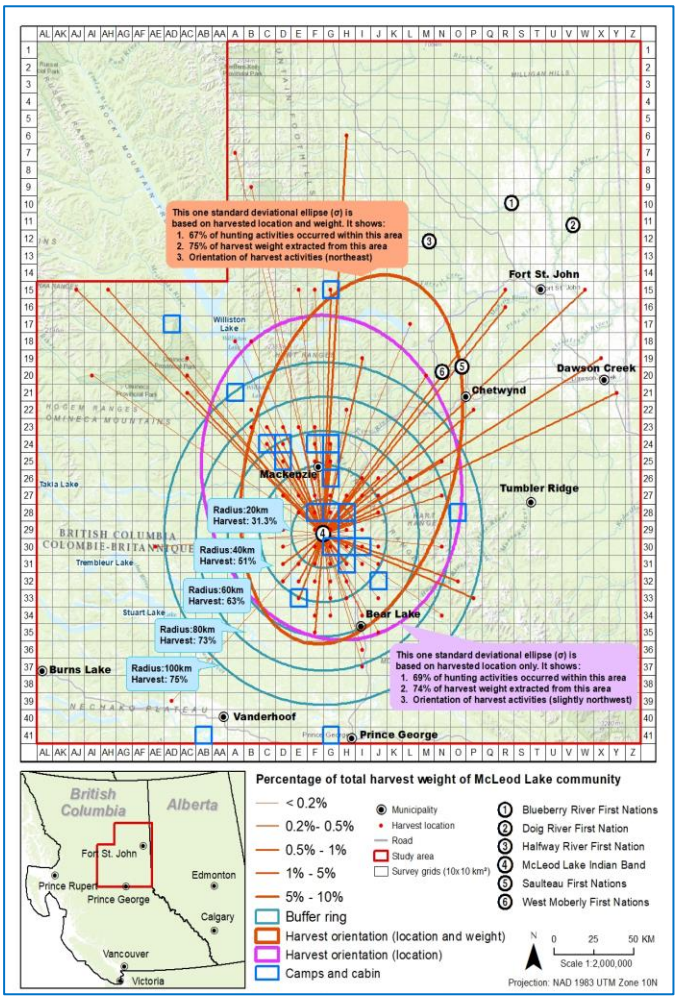


Figure 13. Directional Orientation of MLIB Harvesting

5.0 RESOURCE COMPETITION

Moose represent the primary subsistence resource for First Nations households. The moose harvest provides approximately 43,671 kg of meat annually. However, competition with sport hunters has reduced the availability of moose to First Nations, resulting in nutritional, economic and cultural impacts. In the five Management Units located immediately around the MLIB reserves (IR 1 and 5) (7-16, 7-23, 7-24, 7-29, and 7-30), sport hunters killed 411 moose in 2017. In the same MUs, MLIB hunters killed only 33 moose. This equates to nearly 12:1 moose killing rate of sport hunters to MLIB hunters. MU 7-24, where MLIB reserves is located, is the most productive zone for MLIB hunters who harvested 13 moose harvested in 2017. In the same year, sport hunters killed 131 moose from that same Management Unit. Although the number of moose killed by sport hunters varies by year, an average of 138 moose are killed annually by sport hunter in MU 7-24 (Figure 14).

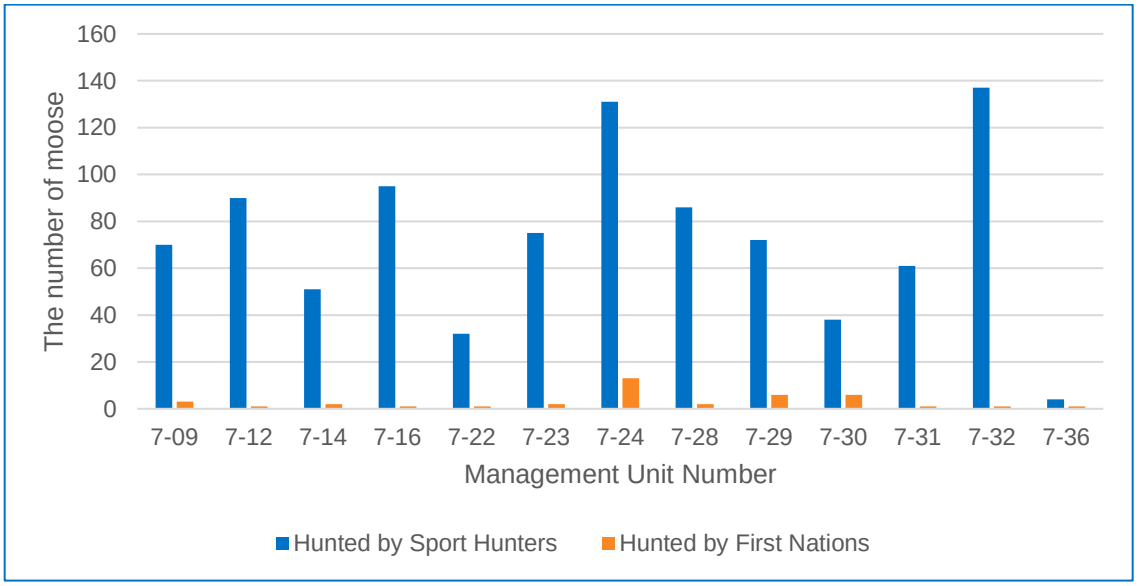
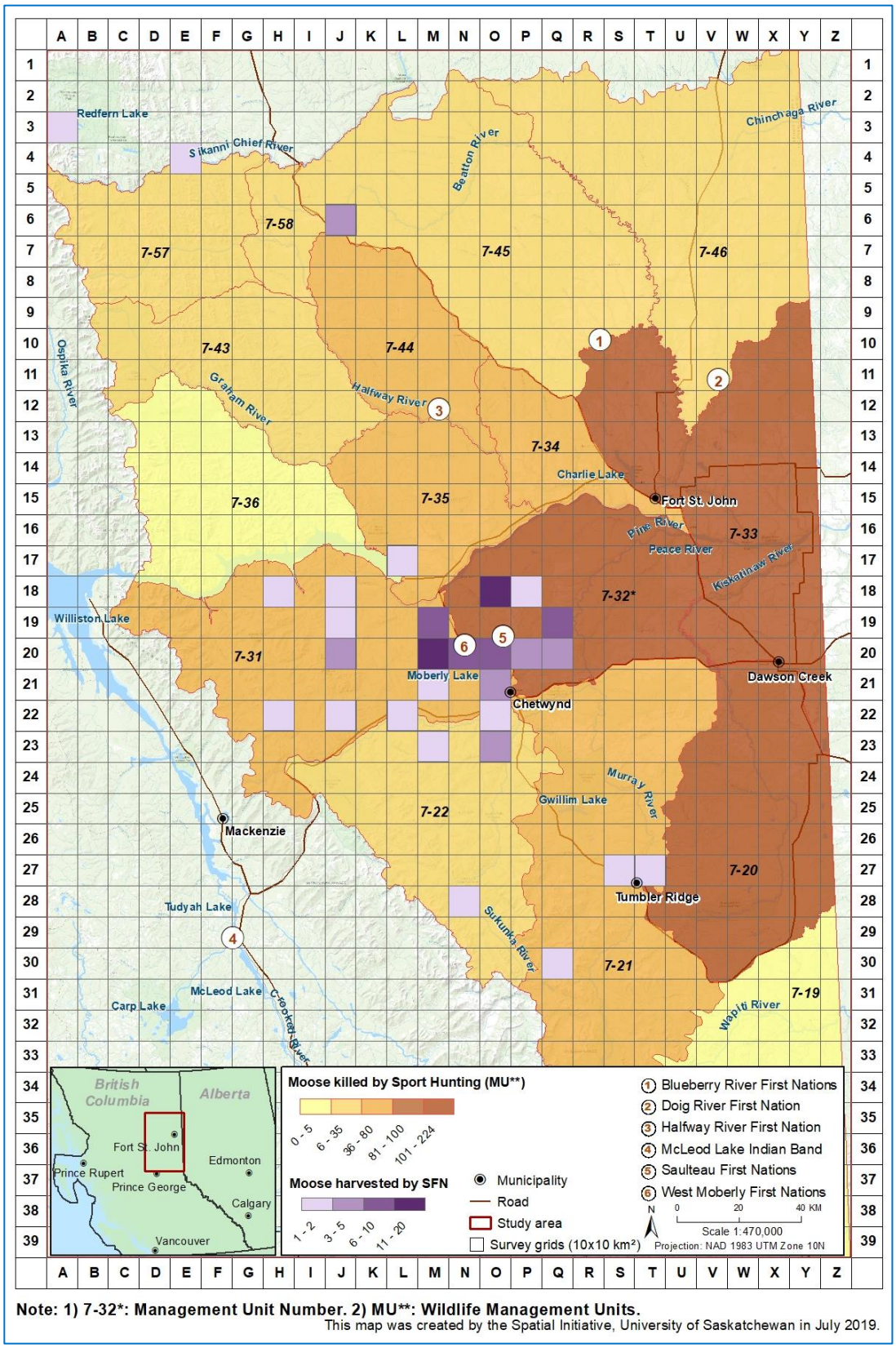


Figure 14. Sport and MLIB Subsistence Moose Hunt Comparison (2017)

Similar competitive conditions were found in the SFN territory. Historical sport hunting data shows that on average 1,000 moose are killed in the SFN traditional territory (16 Management Units). In the 5 Management Units located directly around the SFN community, sport hunters killed 304 moose in 2017 (Figure 15).



Note: 1) 7-32*: Management Unit Number. 2) MU: Wildlife Management Units.**
This map was created by the Spatial Initiative, University of Saskatchewan in July 2019.

Figure 15. Sport and Subsistence Moose Hunting in the SFN Territory

The most obvious impact of sport hunting is that it has significantly reduced the moose population in the vicinity of the SFN community, limiting the number available to SFN hunters and households. The increased presence of sport hunters has also contributed to more frequent contacts with SFN hunters, resulting, in some cases, tensions and conflicts. These two factors have forced many SFN hunters to expand their hunting areas in order to improve the likelihood of hunting success but also to avoid conflicts. The less observable impacts of sport hunting are the effects experienced by First Nations hunters who lack the means to access more distant and less pressured areas. This has a direct impact of household food security, particularly among those households who are already vulnerable to economic and environmental disturbances. Losing regular access to local hunting areas, has also limited the opportunities of First Nations youth to participate in hunting and other land-based activities; thereby limiting the acquisition of knowledge that will enable them to secure environmental resources in the future and maintain a cultural connection with their traditional lands. Together, the impacts of sport hunting near the MLIB and SFN communities has had social, economic, nutritional and cultural impacts that are limiting opportunities for First Nations to maintain an adequate environmental livelihood.

Participants were also asked to provide additional comments to supplement their survey responses regarding the perceived impacts of industrial development. These results are summarized as a word cloud figure, with the most frequently cited concerns scaled accordingly (Figure 16). Responses from MLIB members indicate that that industry, especially logging and its associated activities, are a major constraint wildlife harvesting.

Figure 16 Industrial effects on plant and animal harvesting: word cloud comments.

Major industrial activities and recreation sites in the study area are shown in Figure 17; they include logging, oil and gas extraction, a transmission line, power line, mining activities and recreation sites. Logging activities are more pronounced towards the southwest of the study area, which also is found across MLIB's harvesting area. Oil and gas industries are concentrated on the northeast side of the study area.

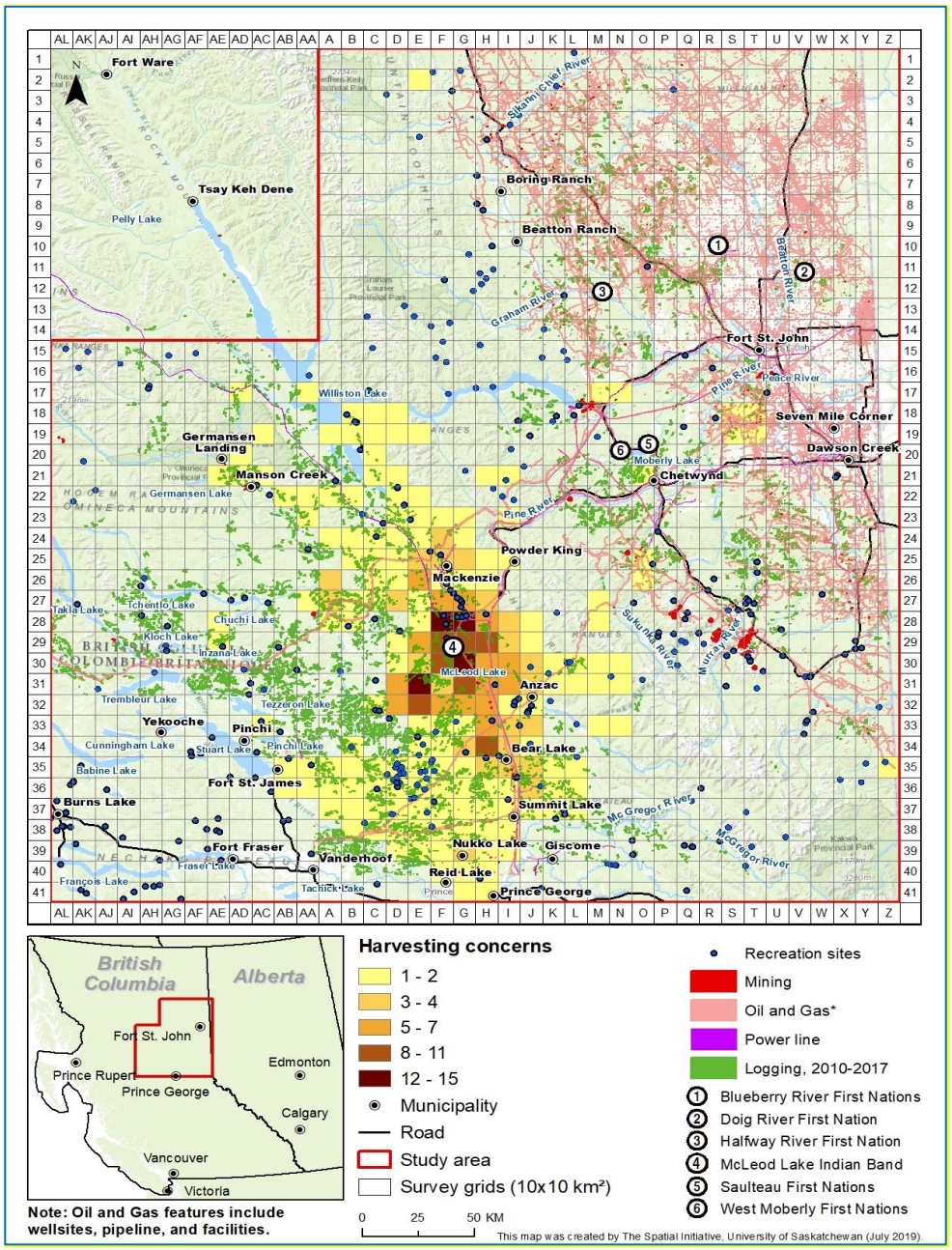


Figure 17 Existing industrial activities in study area.

When asked about opportunities for MLIB youth to spend time on the land, the majority of respondents (93%) believed that the younger generation had less opportunity than the present generation.

6.0 THRESHOLDS AND IMPACT SCENARIOS

6.1 Harvesting-Industrial Threshold Analysis

As described above, the Harvest Utility Index (HUI) and the Industrial Disturbance Index (IDI) were used to examine the interactions between First Nations harvesting and industrial disturbances. To examine the interactions between First Nations harvesting and industrial disturbances, the HUI and IDI maps were created and then overlaid and combined into a composite image, or a threshold map. The HUI and IDI were classified into high, medium and low categories respectively. The threshold map shows the intensity of harvesting related activities ranges, and can be interpreted as follows: (1) black areas indicate low industry disturbance and low harvest intensity (LDLH); (2) bright green areas show the presence of high industry disturbance and low harvesting related activities (HDLH); (3) bright red areas depict low industry disturbance and high harvesting activity (LDHH); (4) bright yellow areas, a mix of bright green and red, indicates high in both industry disturbance and harvest activities (HDHH). Figure 18 delineates the regions of conflict between industrial activity and First Nations harvesting activity. For example, for MLIB, areas of conflict (in yellow) are in close proximity (10-20 km) to the MLIB reserves (G27 and H31), where both industrial disturbance and harvest activities are high. Moderate conflict zones (orange) exist northeast of MLIB (G28-H29), where medium industry disturbance and high harvest activities present. The red area to the southwest of MLIB (E29-33, F30-32) and AE17 are important hunting zones, with little or no industrial disturbance (Figure 18).

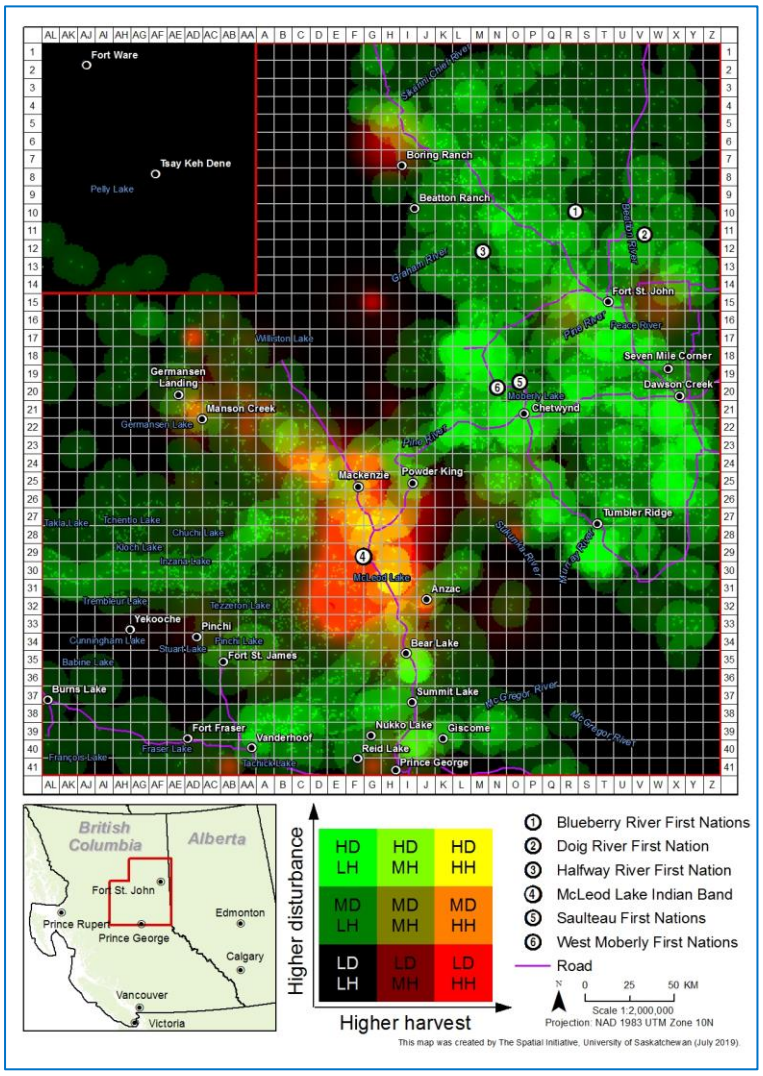


Figure 18. MLIB Harvesting-Industry Threshold Map

A similar threshold map was developed for SFN that shows areas of conflict are located around the SFN community (~ 40 km from its geographic centre). Other zones of significant conflict reside in grid M18 (Hudson's Hope) and grid K22 (Fisher Creek). High conflict zones exist west of the SFN community (L19, M19), in Chetwynd (N21, O21, N22, O22), and in Tumbler Ridge (T27). Grids A3 and D4 are important hunting zones, with little or no industrial disturbance; both grids are located far from the SFN community.

6.2 Scenario Planning

One of the primary objectives of this assessment was to develop scenarios that favor desired outcomes and best safeguard the environmentally based livelihoods of First Nations. While no scenario can provide a definitive portrayal of exactly what will happen in the future, the tools that have been developed serve as an effective starting point for exploring possibilities that are at least consistent with current knowledge and can serve as a platform for collaborative learning and conflict management. For the sake of this CCR, we consider the potential effects the Prince Rupert Gas Transmission (PRGT) pipeline may have on the environmental livelihoods of the SFN.

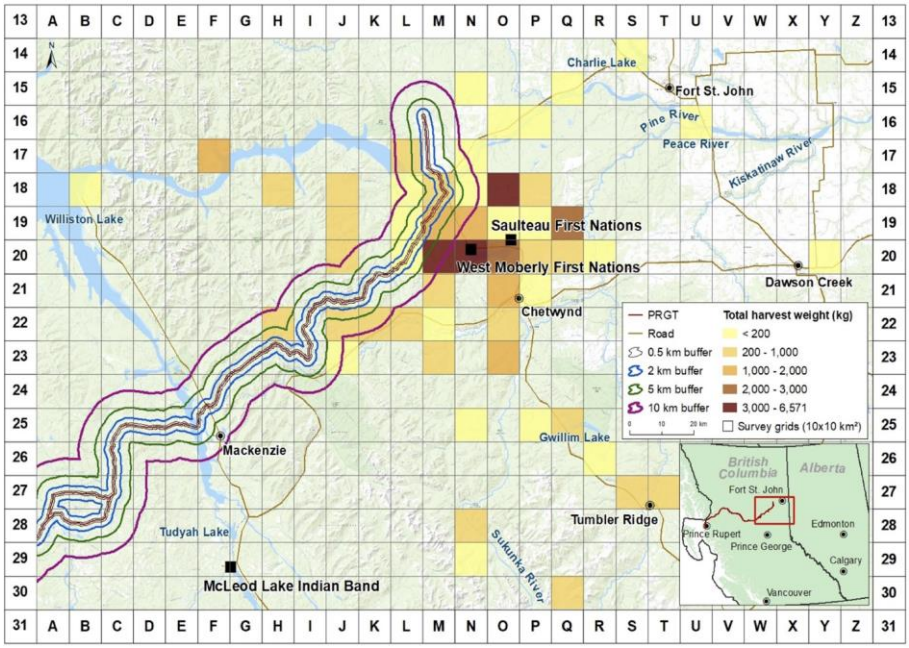


Figure 19. Proposed Route and Impact Display of the PRGT Pipeline

The planned route of the PRGT pipeline originates northwest of the SFN reserve and extends south before turning west to the Rocky Mountains and the British Columbia coast. The proposed route will affect several zones used by SFN hunters. These zones are shown in Figure 20, which identifies the effected zones at each of the four setback distances[2]. Based on the

[2] See Natcher, David C., Naomi Owens-Beek, Ana-Maria Bogdan, Xiaojing Lu, Meng Li, Shawn Ingram, Ryan McKay and Abigael Rice. 2021. Scenario Planning Tools for Mitigating Industrial Impacts on First Nations Subsistence Economies in British Columbia, Canada. *Sustainability Science* (on-line first) https://doi.org/10.1007/s11625-021-00969-0.

four setback distances, the construction of the PRGT pipeline will affect 4 harvest zones within a 500 m setback, 8 zones at a 2,000 m set back, 15 zones at 5,000 m, and 17 zones at a 10,000 m setback.

At the most conservative setback distance (500 m), harvesters from 6 SFN households (8%) would be negatively affected by the construction of the PRGT pipeline, whereas 19 households (20%) would be negatively affected by a 10,000 m setback (2,000 m = 10 affected households; 5,000 m = 17 affected households). At these setback distances, it is estimated that the SFN food harvest would be reduced by 4% (2,262 kg) to 24% (13,348 kg). For example, at a setback distance of 2,000 m, the total food weight harvested by SFN hunters would be reduced by 9,812 kg, or an estimated 18% of the total SFN food harvest. This includes a 7,595 kg reduction in the SFN moose harvest (Table 7). With moose serving as a primary food source for SFN households, this reduction could potentially jeopardize the food security of some SFN households. Compounding this impact is the reduction (27-28%) in small mammal harvest (e.g., rabbits, squirrels), which are often targeted by younger (20-29 years of age) and older (+65 years of age) households that lack the labour or financial resources to target larger and more geographically dispersed species.

Table 7: Estimated Decrease of the Saulteau First Nation Wild Food Harvest, Measured in Kilograms (kg) of Edible Food, Given Setback Distances for the Prince Rupert Gas Transmission (PRGT) pipeline.

	500 m	**2,000 m**	**5,000 m**	**10,000 m**
Moose	1,715	7,595	8,380	9,065
Lg. Mammals	138	1,770	3,899	3,899
Sm. Mammals	353	361	361	369
Fish	49	64	72	88
Birds	7	22	27	28
Total Reduction	2,262 (4% reduction)	9,812 (18% reduction)	12,739 (23% reduction)	13,449 (24% reduction)

A subsequent effect of the reduced harvest involves diminished frequency of food sharing and a reduction in the number of households participating in food exchanges. Figure 13 shows that under each scenario, food sharing could decline by 4% to 20%, with 10 to 35 households being negatively affected. At a 2,000 m setback, the frequency of food exchanges would decline by 16% (N=23 exchanges), negatively affecting 38% of SFN households (N=30). Furthermore, 7 households would be excluded entirely from the SFN food sharing network. At a 10,000 m setback, the impacts are even more pronounced, with a 20% decline in food sharing frequency affecting 35 households, 9 of which would be excluded entirely from food sharing (Figure 21).

Those households most affected by the reduction in food sharing tend to be those most vulnerable to economic insecurity. These households are overly represented by younger (20-29 years of age) and older (+65 years of age) households that harvest little to no wild foods of their own and have limited wage-earning involvement. In these cases, receiving food from other households contributes in a large part to their social, cultural, and economic security.

500 m	Number	Percent
Households	10	12.7
Exchanges	6	4.2

2,000 m	Number	Percent
Households	30	38.0
Exchanges	23	16.0

5,000 m	Number	Percent
Households	31	39.2
Exchanges	26	18.1

10,000 m	Number	Percent
Households	35	44.3
Exchanges	29	20.1

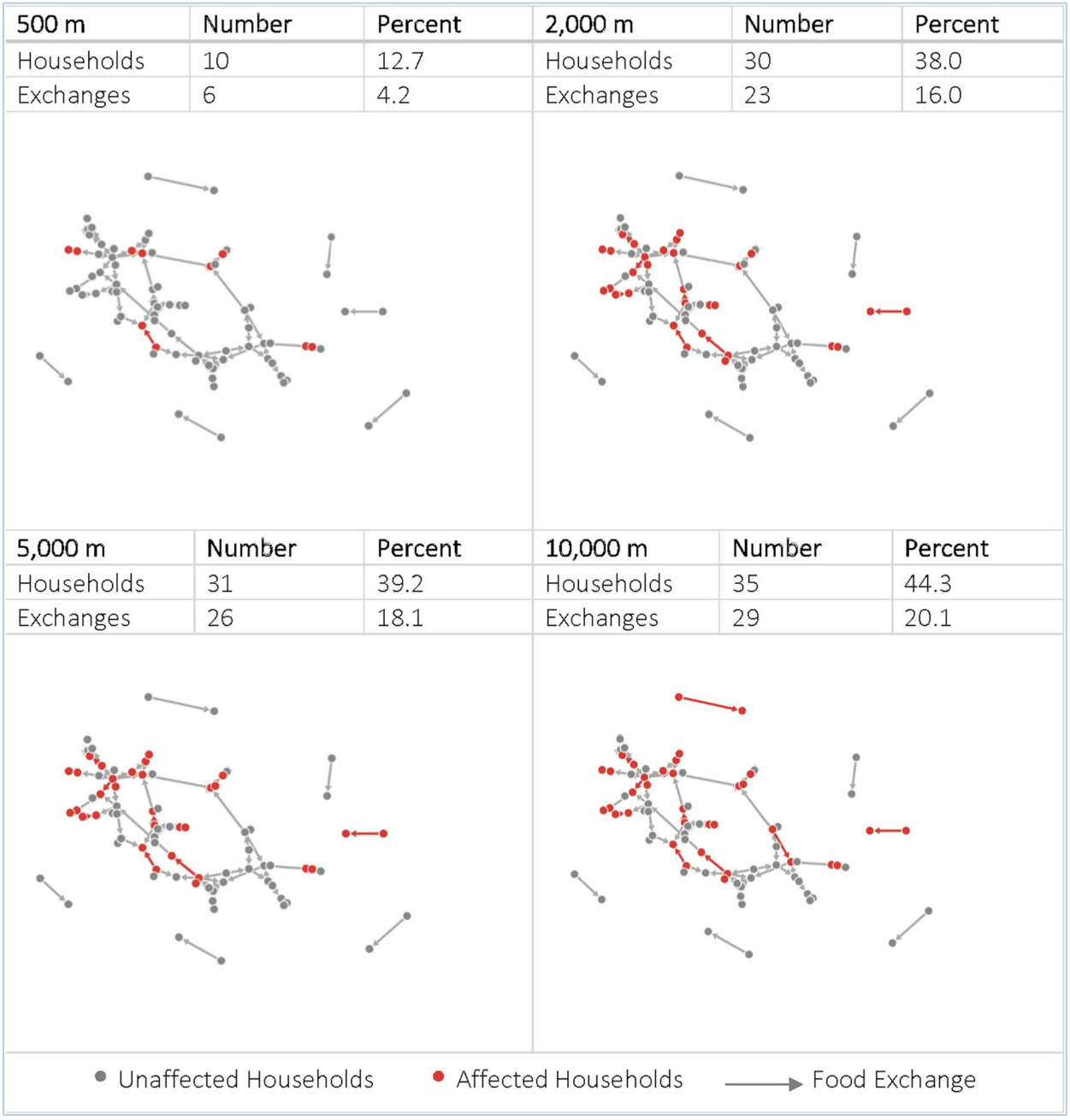


Figure 20. Estimated Impact of the PRGT Pipeline on SFN Food Sharing

The use of several different scenarios can further identify the synergies and trade-offs between possible development and mitigation options. In doing so, it will also be necessary to consider the cumulative and historical impacts of past developments which have already constrained First Nations land use to a significant degree (Table 8).

Table 8. Examples of Scenario Outputs

Prince Rupert Gas Transmission Pipeline	• With a 2 km buffer around Prince Rupert Gas Transmission pipeline, the SFN harvest weight is estimated to decrease by 18%, with an estimated 10,000 kg of traditional food lost. Moose would be the most impacted, with the potential harvest reduced by 7,600 kg (24%). Thirty-eight percent of SFN households would experience declines in their food harvest, and food sharing originating from impacted zones will be diminished by 16%.
	• With a 2 km buffer around Prince Rupert Gas Transmission, the MLIB food harvest weight is estimated to decrease by 5.6%, with an estimated 1,504 kg of traditional food lost. Moose harvesting would be the most impacted, with the potential harvest reduced by 1,225 kg (11%). An estimated 9% of MLIB households would experience declines in their food harvest, and food sharing originating from impacted zones will diminish by 3.4%.
Coastal GasLink pipeline	• Within a 2 km buffer around the Coastal GasLink pipeline, the SFN could experience an overall loss in harvested food weight to be 1,200 kg (2%), with a 3% loss in the moose harvest. Food sharing will not be significantly impacted.
	• Within a 2 km buffer around the Coastal GasLink pipeline, the MLIB could expect an overall loss in harvested food weight to be 1,442 kg (5.4%). An estimated 6% of MLIB households would experience declines in their food harvest, and food sharing originating from impacted zones will diminish by 2.5%.
Westcoast Connector Gas Transmission Pipeline	• Within a 2 km buffer distance around the Westcoast Connector Gas Transmission pipeline, the MLIB food harvest could decrease by 7.4%, with an estimated 1,990 kg of traditional food lost. Moose harvesting would be the most impacted, with the potential harvest reduced by 1,715 kg (15.9%). An estimated 8% of MLIB households would experience declines in their food harvest, and food sharing originating from impacted zones will diminish by 2.7%.

7.0 DATA MANAGEMENT

To facilitate collaboration within the RSEA Project Team, a 2D and 3D web-based data management platform was developed that can store, managing, and visualizing spatial data. The 2D and 3D tools are integrated within a single web-based platform that is password protected and can be accessed remotely from any Web browser. The 2D visualization platform displays data derived from each of the spatial analyses. At larger scales, the 2D platform provides an overall view of the study area and allows for spatial queries, such as: (1) what is the proposed route of a pipeline?; (2) how many hunting zones will be affected after development?; (3) what impact will development have on total food weight harvested?; and (4) how will food sharing between households be affected? Additional information regarding specific zones can also be accessed by clicking on 'zone of interest.' The data viewer contains all the queried information and is a single and accessible portal for viewing and updating the raw data (Figure 22).

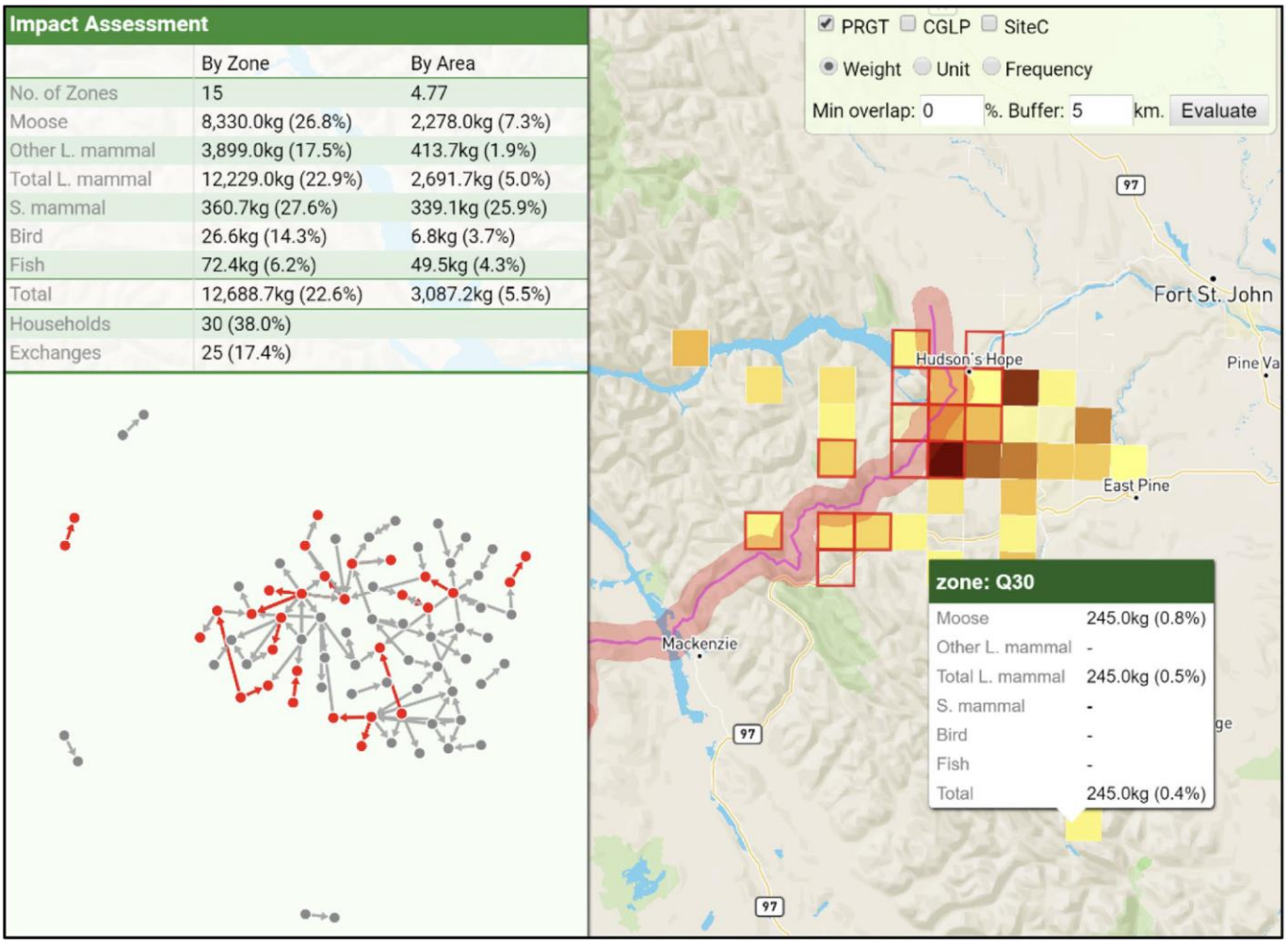


Figure 21. On-Line 2-D Data Viewer

The 3D visualization is more interactive and allows for analyses at finer scales (Figure 23). These scales provide an animated view of locations, and to a certain extent brings the 'real world' into desktop and mobile devices. At finer scales, the 3D application allows for a more informed understanding of a potential impact on a specific place or landscape (i.e., harvest location, critical habitat, and cultural sites). Users can scroll through the map to gain new perspectives on terrain, existing infrastructure, or critical sites that are valued by SFN members. This 3D application also allows users to visualize harvesting locations in different viewing scales and dimensions. This information can then be used in scenario planning exercises that engage government, industry, and community members in a collaborative learning and planning process.

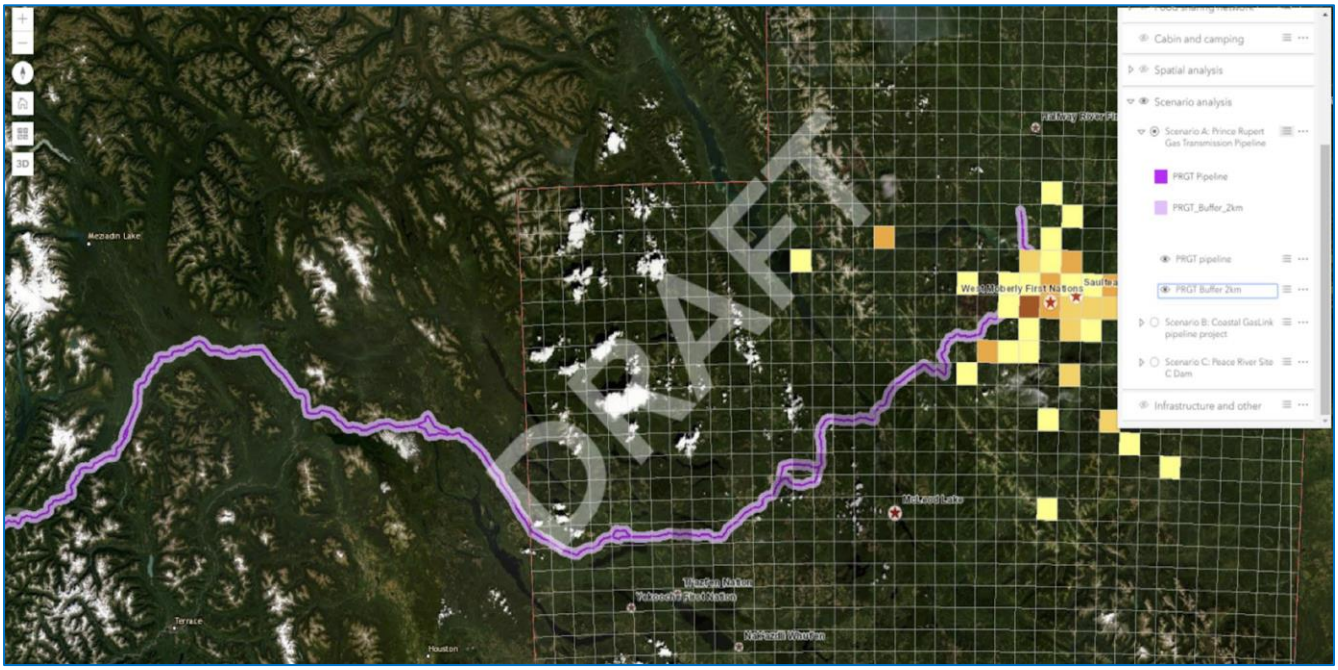


Figure 22. On-line 3-D Data Viewer

8.0 SUMMARY

In 1981, Hugh Brody asserted that, "if the cultural and economic distinctiveness of First Nations are to be respected and guaranteed into the future, then their hunting territories must also be recognized and protected" (1981, p.276).[3] Forty years after making this decree, First Nations and the provincial government are still discussing how best to reconcile competing interests in the land. For the SFN, MLIB, and WMFN there is

[3] Brody H (1981) Maps and Dreams. Illinois, Waveland Press, INC.

cautious optimism that RSEA for northeast British Columbia can be used to mitigate the negative impacts First Nations may experience from future resource development. If achieved, this may serve as a meaningful step towards reconciling the political and environmental injustices of the past.