Regional Broadband Strategy

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1 EXECUTIVE SUMMARY

The Regional District of Fraser Fort George ("RDFFG" or the "Regional District"), the District of Mackenzie ("Mackenzie"), the Village of McBride ("McBride") and the Village of Valemount ("Valemount") need broad access to broadband connectivity at the CRTC universal service objective of 50 million bits per second download speed and 10 million bits per second upload speed ("50/10" or the "USO") and that need has been highlighted even more in the current global pandemic. TANEx has completed a current state analysis, identified areas of focus and understands the goals of RDFFG, Mackenzie, McBride and Valemount from a high-speed broadband connectivity perspective.

According to federal government data, just over 30% of households and businesses in the RDFFG Electoral Areas and Mackenzie, McBride and Valemount are served at the USO. While that data also suggests that the Municipalities are served at the USO, public feedback and performance testing data does not consistently bear that out. As a result of that data, the Municipalities will have difficulty establishing eligibility for the government funding programs that are often required to obtain improved service.

This project identified nearly 60 identified project areas in the RDFFG over a large geographic area. While some initiatives are currently underway that may address some areas of the region, a large number will still exist even once complete. Some are considered remote and perhaps are realistically suited to technologies such as wireless and emerging satellite technology. Removing those from consideration, there are still many located along major corridors that should not be underserved considering the availability of already existing core infrastructure.

To move towards your vision of a region where technology connects residents and supports their access to education, health, commerce and lifestyle services through the provision of affordable, high-speed internet technologies, regardless of where they live, TANEx recommends the following steps:

- Prioritize specific project areas and assess them for feasibility and ability to collaborate between the Municipality and the Regional District or with other jurisdictions such as neighbouring Regional Districts or First Nations.
- Decide what the Local Governments are prepared to do to get improved connectivity. This does not necessarily mean becoming a service provider but could include a role of coordination, facilitation and financing flow through.
- Confirm and correct the service levels indicated by federal eligibility maps. The ability the obtain access to large pools for funding is critical to deploying improved connectivity, particularly to the Municipalities.
- Leverage opportunities with other like-minded organizations. These opportunities must be exploited to not only bring a level of service not available in other rural areas of the province but also set a baseline of the level of service all residents of the RDFFG and BC should aspire to.

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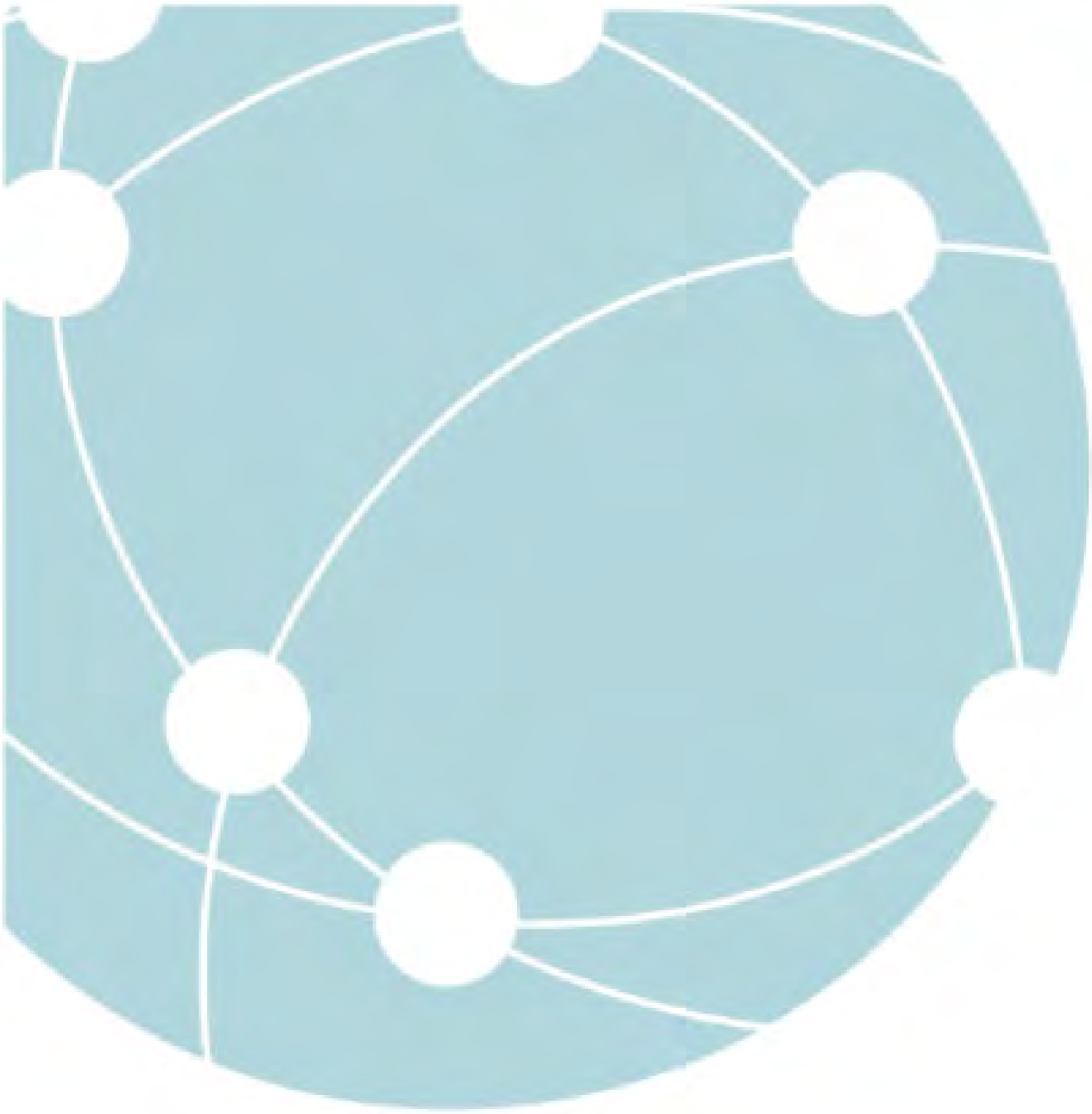

2 INTRODUCTION

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2.1 Purpose and Organization of Report

In this report, Mackenzie, McBride and Valemount are sometimes collectively referred to as the "Municipalities" and the Municipalities and the RDFFG together are referred to as the "Local Governments".

This report provides a strategy for the Local Governments to develop options for residents and businesses that do not already have broadband service at the CRTC universal service objective of 50 million bits per second download speed and 10 million bits per second upload speed ("50/10" or the "USO") to get that service. It also identifies the strategic steps for Local Governments to take in advancing that initiative.

The report is organized to step the reader through relevant background information about the RDFFG as a whole, the Local Governments' vision for the region, a summary of the current state of connectivity and the steps that can be taken to improve broadband connectivity. In doing so, it identifies strategic considerations and summarizes funding sources and provides high level budgetary cost estimates.

A separate section has been created for the RDFFG Electoral Areas as well as a section for each Municipality which provides a short summary of public feedback in the area, illustrates and summarizes the project areas within the region, and provides specific strategic considerations for that particular region.

2.2 Intended Audience

This report is intended to be utilized internally by Local Government staff and elected officials for education, guidance, and planning purposes to support decision making and advocacy efforts to improve access to, and availability of, high speed connectivity throughout the Local Governments' jurisdiction. This regional connectivity strategy has been provided along with ancillary supporting information and documentation to the Local Government for their sole benefit and reference. It is not intended to be relied upon by third parties without TANEx's consent.

2.3 Project Scope & Assumptions

The project had four primary focal areas -- the three municipalities of Mackenzie, McBride and Valemount as well as the rural communities throughout Electoral Areas of the RDFFG. It included an assessment of existing broadband connectivity throughout the region and then developed a strategy for improvement. The RDFFG focus was on the rural communities throughout the Electoral Areas whereas the focus of the Municipalities is on the areas within municipal jurisdiction.

Additionally, the information gathering on this project included efforts to reach out to rural First Nations in the area to obtain information about connectivity on populated reserve lands but assessing and creating a strategy for improved connectivity on First Nations lands was not within the scope of this project. Finally, while the project included consideration of cellular coverage as it pertains to broadband connectivity, creating a strategy specifically to increase cellular coverage was outside the scope of the project.

2.4 General Approach

TANEx and Local Government resources worked collaboratively to complete the strategy through its various phases. At a high level, developing this strategy included a series of activities including project

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kickoff, information gathering, public and stakeholder outreach, data analysis, strategy development, presentation of draft strategy to the elected officials of the Local Governments, receiving feedback, and ultimately, report preparation and finalization.

The current state of broadband connectivity was assessed by:

- undertaking public domain research;
- survey of area residents and businesses;
- direct outreach to service providers and stakeholders;
- direct outreach to rural area First Nations where possible.

An analysis of the difference between the current state of connectivity and the future desired state was completed. An analysis of alternatives to fill those gaps was completed and then a draft strategy was prepared and reviewed with the Local Government project team. The draft strategy incorporated feedback from the project team and was then presented to the elected officials of the Local Governments.

2.5 Impact of COVID-19 on the Project

This project was completed during the COVID-19 pandemic. While broadband connectivity has been a clear priority before the pandemic, the pandemic highlighted its importance even more clearly. Everyone, whether resident in a major metropolitan area or a tiny rural town, was forced to rely on connectivity to work from home, get access to healthcare services, and get an education among other things like running a business! The restart and success of the economy is highly driven by the ability to work remotely and be productive. The right to do so and engage in the economy belongs to every Canadian and connecting rural Canadians to effective, affordable and reliable broadband service must be of the highest importance as Canada navigates its way through the COVID-19 pandemic and the recovery from it.

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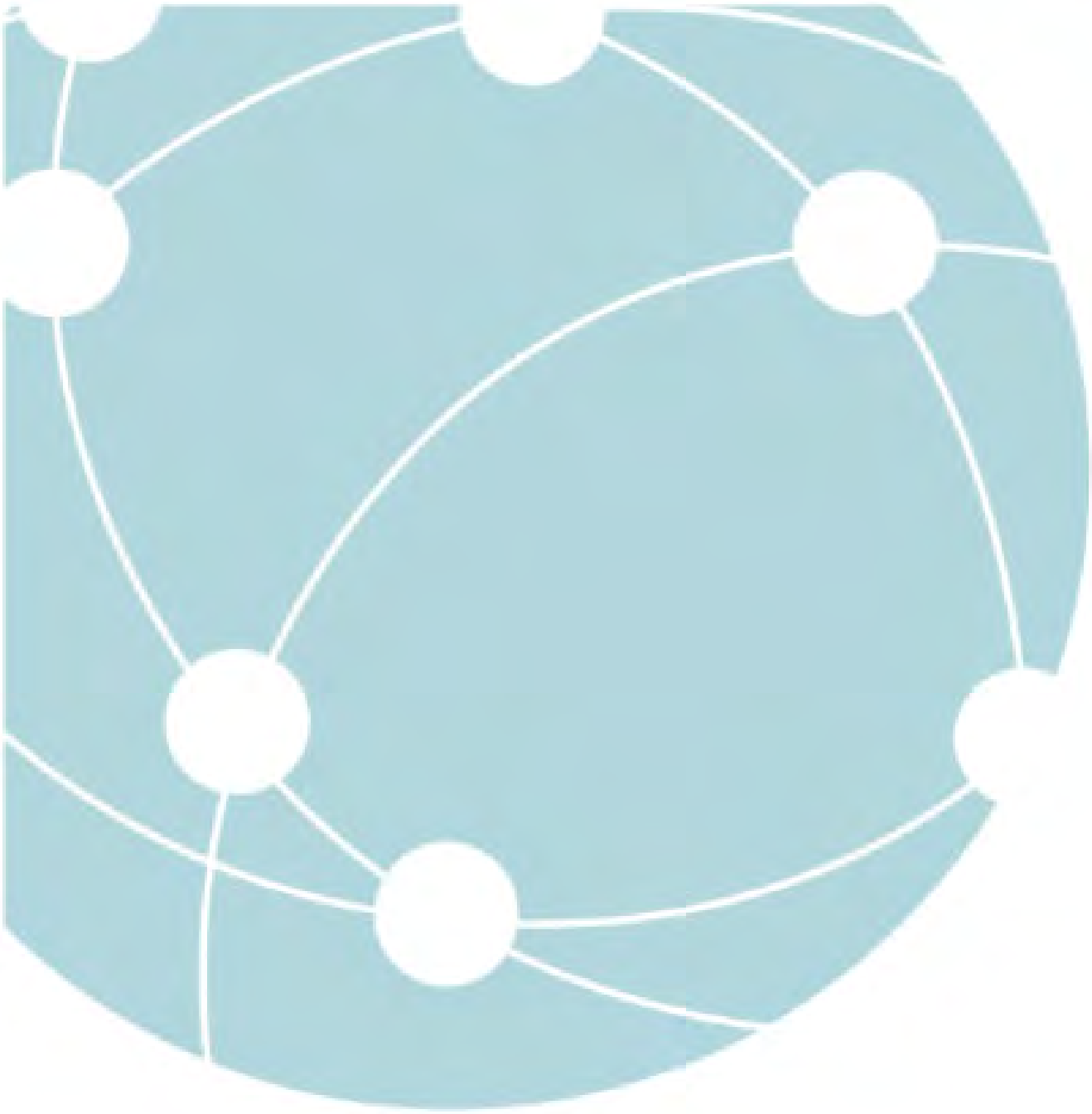

3 GEOGRAPHIC SUMMARY

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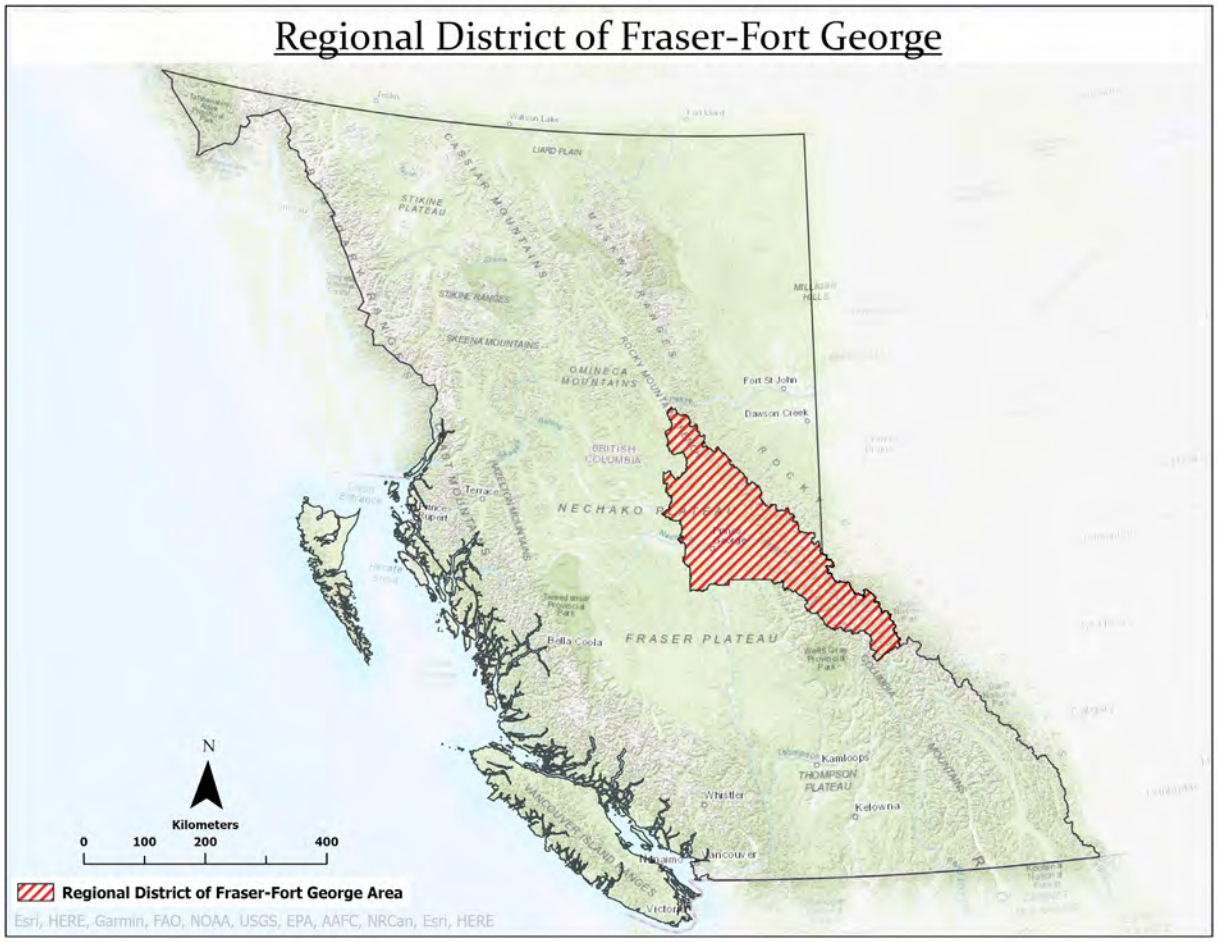
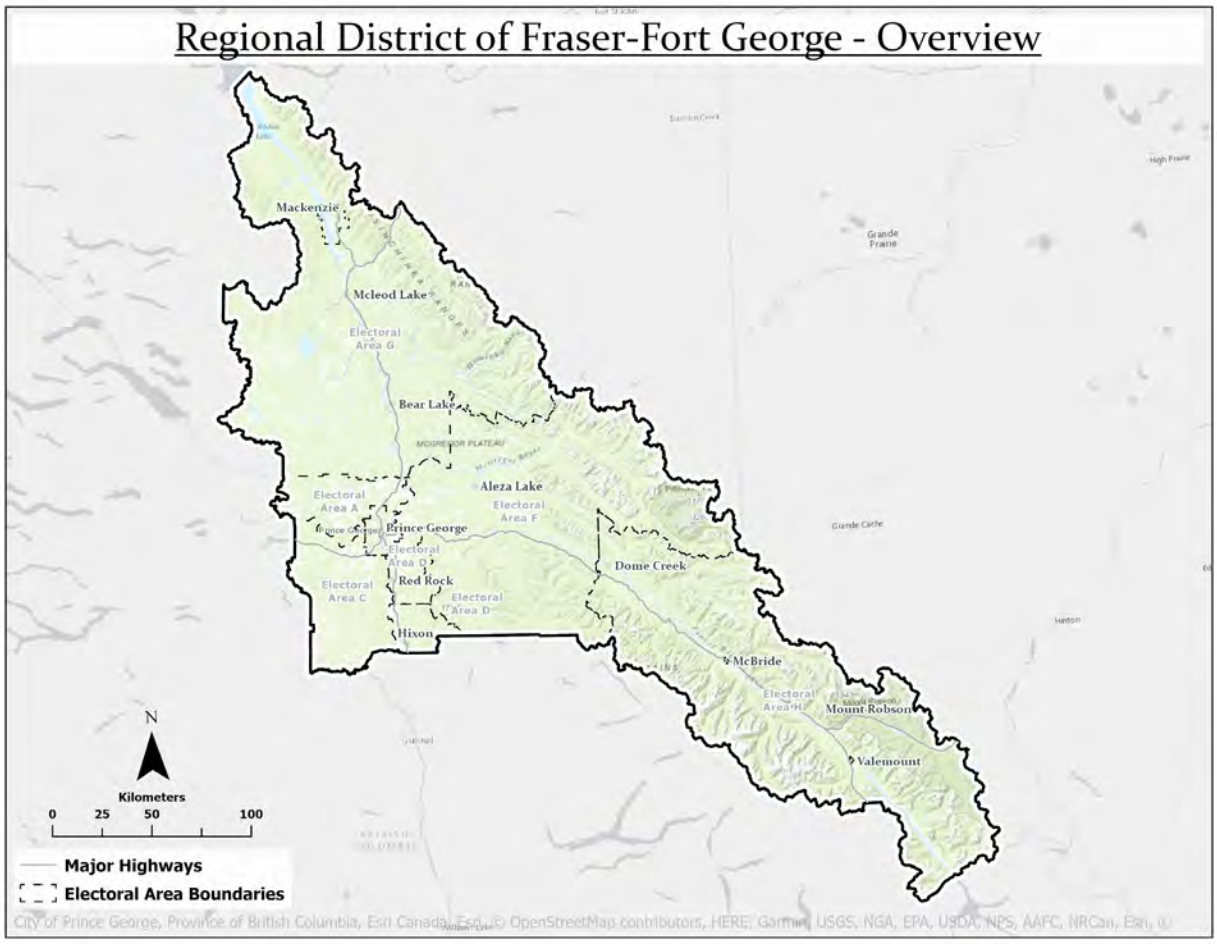
This section provides a background understanding of the Regional District as a whole and a lens through which to view this report, the strategy, and the recommendations.



3.1 Geographic Location

The Regional District is located on the central-eastern portion of the province of British Columbia. It is just over 50,000 km^2. It borders the Alberta border as well as the Peace River Regional District, the Regional District of Bulkley Nechako, Cariboo Regional District, Thompson-Nicola Regional District and the Columbia-Shuswap Regional District. Within the Regional District, Mackenzie is located in the north-western portion of the RDFFG while the Villages of McBride and Valemount are located in the south-eastern portion with Valemount south and east of McBride.



3.2 Population and Communities

The most recent federal census puts RDFFG's total population at 94,506, however, at the time of writing, those number are out of date with a new census scheduled to be done in 2021. BC's estimated population for the Regional District of 101,004 is more recent[1]. Population numbers noted below are drawn from the 2016 census data. Electoral Area population numbers do not include population from within the member municipalities nor from First Nations' reserve lands geographically located in that Electoral Area.

3.2.1 Member Municipalities

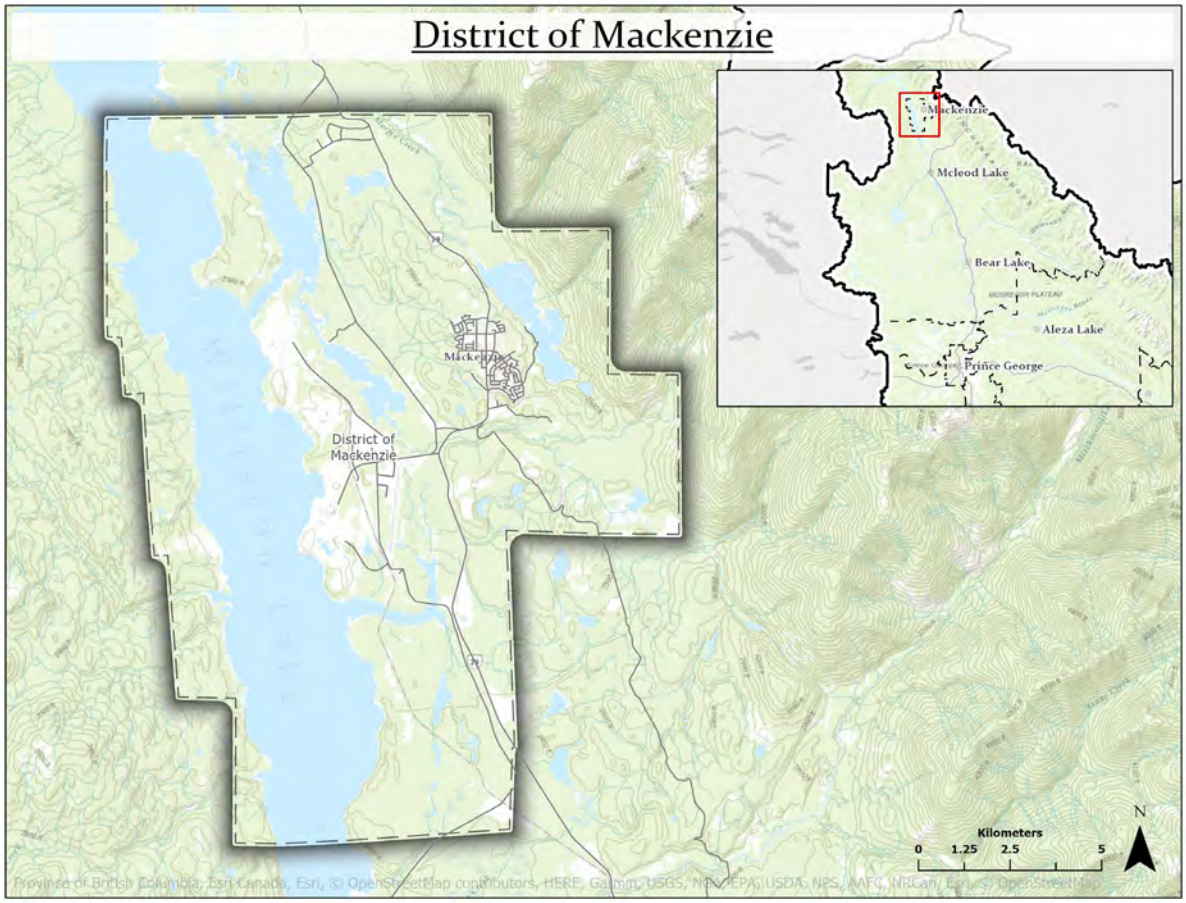
There are four member municipalities within the RDFFG, three of which were part of this project:

[1] Province of British Columbia – 2019 Population Estimate

Member Municipality	Population 2016 Census[2]	Electoral Area
Prince George	74,003	A, C and F
Mackenzie	3,714	G
McBride	616	H
Valemount	1021	H

3.2.1.1 District of Mackenzie

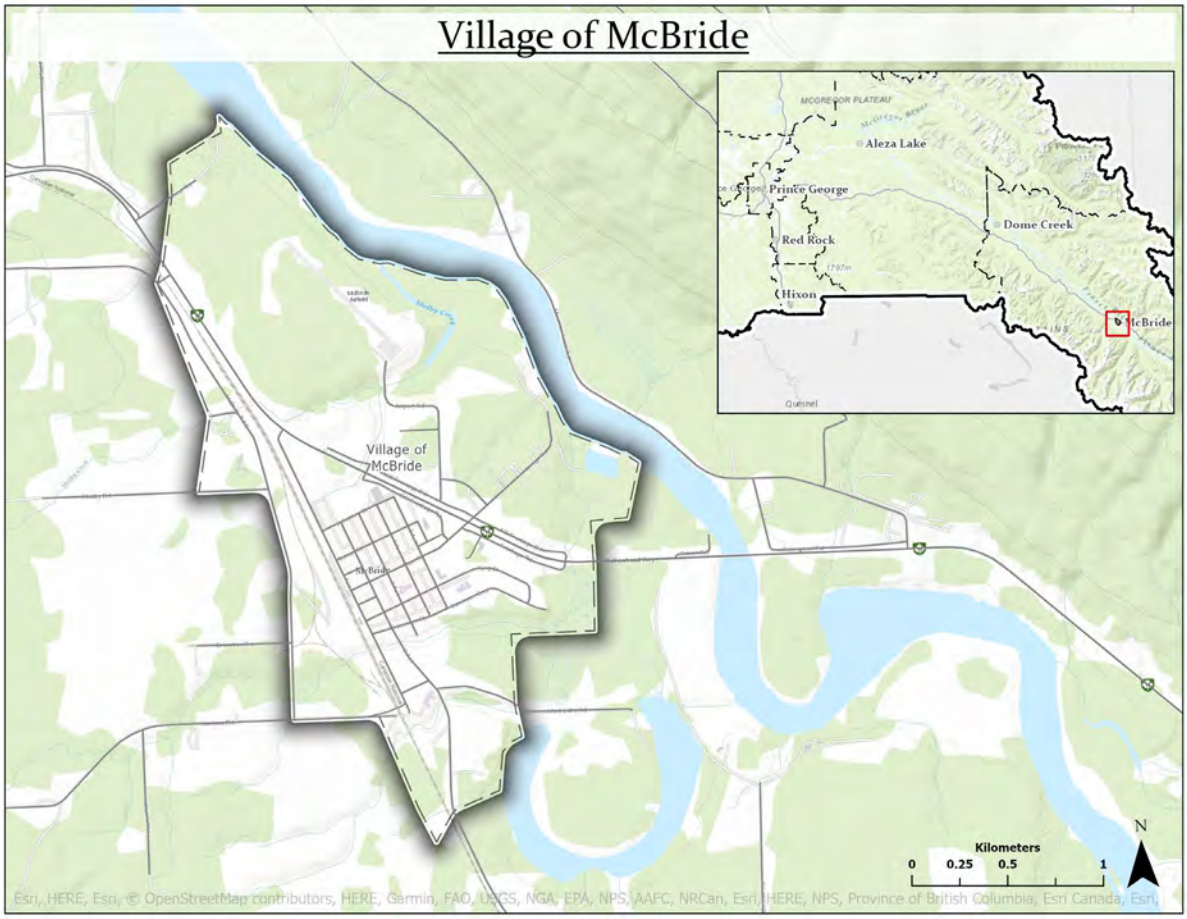
Mackenzie is a sizable municipality located on highway 39, not far from highway 97 in the northern portion of the Regional District. While highway 39 does continue for a short distance past Mackenzie, there aren't really any further sizeable communities north of Mackenzie. Due to its remote nature and the few destinations past it, Mackenzie really is a destination unto itself. Mackenzie had its origins in the forestry industry and has been significantly impacted by its downturn. Its location in the Rocky Mountain Trench makes it close to numerous outdoor recreational pursuits.



[2] Statistics Canada, 2016 Census Profiles

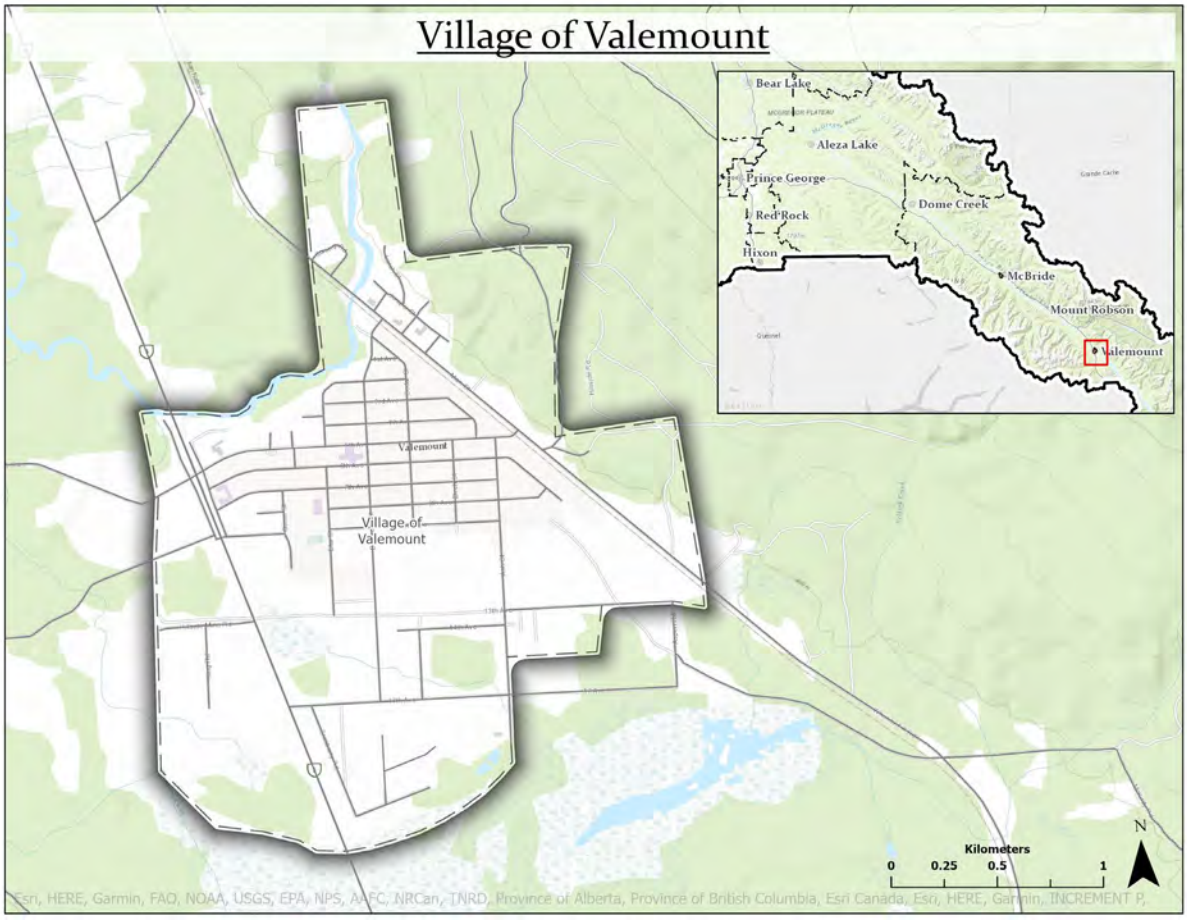
3.2.1.2 Village of McBride

The Village of McBride is a small municipality located along the Fraser River on Highway 16 centrally located in the heart of the Robson Valley between the Rocky Mountains and the Cariboo Range. It serves the surrounding area including the rural communities of Dome Creek, Crescent Spur and Dunster. Its original history is as a rail stop but has broad industries now including rail, forestry, tourism, and agriculture.



3.2.1.3 Village of Valemount

The Village of Valemount is a Resort Municipality located along Highway 16 in the southern part of Electoral Area H in RDFFG. It is just north of the northern tip of Kinbasket Lake within the Columbia Basin of south-eastern British Columbia very close to the Alberta border. It also has been the subject of the boom and bust of the forestry industry but has developed a strengthening tourism industry arising out of its location between the Rocky, Monashee and Cariboo Mountains close to a myriad of recreational opportunities.

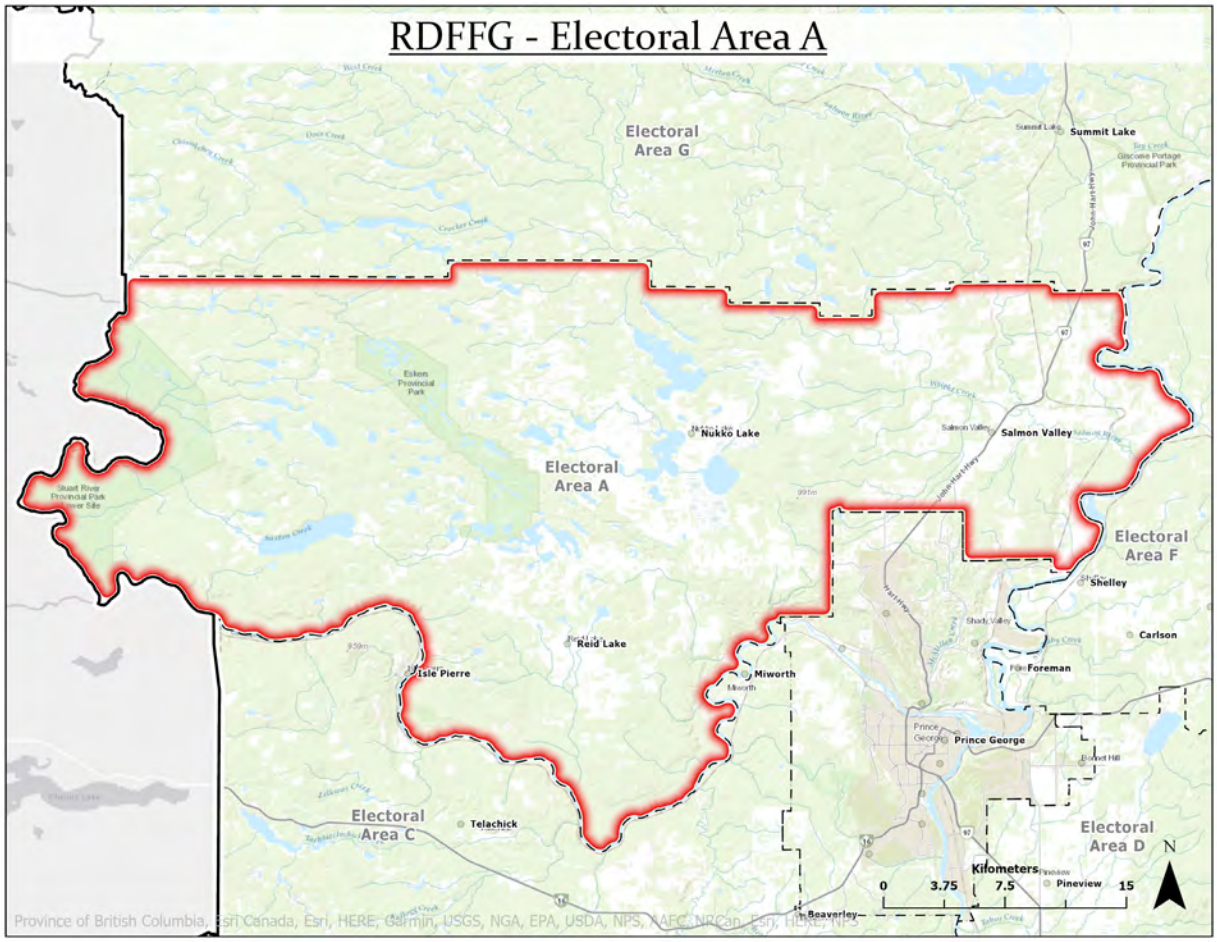


3.2.2 Electoral Areas

The Regional District is divided into seven Electoral Areas enumerated as A, C, D, E, F, G and H which are shown on the map below. A description of each Electoral Area follows.

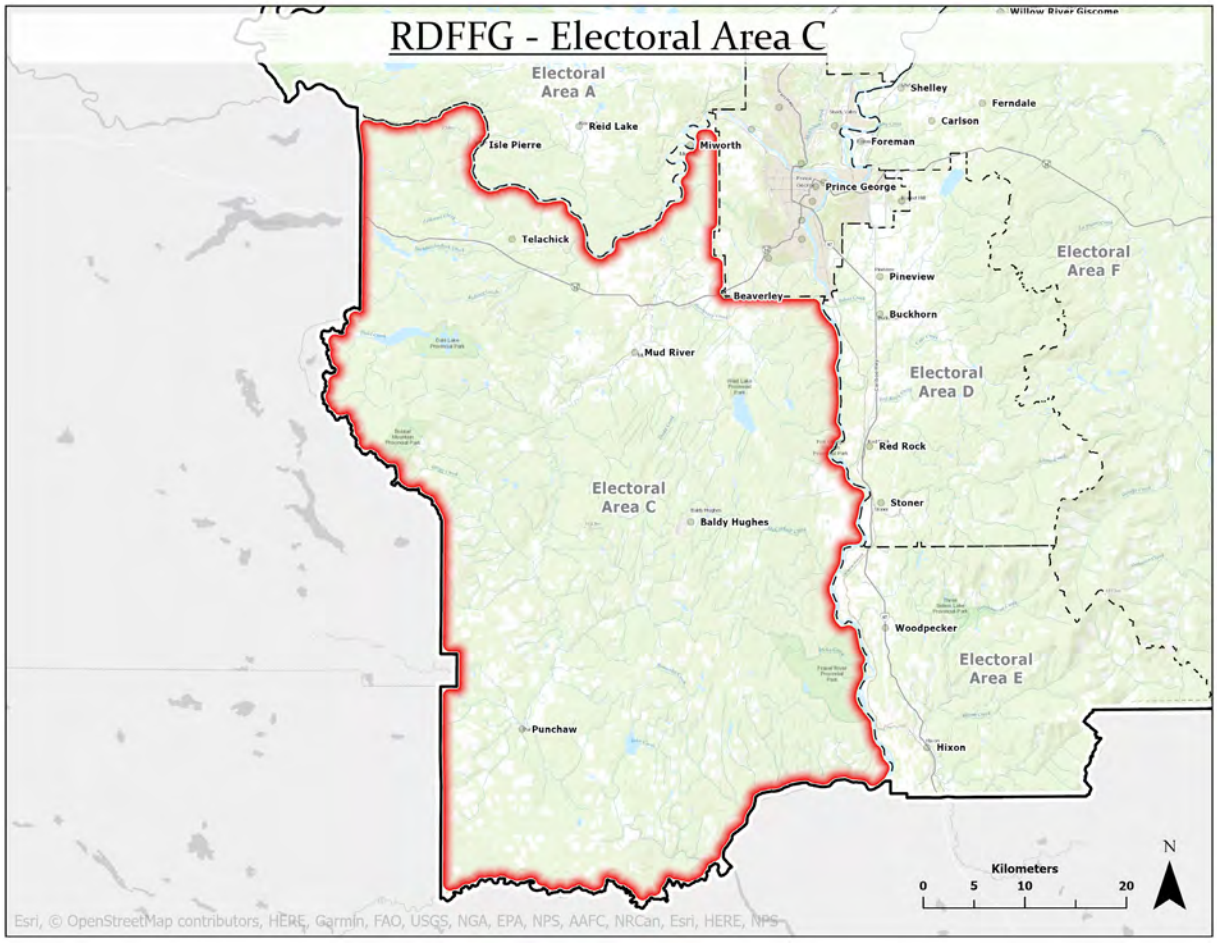
3.2.2.1 Area A – Salmon River – Lakes

Area A is situated in the western part of the region close to Prince George. The significant populated places in this area include Salmon Valley, Nukko Lake, Reid Lake, and the areas between these communities. Highway 97 runs northward through the eastern section of this area. The western portion borders the Regional District of Bulkley-Nechako ("RDBN") and is sparsely populated. Area A is one of the smaller areas in the region with an area of nearly 1,400 km^2 for its population of 3,463.



3.2.2.2 Area C – Chilako River – Nechako

Area C covers the southwestern part of the RDFFG south and west of Prince George. Highway 16 transects the northern portion connecting Area C to the RDBN. Significant communities in this region include Beaverly, Mud River, and Telachick. There are also significant clusters of homes around Bednesti and Norman Lakes in the west as well as near West Lake which lies south of Beaverly. Areas further south than this are sparsely populated. With a population of 3,527, Area C spans just over 2,800 km^2 in total area.



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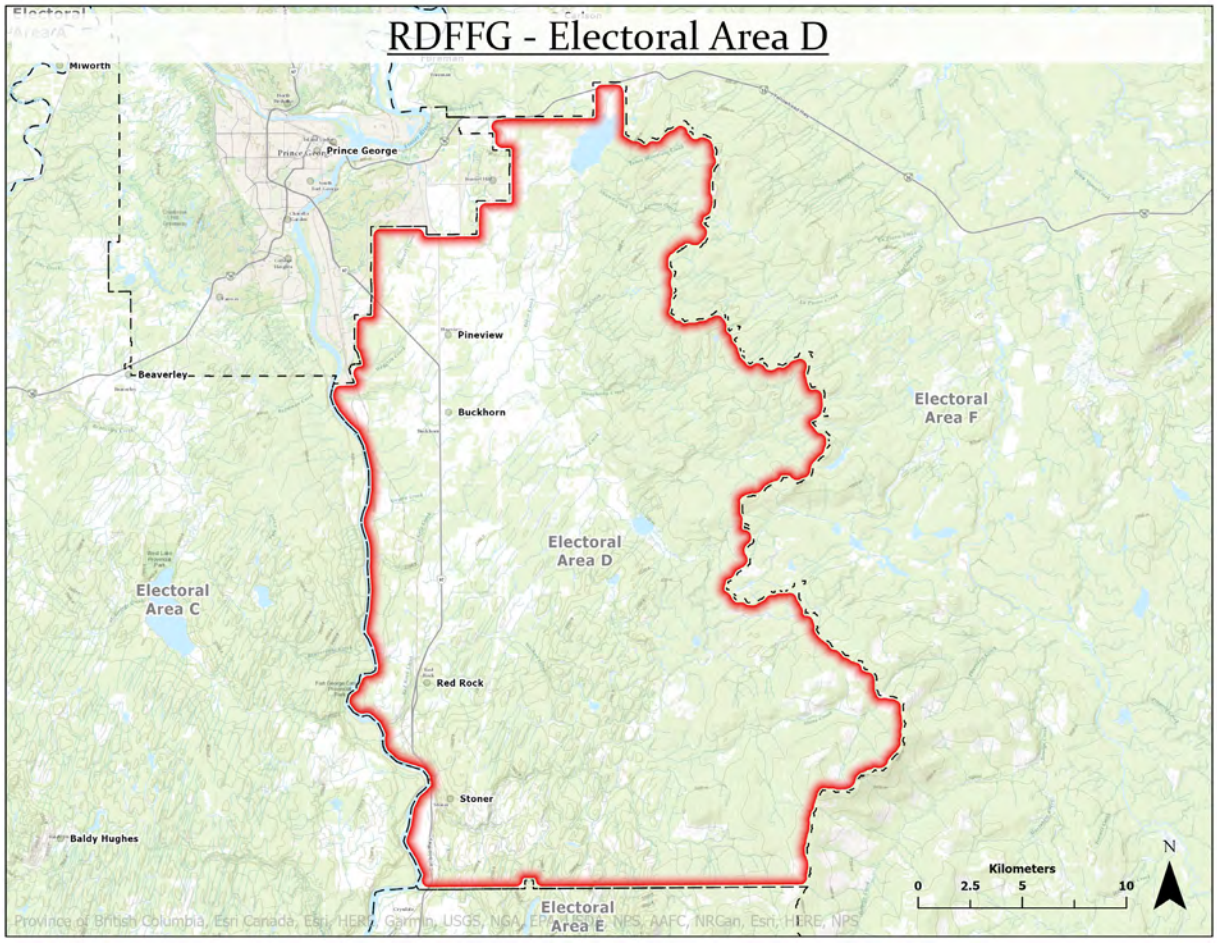
3.2.2.3 Area D – Tabor Lake – Stone Creek

Southeast of Prince George lies Electoral Area D. This region is densely packed with a few significant clusters of homes near Pineview, Buckhorn, and Red Rock. Tabor Lake in the north part of the area also has a fair number of homes situated near and around it. For the most part, the east part of the area is unpopulated. Highway 97 runs southward through this are connecting to Area E and then on to the Cariboo Regional District further south. Like Area A, Area D is another small Electoral Area in RDFFG and covers only 668 km^2 but with its population of 4,278, it is very dense.



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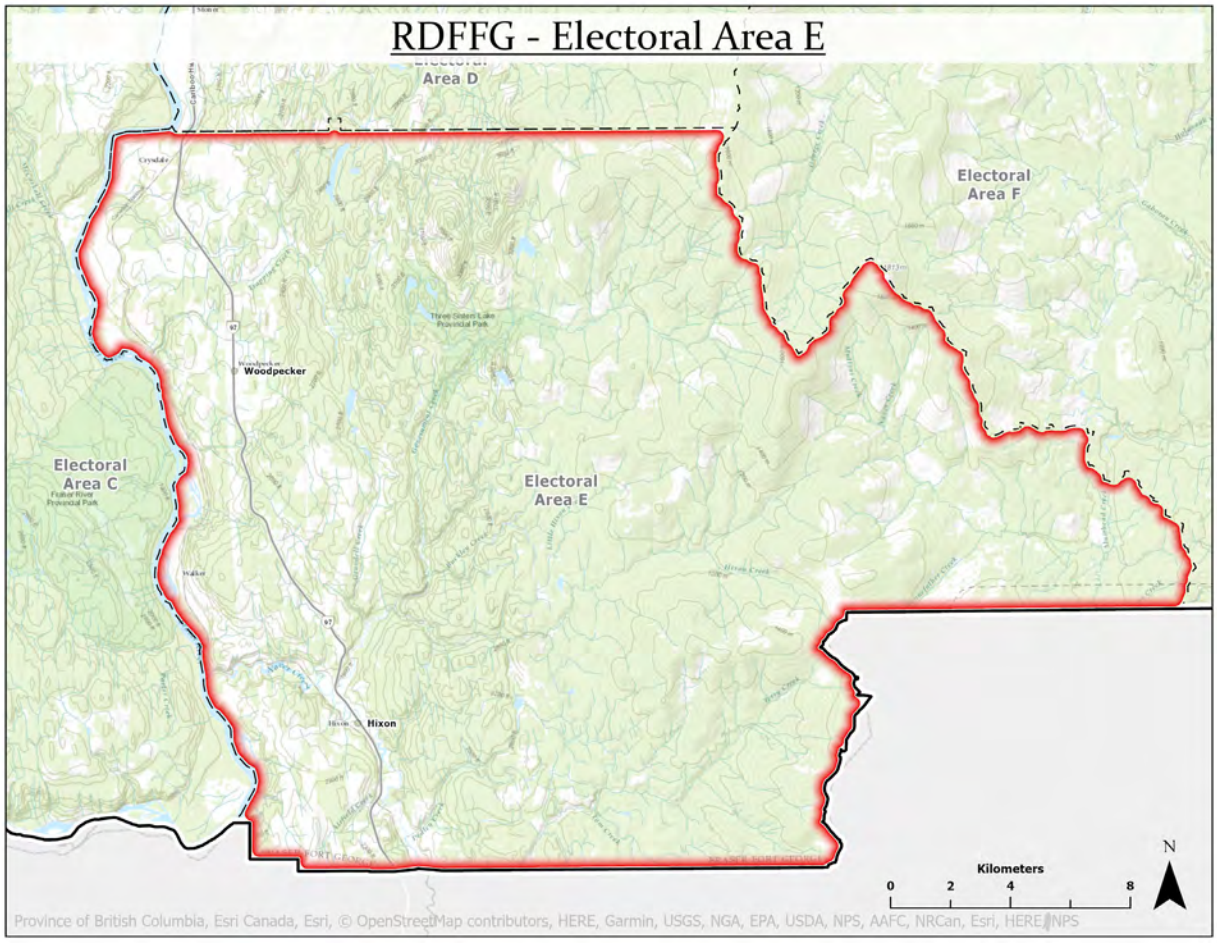
3.2.2.4 Area E – Woodpecker – Hixon

As the gateway to the southern part of the RDFFG, Area E is a small but key Electoral Area in the south portion of RDFFG. Area E has a total population of only 526. Hixon is the most populated place in this area although there are a number of homes spread along the Highway 97 which runs southward to the border with the Cariboo Regional District. Few homes can be found to the further off the highway in the eastern part of the region. With an area of only 615 km^2, Area E is the smallest region in the Regional District.



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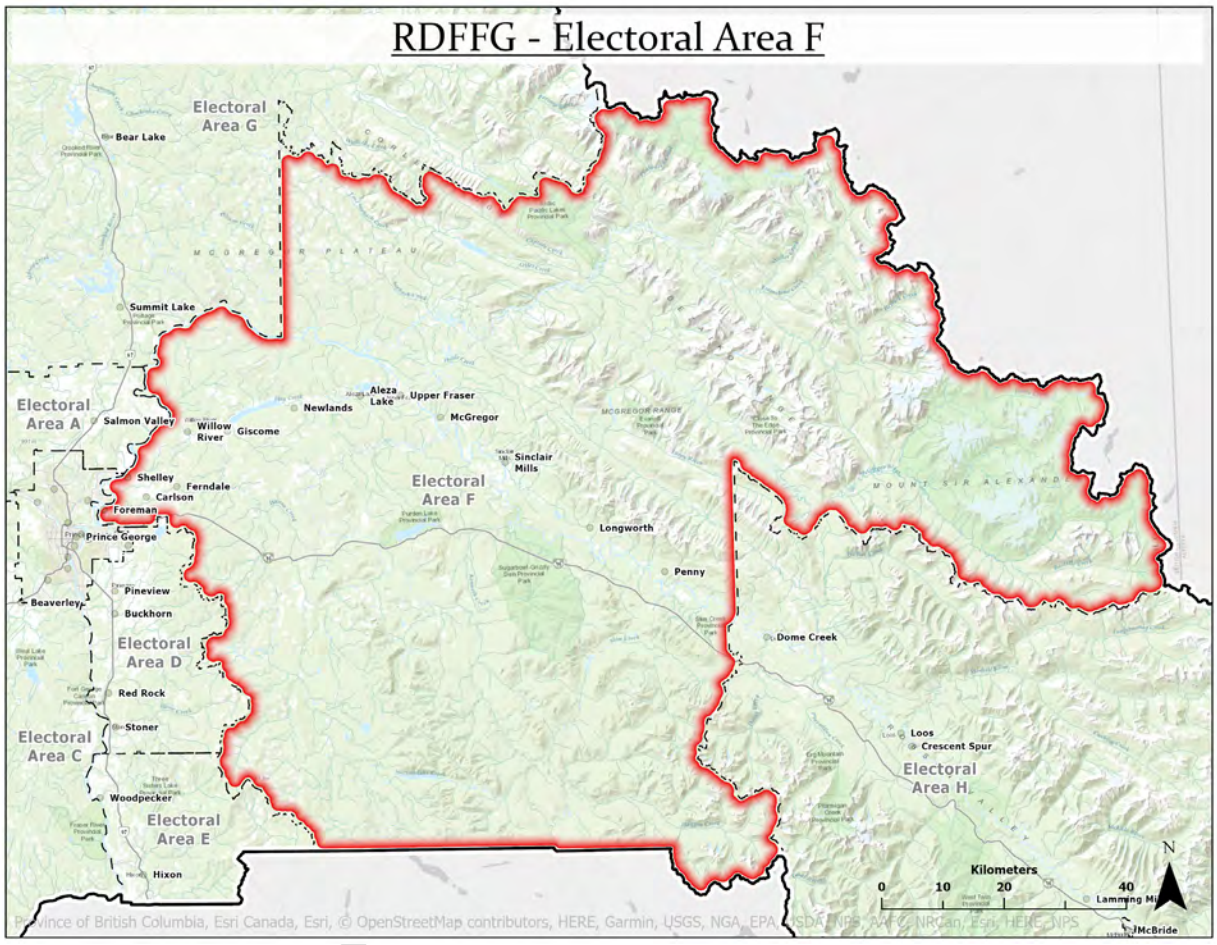
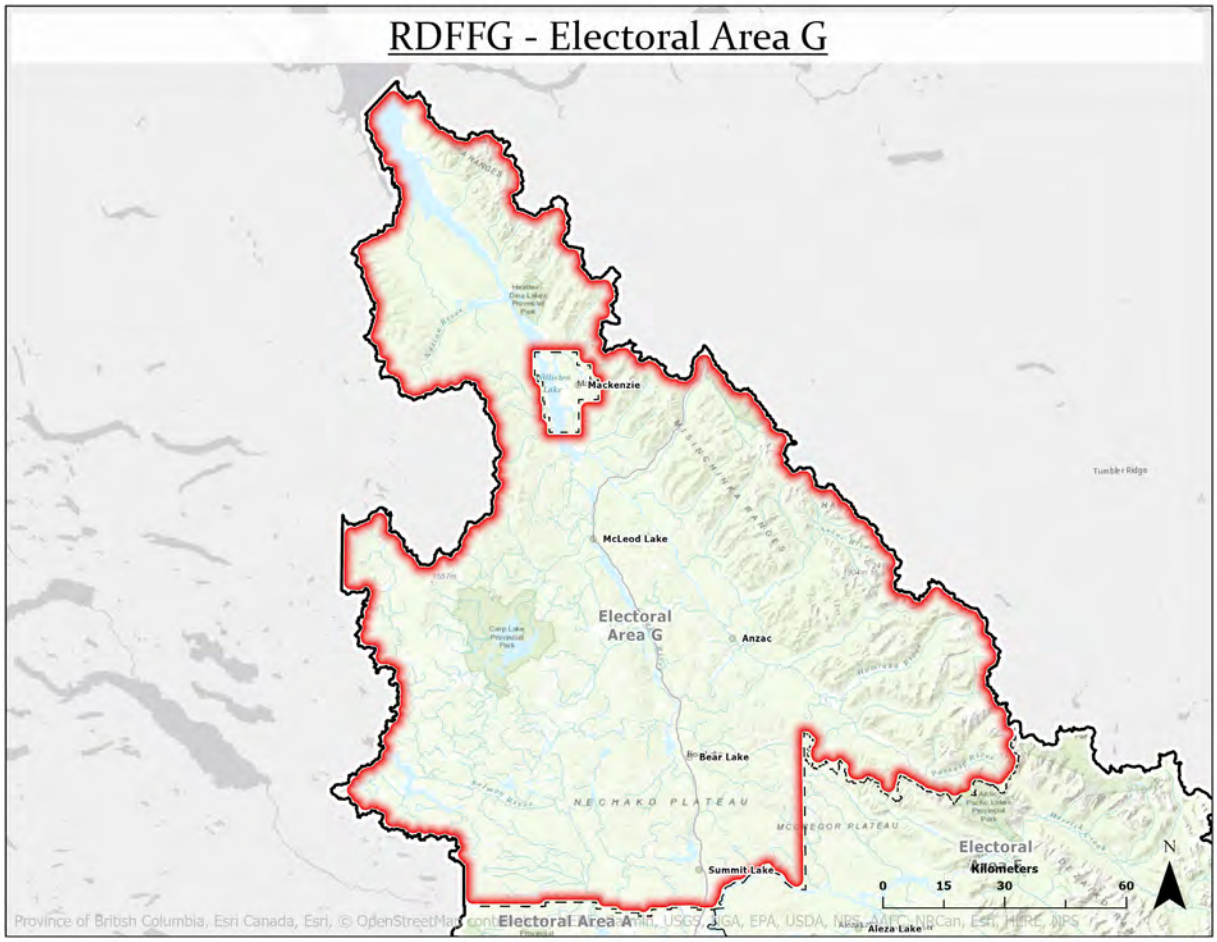
3.2.2.5 Area F – Willow River – Upper Fraser

Area F is centrally located in the region and connects Area H to the more populated areas closer to Prince George. Area F population totals 1,246 with communities in the region found along the Upper Fraser Road and the Canadian National Railway line which both run east-west through the region. Such communities include Sinclair Mills, Aleza Lake, Willow River, as well as a few other small communities. Along Highway 16 which also runs east-west through the area, few homes can be found beyond the areas closer to Prince George such as Carlson. One exception to this is the cluster of homes surrounding Purden Lake in the center of the area along the highway. Areas beyond these two corridors are uninhabited for the most part. Spanning over 12,500 km^2, Area F is one of the larger three Electoral Areas along with Areas G and H which both border it on opposite sides.



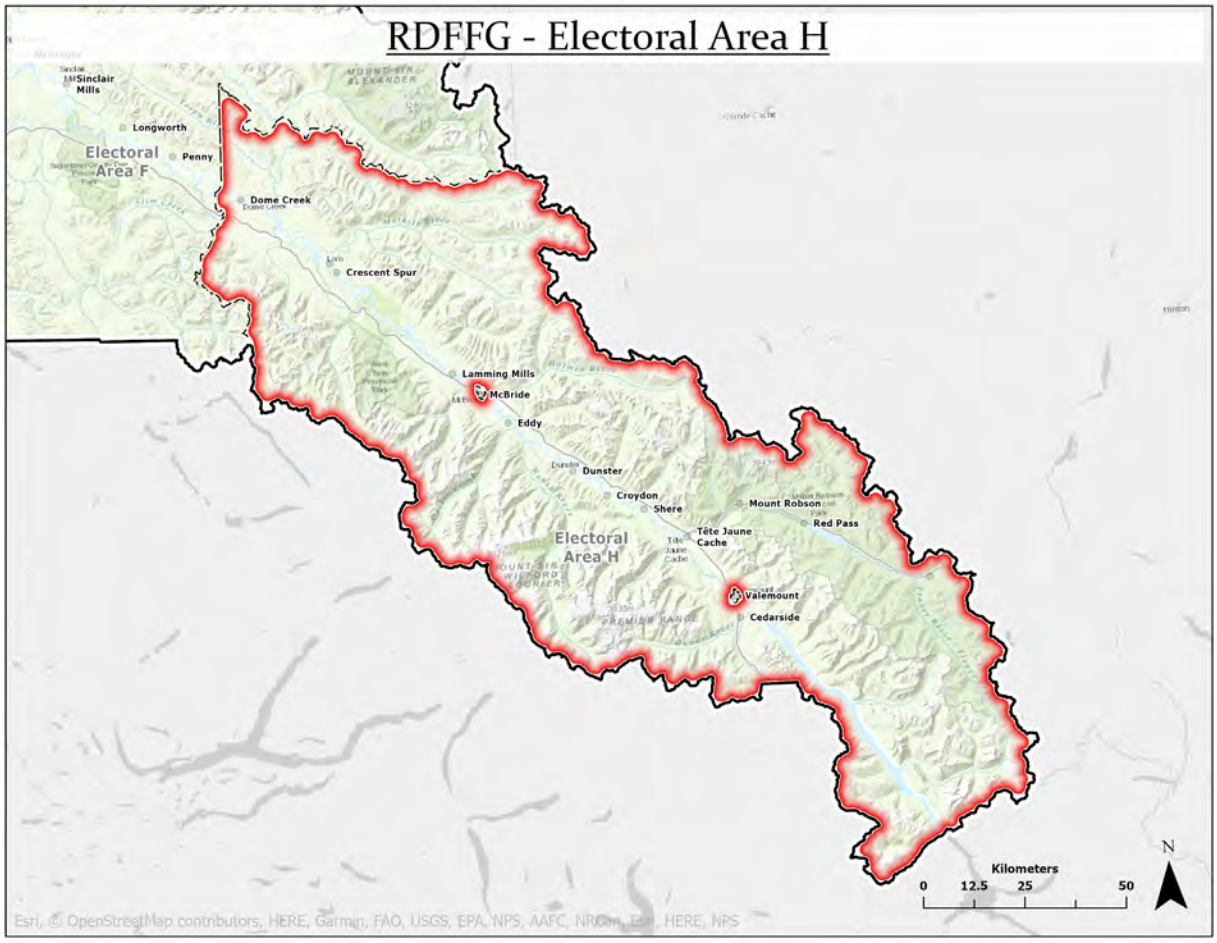
3.2.2.6 Area G – Crooked River – Parsnip

The northernmost Electoral Area in RDFFG is Area G. It is the northern gateway through which Highway 97 runs eventually crossing over into the Peace River Region. The largest communities in the area include Summit Lake, Bear Lake, and McLeod Lake although Area G's population totals just 334. The District of Mackenzie is also situated within this Electoral Area. Area G covers a total of 17,260 km^2 and is the largest area in the Regional District.



3.2.2.7 Area H – Robson Valley – Canoe

Area H is the eastern arm of the region and has two municipalities that fall within it: the Village of McBride and the Village of Valemount. Area H is also a key gateway both to Alberta in the east and the Thompson-Nicola Regional District in the south. Besides the two municipalities, there are a number of communities in Area H. The total population is is 1,586 which is largely centred in communities such as Tete Jaune Cache, Dunster, Dome Creek, Mount Robson, and a few others. Second only to Area G, Area H is one of the largest areas in the region at nearly 15,000 km^2.



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3.2.3 First Nations Reserve Lands

The RDFFG has just two area First Nations with reserve lands in the rural areas of the Regional District:

Band/First Nation	Members On/Off Reserve	Land Base (ha)[3]
McLeod Lake Indian Band	140/431	18,285.70
Lheidli T'enneh First Nation	101/384	675.50

Lheidli T'enneh First Nation is located in the Prince George region whereas McLeod Lake Indian Band is 50 km south of Mackenzie at the north end of McLeod Lake. McLeod Lake Indian Band shares many of the same frustrations with access to high-speed broadband internet service and cellular service as the rural areas of RDFFG.

[3] British Columbia Assembly of First Nations – Cariboo Region

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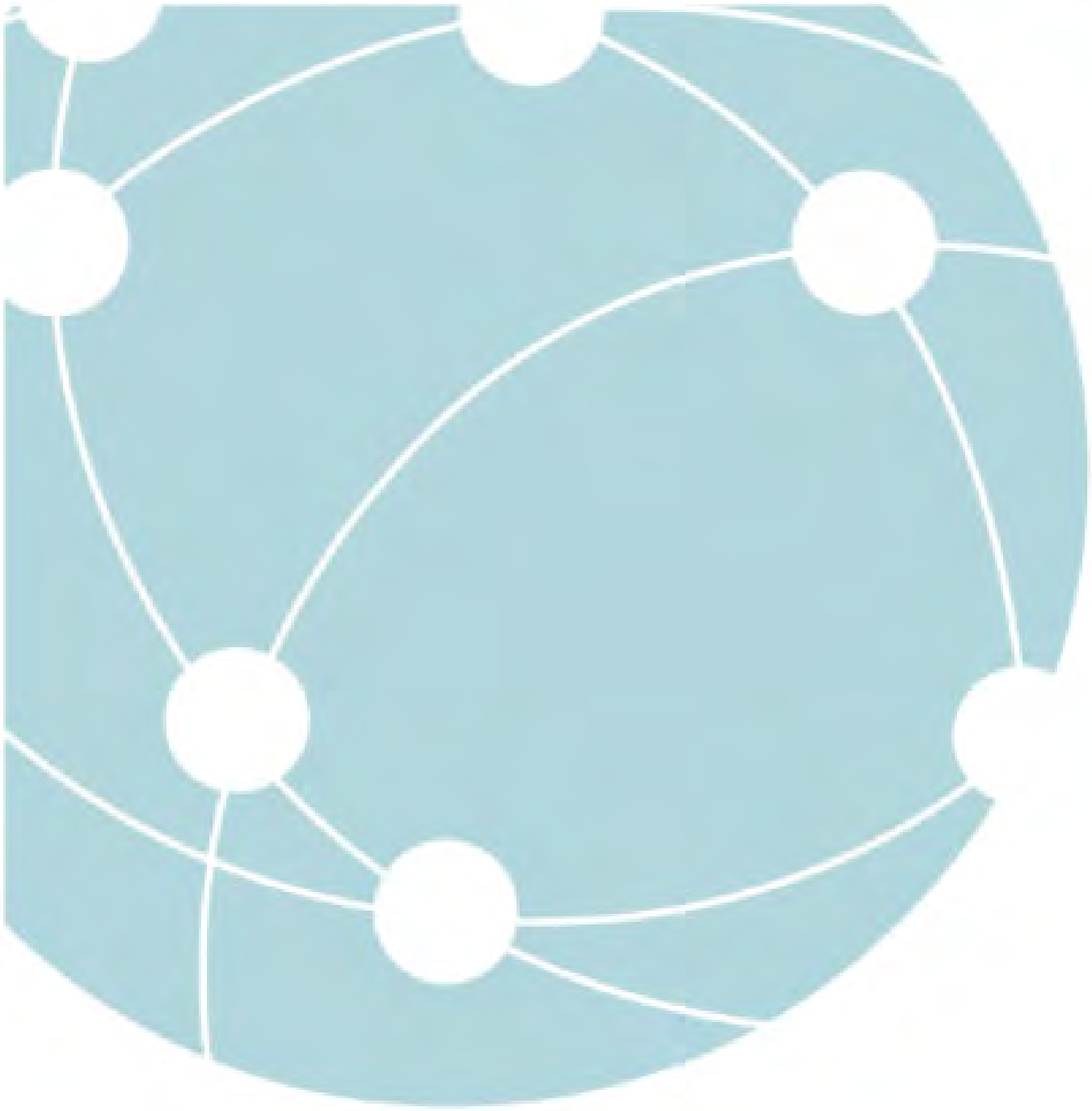

4 VISION AND GOALS

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4.1 Vision

The RDFFG connectivity team prepared a draft vision for the region which was endorsed by the Municipal members of the working group. The draft vision statement is:

"We envision a region where technology connects residents and supports their access to education, health, commerce and lifestyle services through the provision of affordable, high-speed internet technologies, regardless of where they live."

4.2 Benefits & Goals

It is almost trite to say that high-speed broadband connectivity has significant benefits to regions which have access to it. Well known benefits include individual wellness, better access to education and healthcare, economic diversification, better public safety and communication as well as a leveled playing field for business that provides access to the global marketplace. [4]

The following are goals that the RDFFG should seek to achieve on the connectivity front along with specifics against which to measure success:

1. Increase access to high-speed, reliable, and affordable broadband service at a minimum level of the USO to 90% of Points in the Electoral Areas of the RDFFG that are within 250m of a NBD* road by 2026.

2. Connect all government institutions such as hospitals, schools, first responders and libraries in the Electoral Areas with high-speed, reliable and affordable broadband fibre service at the USO by 2026.

3. Increase cellular coverage along major/minor roads[5] in the rural RDFFG to a level where such roads have continuous coverage by the end of 2026[6].

For the Municipalities, the connectivity goals are likely simpler such as:

1. Make high-speed, reliable, affordable, and scalable broadband service available to all Points within the Municipality at a minimum level of the USO.

[4] Brookings Institute – Tomer *et al – Digital prosperity: How broadband can deliver health and equity to all communities*

[5] BC Government, Overview of B.C. Highway Functional Classification https://www2.gov.bc.ca/assets/gov/driving-and-transportation/transportation-infrastructure/planning/inventories/bc_numbered_hwy_functional_classes.pdf

[6] With respect to goal #3 with respect to cellular technology identified in goal 3 above, it is acknowledged that it is very difficult to accurately pinpoint existing coverage as the nature of the technology is that it can be spotty within an area shown as covered. Further, along roads, it is likely that there may be stretches of that road that do not have cellular coverage. This will make it more difficult to assess the success of the cellular goal. It is likely to be a qualitative assessment only.

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5 METHODOLOGY

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5.1 Methodology

This section describes the methodology used to gather, analyze and present the information used in the report. The information obtained will be summarized later in the document.

5.1.1 Mapping Methodology

Part of the information gathering process involved obtaining available Geographic Information System (GIS) data from the RDFFG along with other sources and using it to create maps. The methodology and discussion of elements used for creating the important layers in these maps is generally laid out below.

Sources – The sources used in the analysis include the RDFFG, various stakeholders corresponding to the affected areas, the Canadian Radio-television and Telecommunications Commission (CRTC), Innovation, Science and Economic Development Canada (ISED), Statistics Canada, and BC Open Data. The main dataset of analysis was sourced from the RDFFG and included the Points which are discussed in more detail below. The material sourced from the CRTC included the 25km^2 hexagons that indicate which type of service is available in a location[7]. Examples of the types of service include cable, fibre, DSL, wireless among others. Data from Statistics Canada included census data that determined the number of people and the number of dwellings in certain communities within the RDFFG. Another important layer sourced from the CRTC/ISED is the National Broadband Road Segments layer which is discussed in more detail below[8] as well as the National Broadband Internet Service Availability Map (the ISED Map). The existing infrastructure dataset that came from the public sources showed where existing cell towers were located[9]. Contextual information sourced from BC Open Data included anchor institutions such as schools, hospitals, government buildings, etc[10]. Road networks, administrative boundaries, and other layers were also sourced from BC Open Data and the RDFFG.

Potential Subscriber Points – Potential subscriber points ("Points"), are one of the most important datasets in the analysis. TANEx used RDFFG's GIS dataset of Address Points which is used to approximate a potential subscriber location which may be a single dwelling or multiple dwellings within one geographic location. The Points were then assigned both density and available internet speed characteristics which are discussed in more detail below. The combination of Point characteristics created the foundation for delineating proposed project areas and the overall characteristics of those project areas as discussed in the project areas section below.

CIRA Point – Similar to the Potential Subscriber Points outlined above, the Canadian Internet Registration Authority (CIRA) point data shows the results of a speed test at a given location by an internet subscriber. This data is derived from a map and underlying database collected and hosted by CIRA. This data was collected, imported, and then compared to the speeds available to Potential Subscriber Points in order to show areas where the ISED Map showed available speeds that differ from the highest speeds reported by CIRA. Areas where ISED speeds are greater than those of CIRA are of particular importance given that they suggest ISED may be overstating available speeds in that area. Note that ISED speeds show potential speeds available across all technology types and all service packages whereas CIRA speeds show the speed experienced for a certain technology type, at a certain time, while subscribed to a certain service package which may not be the highest available. It is acknowledged that the difference between the CIRA results and the ISED Map are not solely attributable to errors in the ISED Map.

[7] Government of Canada, *National Broadband Data Information*, Hexagonal Grid of Canada
[8] Government of Canada, *National Broadband Data Information*, National Broadband Data Road Segments
[9] Steven Nikkel, 2020, *Canadian Cell Towers Map*
[10] Government of British Columbia, BC Data Catalogue

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Density & Density Buffer Areas – In order to gauge the density of certain areas, six buffer zones around the Points were created. The six buffer distances used were 25m, 50m, 100m, 200m, 1km, and 2km. Individual buffer zones emanating from the Points were then dissolved into contiguous areas. If any of the buffer zones contained only one Point, they were erased. The results are contiguous areas that contain two or more Points. If a Point falls within a buffer zone, it is designated as Type 1 (25m), Type 2 (50m), Type 3 (100m), Type 4 (200m), Type 5 (1km), or Type 6 (2km) density, defaulting to the higher designation if it falls within two or more of the buffer zones. If a Point does not fall within the lowest density buffer zone designation (Type 6), it is designated as Type 7 which means it is outside the 2km buffer area. Such Points are fairly remote and rare.

Speeds & Speed Buffer Areas – ISED maintains a dataset of national broadband road (NBD) segments which designate the internet speed a person could expect if they lived in the area of that road. ISED notes that the data collected and used internally by ISED is, in most cases, accurate to within 250 metres[11]. This data is based on information provided annually by service providers[12].

Based on the accuracy ISED denotes, as referenced above, a buffer of 250m from the road segments data was created to capture assumed download and upload speeds for a Point located within the buffer. The range of speed combinations (download speed/upload speed in Mbps are as follows: 50/10, 25/5, 10/2, 5/1, Less than 5/1, or No Service. If a Point fell within two or more buffers, then it was designated with the higher speed buffer. If a Point did not fall within a buffer, its speed was undeterminable and was designated “Unknown”.

Project Areas – Project areas were created from the Points and the density buffers. Minor project areas were delineated 1km around the densest clusters of Points with a number of things in mind: Point characteristics for density, speed, topography, and distance between clusters. Lower density Points such as those 2km or further away from another Point were omitted from project areas. Large, consistent, and isolatable clusters of Points with speeds of 50/10 Mbps were also omitted since they already have service at the USO. Points and clusters of Points separated by natural boundaries (e.g. cliffs, water bodies, etc.) were either omitted or split into different areas where necessary. Clusters of Points far away from others were not determined to be logical groupings unless absolutely necessary such as when they fall along corridors where existing or future fibre lines may run. Minor project areas were then grouped together into major project areas based on proximity to one another and connecting features such as fibre lines/highways.

Fibre Lines – The routes of fibre lines were sourced from public domain. Fibre lines and an understanding of where they are situated are important since they form a key element of the network infrastructure needed to serve potential customers.

Cell Towers – Cell tower locations and data were also sourced from public domain. Cell towers are another important element in providing existing and potential future internet service to underserved areas and their constituents.

Service Provider Coverage – Service provider coverage was sourced from ISED databases and where possible, verified with the service provider. The databases derive their information directly from individual service providers. Some of the information may be out of date but nonetheless gives a sense of which service providers operate in which area and what types of technology they utilize in those areas. Examples of such technology include coaxial cable, DSL, fixed wireless, or Fiber-to-the-Premises/Home.

Limitations of Data – The data used for the analysis has a number of drawbacks. ISED has created coverage maps using 25km^2 hexagons upon which they base certain assumptions about connectivity

[11] Innovation, Science, & Economic Development Canada
[12] Government of Canada, *National Broadband Data Information*, National Broadband Data Road Segments

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within that hexagon. This creates a geographically large area which may well have varying degrees of connectivity but the ISED assumptions are such that service within that hexagon is uniformly at the highest level achieved in the hexagon. ISED has also developed 250m NBD road segments that depict Mbps speeds in that area. These are more accurate geographically speaking but lack specificity in terms of which ISPs operate in the area or what the technology type is available there.

5.1.2 Outreach Methodology

5.1.2.1 Public

A publicly available survey was developed to get information from residents and businesses about their access to, use of, and satisfaction with, broadband internet connectivity in the Regional District and the Municipalities.

Surveys were available online and in paper form to residents, businesses, organizations, First Nations, and institutions and provided feedback from the public about different aspects of internet service. The survey asked the respondents if they were interested in further communication on the topic. Respondents who responded in the affirmative were sent an email directly to obtain more granular information about connectivity experience and impacts.

A summary of the results of the surveys are available later in this report. Reported results are simply as reported by the participants with it being beyond the scope of this report to undertake any form of validation including with respect to cost and speed of service.

5.1.2.2 Key Stakeholders & First Nations

Key stakeholders and area First Nations were identified by the Local Governments and telephone or email contact was made (or attempted) with those stakeholders and First Nations to schedule a one-on-one call to obtain information and views on the state of connectivity and challenges from their perspective. Stakeholders included Electoral Area directors, First Nations' band administration, community leaders, community champions, business and industry representatives, emergency services representatives and other parties holding valuable insight into the connectivity challenge. A summary of the feedback obtained from those key stakeholders is contained later in this report.

5.1.2.3 Internet Service Providers

A list of service providers was created from information provided by the Local Governments, stakeholders and research of publicly available sources identifying providers in the area. TANEx conducted at least one one-on-one telephone interview with each known area service providers and in some cases, more than one.

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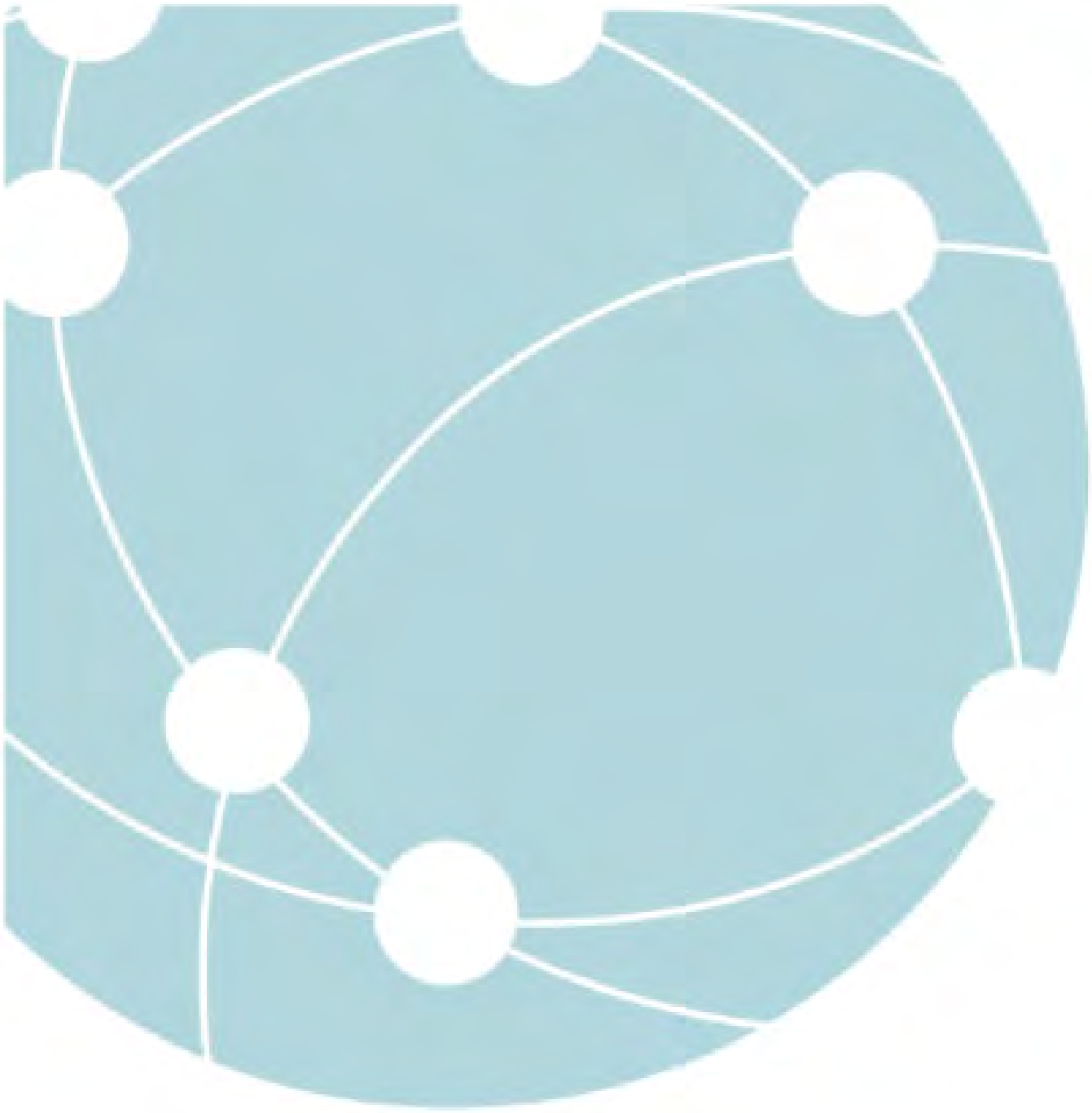


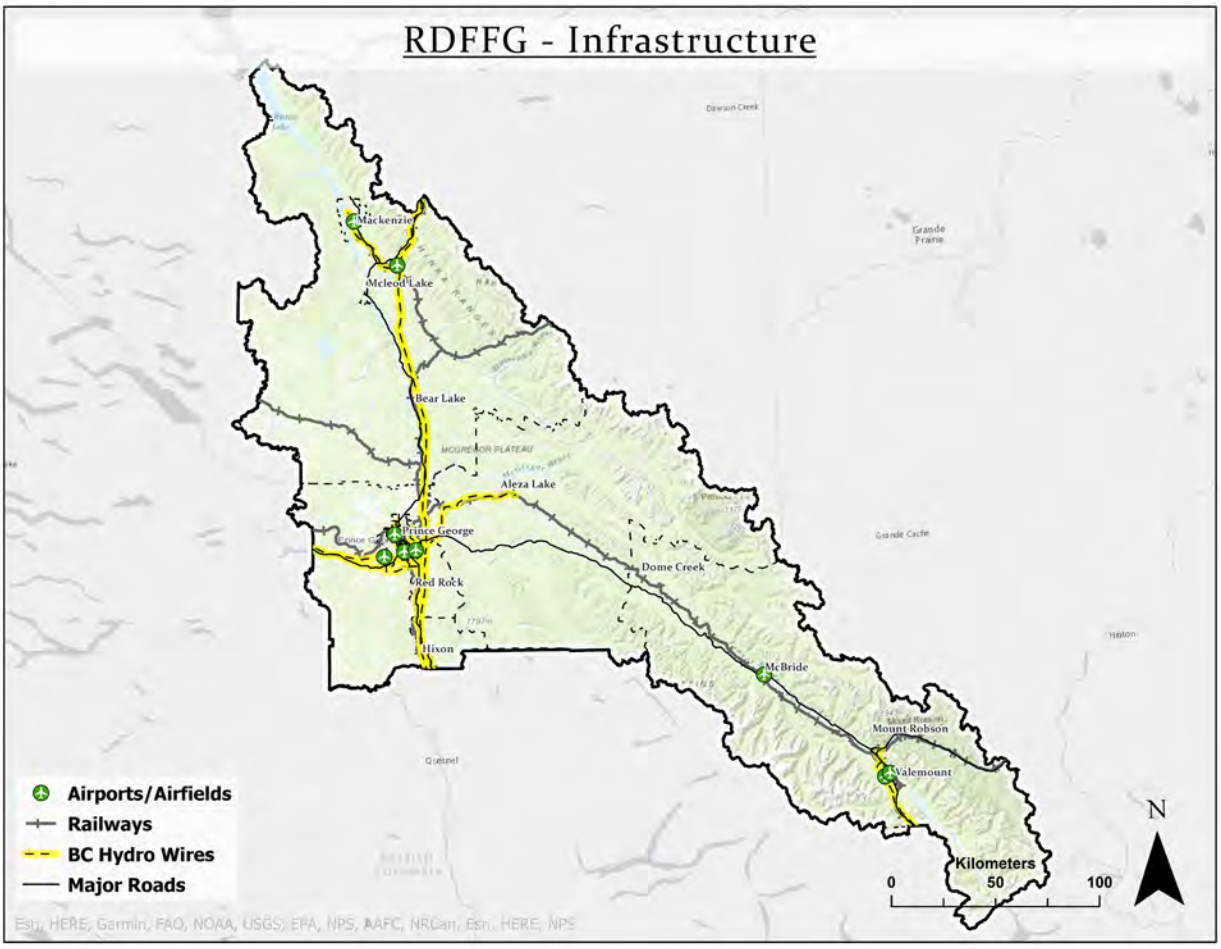
6 CURRENT STATE

To develop a strategy, the current state of the area of interest must be clearly understood to identify the gaps and define the steps that must be taken to improve connectivity to underserved areas.

6.1 Infrastructure, Industry & Institutions

The Regional District occupies the northern part of British Columbia's central interior plateau and extends as far north as the south arm of Williston Lake and as far east as the Rocky Mountains and the Alberta border. This creates a diverse and varied geography, climate zones and vegetation. The region is home to the headwaters for three major continental watersheds: the Peace River, the Columbia River, and the Fraser River. In particular, the region is defined by the Fraser River from its source on the continental divide, through the Robson Valley and onto where it leaves the region south of Prince George.

6.1.1 Transportation



6.1.1.1 Road & Rail Transport

The Yellowhead Highway (#16) traverses RDFFG east and west, connecting Alberta and Prince Rupert while the John Hart Highway (#97) traverses it north and south, connecting Fort St. John and other northern points in BC and Alberta to BC's lower mainland area. Prince George is at the junction of these two major highways. The municipality of Mackenzie is at the end of Highway 39, a 29 km spur that runs

north from Highway 97. CN Rail operates rail lines that generally run along the Highway 16 and Highway 97 corridors. The line along Highway 97 includes two spurs to service resource extraction activities: one spur goes east to Tumbler Ridge and the other west through Fort St. James and extending west to points outside the region[13].

These road and rail transportation corridors are vital for the movement of goods and people north-south and east-west through the central and northern part of British Columbia.

6.1.1.2 Air Transport

The Prince George Airport (YXS) is a well-equipped regional airport with 3 paved runways; one of which can handle heavy aircraft (11,450 feet / ~3500 m). The airport serves the immediate area and acts as a hub for flights to destinations in central and northern BC. Several commercial operators have service including Air Canada Express, WestJet Encore, Flair Airlines, and Northern Thunderbird Air. Prior to the pandemic, in 2019, there were more than 300 commercial flights per week and overall, nearly 500 thousand passenger movements during the year. There are also airports with hard surface runways at Mackenzie, McBride and Valemount. There are also three turf airstrips -- Beaverly Airport and North Cariboo Air Park (current status uncertain) that are located west of Prince George, and one at Kennedy Siding (south of Highway 97 near the junction with Highway 39 to Mackenzie)[14].

6.1.2 Economic Activity & Industry

Forestry was the early economic driver for most of the Regional District. Today, forestry is in decline with mills closing in recent years. Nonetheless, forestry related activity continues to be significant, and manufacturing based on wood and paper products continues to be a source of economic activity. Although only a small percentage of the region is suitable for crops and grazing, agriculture is a significant source of economic activity; in particular, along the Fraser River. Today, the services sector accounts for most employment in the Regional District (about 70%). This includes wholesale and retail trade, construction, transportation, health, accommodation, food services, and education[15].

Economic diversification was a focus in the strategic priorities for 2016-2019[16] with this theme continuing under the "economic health" goal in the strategic priorities for 2019-2023[17]. Professional services (e.g. for high-tech and business) and tourism are two areas of potential economic diversification and growth in the region. Attracting and retaining local businesses is a vital component, with the promotion of community livability a key supporting ingredient[18].

6.1.2.1 Energy

Electric power generation: Although there is no grid scale electric power generation in the region, there is some generation from independent power producers' (IPP). The following table identifies the independent power products in the region that have electricity purchase agreements with BC Hydro (as of 2021-01-04)[19][20].

[13] Railway Association of Canada - Canadian Rail Atlas
[14] OurAirports.com – BC
[15] Guide to the BC Economy – Cariboo Region
[16] RDFFG – Strategic Priorities 2016-2019
[17] RDFFG – Strategic Priorities 2019-2023
[18] Guide to the BC Economy – What is the New Economy?
[19] BC Hydro – Independent Power Producer (IPP) Supply List
[20] Energy BC – BC Electricity Infrastructure Map

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Independent Power Producer (IPP)	Location	Type	Capacity (MW)	Energy (GWh/yr)
Conifex Green Energy	Mackenzie	Biomass	36	220
Northwood Green Power / Canfor Pulp	Prince George	Biomass	94.5	159
Intercon Green Power / Canfor Pulp	Prince George	Biomass	31.7	73
PGP Bio Energy Project / Canfor Pulp	Prince George	Biomass	59.9	105.5
East Twin Creek Hydro	McBride	Hydro - non-stored	1.6	6
Robson Valley Power Corp	McBride	Hydro - non-stored	3.6	19.2
Hystad Creek Hydro / Valemount Hydro	Valemount	Hydro - non-stored	6	60
Hauer Creek Power	Valemount	Hydro - non-stored	2.4	12.5
McIntosh Creek Waterpower / Snowshoe Power	McBride	Hydro - non-stored	1.2	4.1
Castle Creek	McBride	Hydro - non-stored	6	34

Electric power transmission: The BC Hydro's north-south high voltage transmission system runs through the region, generally following the Highway 97 corridor, bringing electric power from generating stations on the Peace River to load centers in the lower mainland. Prince George is a major junction for the transmission system with high voltage lines running west to Prince Rupert through Terrace where spurs run south to Kitimat and north to Bob Quinn Lake[21].

Electric power distribution: BC Hydro provides power to most of the population in the region from their integrated electric grid. Distribution system assets include feeder and distribution pole lines extending out from substations to poles with transformers and drop wires to customer premises.

Liquid petroleum pipelines: The Pembina Oil Pipeline brings liquid petroleum products from Alberta to the BC interior and lower mainland for local use and for export. This pipeline generally follows Highway 97, passing near Prince George. The Trans Mountain Pipeline passes through the north-east corner of the region as the line follows Highway 16 through the Rocky Mountains, then cuts south following Highway 5 and passing near Valemount[22].

Natural gas pipelines: The Enbridge Westcoast natural gas pipeline generally follows Highway 97. This is the primary natural gas pipeline moving product from the gas fields in the north east corner of the province to the lower mainland. The Pacific Northwest Gas Pipeline ties into the Enbridge line north of Prince George and provides natural gas to points west as far as Prince Rupert. Of the various proposed liquid natural gas pipelines proposed for northern BC, it is likely that only the Coastal GasLink Pipeline (TC Energy) will be built (under construction in 2021). This line will connect Dawson Creek with Kitimat. The route cuts through the region entering in the north-east, crossing Highway 97 north of Prince-Rupert at Summit Lake and exits the region along Highway 16[23].

6.1.3 Health

Hospitals: The University Hospital of Northern British Columbia in Prince George is a teaching hospital and the largest Level III trauma centre in Northern BC. The only other hospital in the region is in Mackenzie: the MacKenzie and District Hospital and Health Centre.

Walk-in clinics: There are walk-in clinics in Prince George and one in Valemount. Health centers and clinics provide non-emergency health care services on a walk-in basis during clinic hours, which vary by facility.

[21] BC Hydro – Transmission System Map
[22] Energy BC – BC Oil Infrastructure Map
[23] Energy BC – BC Natural Gas Infrastructure Map

6.1.4 Educational Institutions

Schools: The following table is a listing of the schools in the region that are outside the urban core of Prince George. Most of these are elementary schools serving the local communities. Outside of Prince George, there are secondary schools in Mackenzie, McBride and Valemount.

SD	School name	Address	Type
57	Hixon Elementary	378 Lockyer Rd, Hixon, BC	Elementary
57	Beaverly Elementary	9777 Western Rd, Prince George, BC	Elementary
57	Buckhorn Elementary	5190 Buckhorn Lake Rd, Prince George, BC	Elementary
57	Pineview Elementary	8515 Old Cariboo Hwy, Prince George, BC	Elementary
57	Blackburn Elementary	2222 South Blackburn Rd, Prince George, BC	Elementary
57	Hart Highlands Elementary	2233 Sussex Lane, Prince George, BC	Elementary
57	Heather Park Elementary	7151 Heather Park Rd, Prince George, BC	Elementary
57	Kelly Road Secondary	4540 Handlen Rd, Prince George, BC	Secondary
57	Glenview Elementary	7310 Cluff Rd, Prince George, BC	Elementary
57	Springwood Elementary	4600 Zral Rd, Prince George, BC	Elementary
57	Nukko Lake Elementary	23955 Chief Lake Rd, Prince George, BC	Elementary
57	Giscome Elementary	21840 Upper Fraser Rd, Giscome, BC	Elementary
57	Morfee Elementary	310 Nechako Dr, Mackenzie, BC	Elementary
57	Mackenzie Secondary	500 Skeena Drive, Mackenzie, BC	Secondary
57	Robson Valley Junior Academy	1055 Lamming Pit Rd, McBride, BC	Elementary, Junior Secondary
57	McBride Centennial Elementary	1000 3rd Ave, McBride, BC	Elementary
57	McBride Secondary	1300 2nd Ave, McBride, BC	Secondary
57	McBride Christian Day School	3550 Alder Rd, McBride, BC	
57	Valemount Elementary	98 Elm St, Valemount, BC	Elementary
57	Valemount Secondary	201 Ash St, Valemount, BC	Secondary
SD is the School District number: 57 is Prince George			

Post-secondary institutions: The City of Prince George is home to the main campus for the University of Northern British Columbia (UNBC) and the College of New Caledonia. The College also has five satellite campus locations in northern BC; one of which is in Mackenzie.[24]

Libraries: In addition to the Bob Harkins library in Prince George, there is a Nechako Branch as well as district libraries in Mackenzie, McBride (2 locations) and Valemount.

6.1.5 Emergency Services

[24] College of New Caledonia – Prince George

The public-safety answering point (PSAP) call center is part of the Fire Operations Coordination Center (FOCC) in Prince George. The RCMP provide policing in the Regional District with detachments in Prince George, Mackenzie, McBride and Valemount. RCMP operations in Prince George include several Community Policing locations. In addition to the ambulance stations in Prince George, there are ambulance stations in Bear Lake, Mackenzie, McBride and Valemount. There are multiple fire halls in Prince George. Outside Prince George there are volunteer fire departments in Hixon, Redrock Stoner, Beaverley, Ness Lake, Pilot Mountain, Shell Glen, Ferndale-Tabor, Salmon Valley, Summit Lake, Bear Lake, Mackenzie, McBride, and Valemount[25].

6.2 Telecommunications

6.2.1 Service Provider Overview

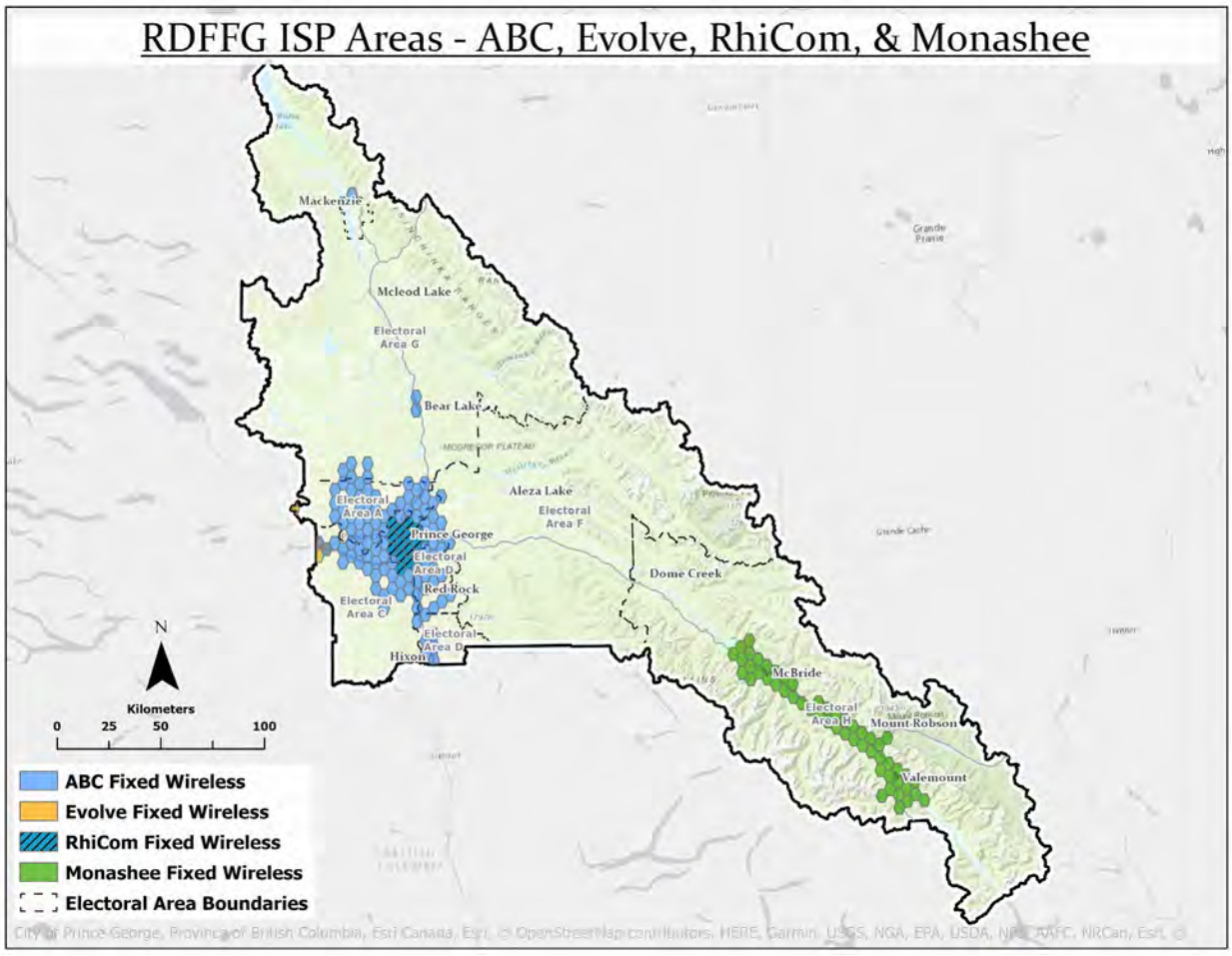
Provider	Summary
ABC Communications	Primarily provides fixed wireless services in some regions of the RDFFG mostly in the Prince George area. ABC was recently acquired by Telus but at this time still operates as ABC Communications.
City West	While not actively providing services in the RDFFG, City West may provide services to the RDFFG in the future through the neighbouring Regional District of Bulkley Nechako where they have been awarded funding for some projects.
Eastlink	Eastlink was providing wired services in the District of Mackenzie. Eastlink was contacted as part of this project but is no longer providing services in this area.
Monashee	Provides services using licensed (backbone) and unlicensed (local access) wireless technology in the areas of McBride, Valemount and the Robson Valley.
Rogers	Primary interest in cellular services along the main highway corridors. Rogers recently announced the purchase of Shaw Communications although at this time, it is unknown how that may benefit / impact connectivity in the RDFFG.
Shaw	Provides wired connectivity using primarily coaxial cable infrastructure in Prince George are of the RDFFG with backbone infrastructure construction along Highway 97 from Prince George to Dawson Creek.
Starlink	Currently (2021 April) provides pre-commercial beta-test internet service from a constellation of low earth orbit satellites. Later this year, full commercial service should be available. While not available in the RDFFG at this time, it is expected that these services will become available as the Starlink network is completed.

[25] Government BC – BC Fire Departments

Telus	Provides services in throughout the Regional District deployed using a mix of fixed wireless, fibre optics and DSL infrastructure and is considered the incumbent provider.
Xplornet	Provides direct to home internet service from a satellite in geostationary earth orbit. Prior to Starlink, Xplornet would be the only viable option for remote residents in the CRD.

6.2.2 Internet Connectivity

The summary map below provides a visual depiction of the areas served by each provider with the associated technology.



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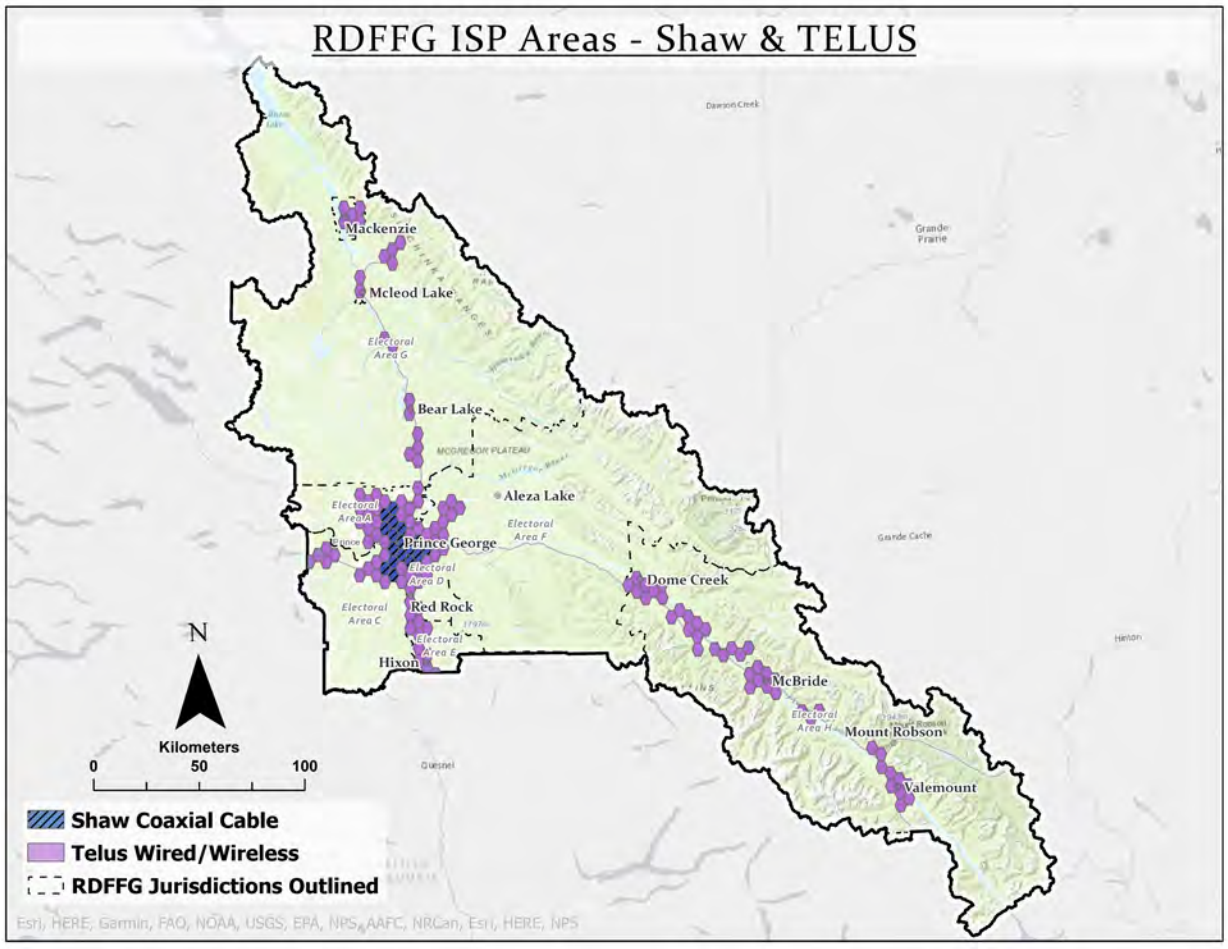
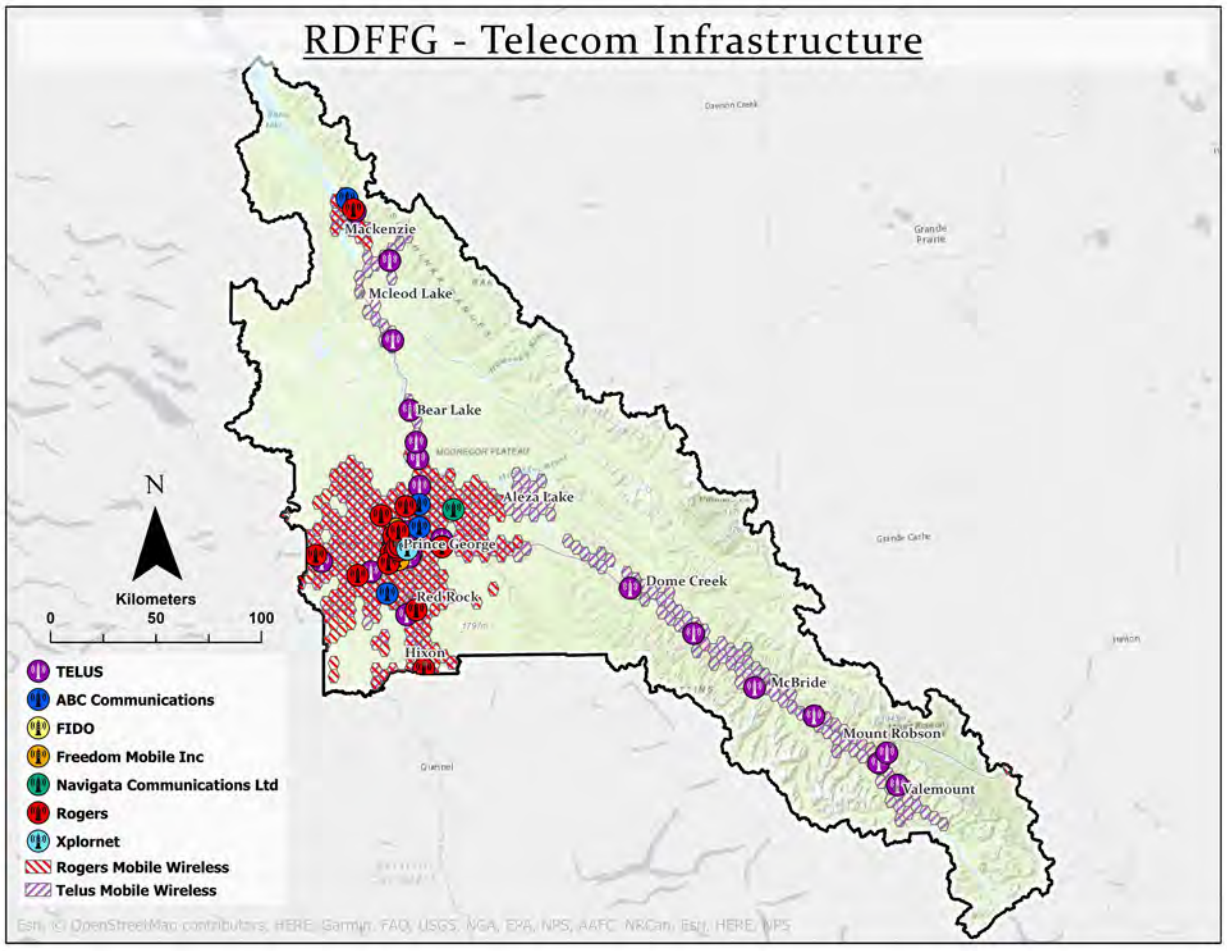


6.2.3 Cellular Services

The following are cellular service coverage maps for providers in the area which have been generated by reference to publicly available data such as coverage maps from the large telecom providers and ISED Canada. Readers should note that cellular coverage is highly variable and the actual cellular service available may be spotty and may not be available in all places shown on the map.



6.2.4 Announced Projects

While not necessarily a complete list, there are some announced initiatives related projects active in the RDFFG and additional projects may be announced after funding submissions are complete. Due to the confidential nature of these projects, detailed information (if applicable) is contained in the confidential addendum to this document.

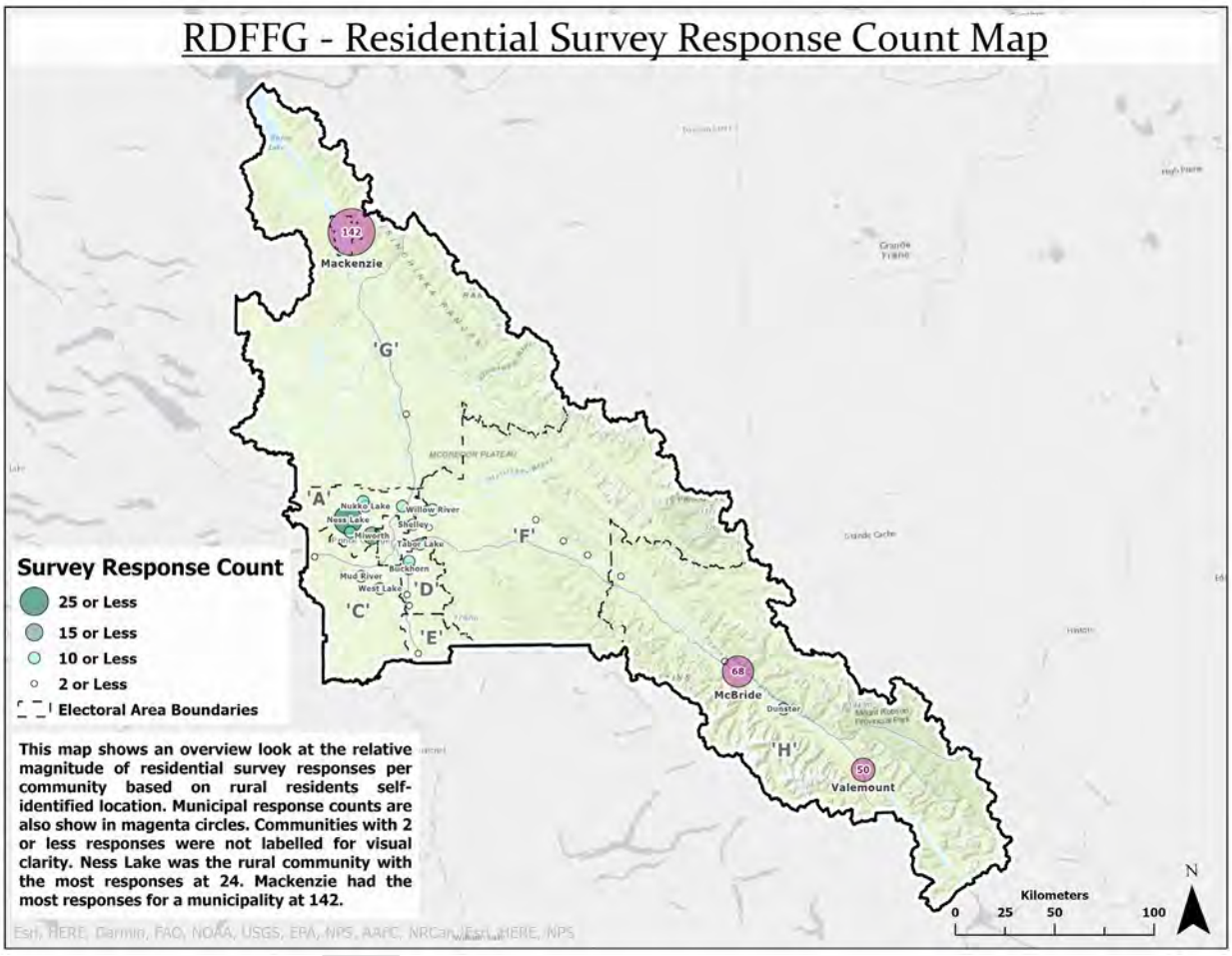
- Shaw is in the last stages of completing a backbone fibre build from Prince George to Dawson Creek. This construction provides for fibre break out points at key locations along the route including the intersection of Highway 97 and 39 providing a future breakout point for the District of Mackenzie.

6.3 Public Feedback on State of Connectivity

As part of information gathering, a survey of the residents and businesses was completed. The survey sought to gather information from residents and businesses about available service, costs, satisfaction, and service providers. A paper copy of the survey was available from the Local Governments as well as being online through the Local Government websites. It remained open for approximately 70 days. The survey was promoted by:

- The Electoral Area directors;
- Local Government publication on their respective websites;
- Social media promotions;
- Making paper copes of the surveys available;

The survey results were analyzed at the entire data set level and the following provides a brief summary of some of the interesting survey results. The analysis of the responses from the individual Municipal summaries as well as the rural region of the RDFFG will be found in sections 8 to 11 later in this document. A complete detailed summary of the survey results is contained in ancillary documents.



6.3.1 Summary of Residential Survey Results

Overview

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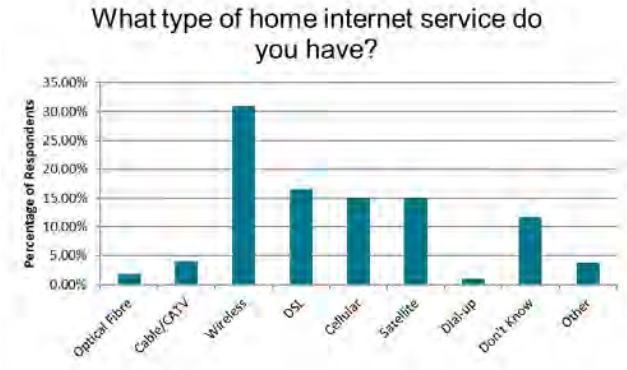


863 households answered the residential survey in the RDFFG. More than half of these came from rural areas with approximately 250 coming from Mackenzie, McBride, and Valemount. In Electoral Areas, Ness Lake was the community with the most responses at 60. Many of the respondents indicated that they are working from home. Over 95% of respondents said internet service is either Very Important or Critical to them. Of the 5% that reported not having internet access currently, over one-half said the reason was no availability. The vast majority stated that Telus is their internet service provider with many using Xplornet or ABC. The type of home internet service respondents varied but Wireless internet service was selected more than any other.

Quality and Cost

Nearly half of respondents said their internet costs are between $50 to $100 per month with 35% stating their internet cost over $100 per month. Over half of respondents said they pay additional overage charges at least one month of the year. Such costs were usually less than $50 although nearly 40% of respondents said they paid more than that. More than 90% of respondents reported download speeds of less than 50 Mbps. Over 65% of respondents said that higher speeds were unavailable to them despite needing higher speeds. 72% of respondents rated their overall quality of internet service as less than good.

> ***"I am paying the same or more for highspeed than elsewhere in the region but get a fraction of the speed they get. Friends in PG pay $80 they get 90 Mbps, I pay $80 and get less than 5 Mbps. That's not right!"***
> *- Municipal Survey Respondent*

Choice and Need for Improvement

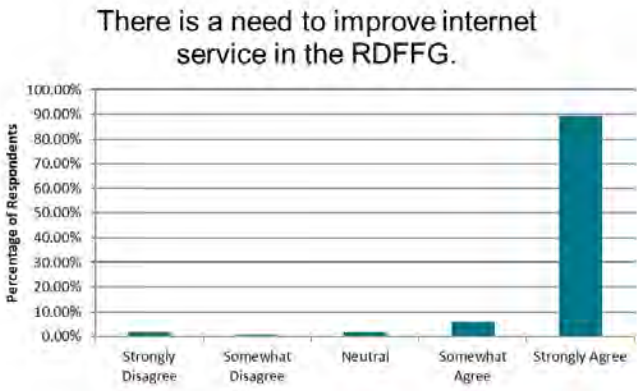
60% of respondents stated they are dissatisfied to some degree with their choice of internet service providers and over 45% said they have no choice of internet service providers. Overall dissatisfaction regarding internet service, the cost/value, and reliability of service was between 65 - 80%. About 35% of people said they would likely be willing to switch to a higher service with higher speeds for an extra $50 per month if it was available. Over 95% of respondents said that internet is an essential service and that there is need for improved internet service in the RDFFG. Nearly 90% or more of people said that improved internet would attract more residents/businesses to the region, increase economic activity, and have significant benefits for the region.

> ***"Faster Internet and especially cell service needs to be greatly improved."***
> *- Rural Survey Respondent*

Cellular Service

Most respondents – 90% – said they currently have cellular service. The 10% who reported not having cellular service primarily indicated that the reason was that it was not available. Nearly 80% said they are concerned to some degree about safety due to the lack of cellular service in the region. 60% of respondents said they have been in an emergency situation without the ability to call for help due to a lack of cell phone coverage. Over 60% of people stated they were dissatisfied with the cellular coverage in the region.

Summary



Overall, among respondents, there is a strongly held desire for improved internet and cellular services. Telus seems to be the main provider for most respondents, with other providers only available to parts of the region. In terms of support for how to improve internet service in the area, most respondents – 64% – like the idea of private industry leading the charge and providing better service without involvement by the Regional District. However, over half are also open to the RDFFG subsidizing the cost of implementing such service but would prefer if control and operation of such service remains under the umbrella of the ISP. Only 36% of people supported the RDFFG fully owning, maintaining, and operating the infrastructure and service outright. Over half supported the idea of a public-private partnership between the Regional District and private industry to share costs, control, and responsibility of the infrastructure and service.

6.3.2 Summary of Business/Organization Survey Results

General Overview

Of the 72 responses submitted by business owners, nearly 60% of them came from the three Municipalities and 23% came from rural areas in the RDFFG. Over 82% of the businesses employ 2 or more people and even more said 2 or more people at their business use the internet simultaneously. There is a wide variety of business respondents who responded to the survey including retail, tourism, information technology, professional services, arts, and many more.

Service Overview

95% of business respondents said they have internet access currently but the 5% who don't, said poor quality was the reason why. The overwhelming majority – 82% – said Telus is their internet provider and most said they have either Wireless or DSL service. Nearly 70% said they pay over $100 or more per month and over half said they pay additional overage charges at least one month of the year. Over 75% said they have download speeds of less than 50 Mbps and over 50% said they have upload speeds of less than 10 Mbps.

Need for Connectivity

> ***"Internet service has been a criteria that could very well cause us to move our business to a location where service is faster and more reliable."***
> *- Municipal Survey Respondent*

80% said the speed they have currently is less than they require and 64% of those said the reason why is because higher speeds are unavailable to them. 70% rated their quality of internet as less than good. Over 95% said internet is either very important or critical to their business and its operations. Over half of respondents said they are dissatisfied to some degree with their choice of internet providers. Nearly 70% are dissatisfied to some

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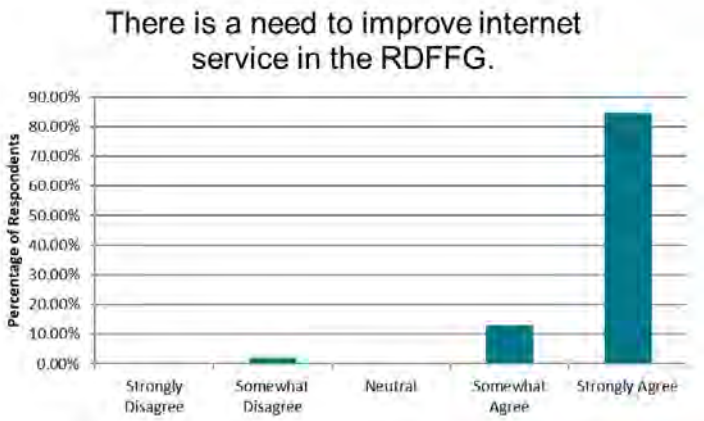
degree with their internet service speed. Similar numbers of respondents expressed these levels of dissatisfaction with the overall cost/value they receive and the reliability of their service. Over 40% said they would likely be willing to switch an internet service with higher speeds even if they had to pay $50 more per month.

Summary

Over 95% agreed that internet is an essential service and that there is a need to improve internet service in the RDFFG region. Over 90% agreed that improved internet connectivity would result in greater economic activity in the region, attract more residents/businesses to the area, and have significant benefits overall for the RDFFG and the three municipalities of Mackenzie, McBride, and Valemount.



Respondents were also asked about potential ways of funding improved internet connectivity in the region. Of the following four options, respondents tended to support either the service provider dealing with the problem or some form of a partnership between the service provider and the RDFFG and/or a Municipality.

1) "Internet service provider (like Telus) builds the infrastructure to provide service and owns it. All control and future responsibilities are the responsibility of the provider." – 63%

2) "RDFFG and/or my municipality subsidizing the cost (through federal grants, ie. gas tax or other) to help the service provider. The service provider still owns the infrastructure and all control and future responsibilities are the responsibility of the provider." – 51%

3) "RDFFG and/or my municipality owns and maintains an internet utility (through federal grants, ie. gas tax or other). A new ongoing taxpayer funded service would be established and control and future responsibilities are the responsibility of the RDFFG and/or municipality." – 36%

4) "RDFFG and/or municipality partnership with private industry partners and shares costs, control and responsibility." – 59%

6.3.3 Stakeholder Response

In addition to the survey outreach, key stakeholder information was provided by the Local Governments and augmented by TANEx and TANEx attempted to contact the stakeholders by direct telephone contact to have a one-on-one interview to gather insight and additional detail about the challenges or successes of connectivity in the area. The following provides a summary of the themes identified in these discussions where contact was successfully made:

Stakeholder Summary: Elected Officials
Summary of Information Reported: • Areas close to Prince George are relatively well served with poor service reported elsewhere often only available by satellite. • Wireline solution required because of challenging topography – existing phone lines are extremely old and do not provide the necessary functionality.

- Support for senior government strategy that uses cross-subsidization to provide service where business case does not stand up.
- Connectivity is an essential service.
- Concerns over public safety particularly in winter.
- Concerns over communities being left behind because of lack of reliable, affordable, high-speed connectivity and poor cellular coverage.
- Downturn in the forestry industry makes economic diversification extremely important and that is very difficult without connectivity infrastructure and services in place.
- Many constituents struggling with work from home, accessing educational services and lack of social connection in pandemic.
- Operational subsidy may be required.

Stakeholder Summary: First Nations

Summary of Information Reported:

- People living on rural reserve lands have a similar lack of acceptable connectivity as the off-reserve areas in RDFFG.
- Cellular service is spotty and unreliable.
- Broadband service does not support education, healthcare or other kinds of video meetings.

Stakeholder Summary: Business Community

Summary of Information Reported:

- Difficulty in accessing online training to keep employees updated.
- Lack of availability to same tools and opportunities as urban peers negatively impacts their competitiveness.
- Difficult to attract new business because of lack of connectivity that people expect.
- Movement away from landlines toward VOIP phones has risks for customer contact.
- Within municipalities, there are vastly different levels of service depending on where you are located.
- Connectivity holds back the existing business community and prevents new business from coming in.
- Existing levels of connectivity are problematic for the agricultural industry. Inability to access online auctions impact ability to acquire stock.

Stakeholder Summary: Community Representatives

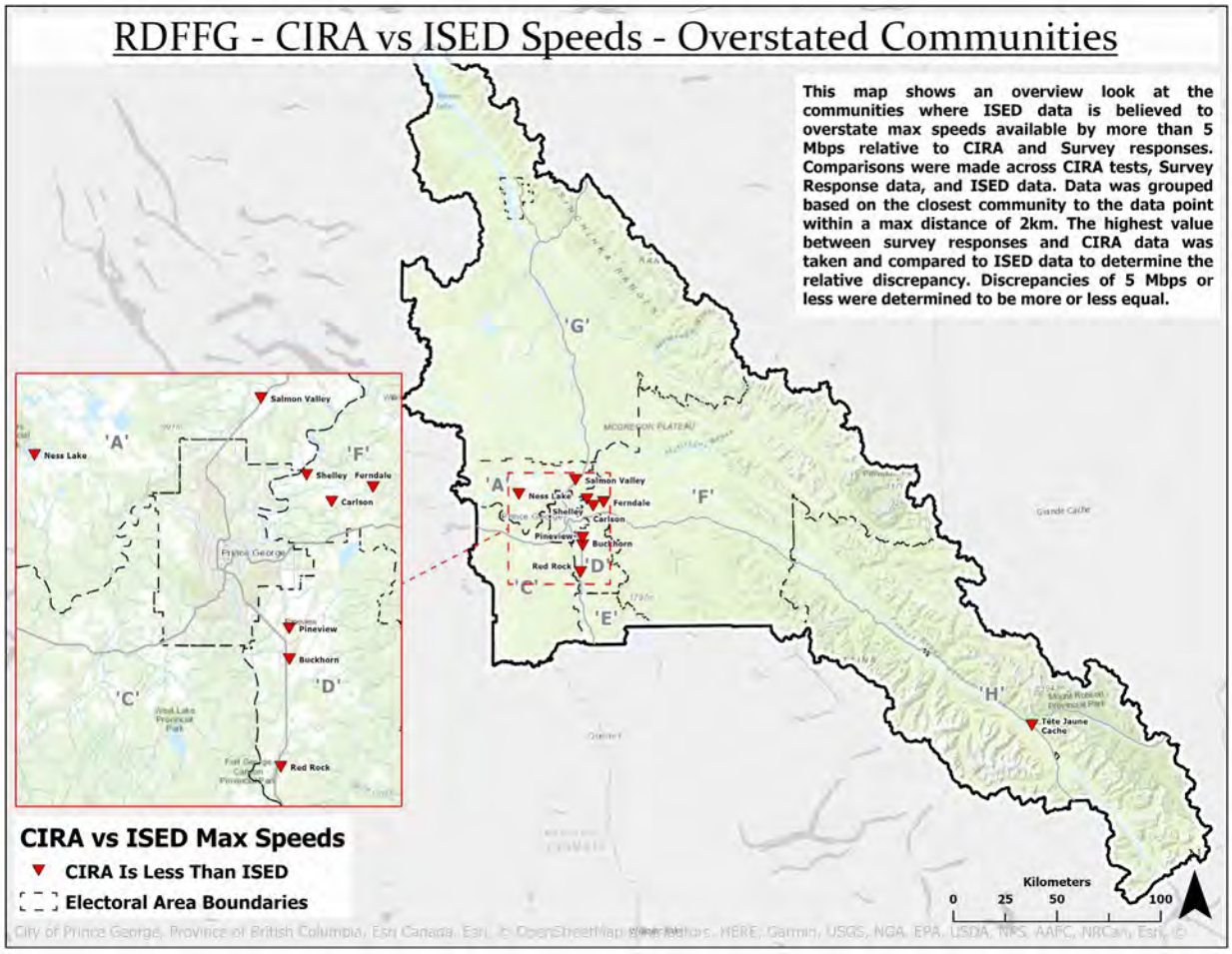
Summary of Information Reported:

- High levels of frustration over the fact that Shaw is going by with fibre but no plans to serve communities.
- Serious public safety issue because of lack of emergency service access arising from lack of connectivity.
- Long stretches without cellular coverage create vulnerability in a very wintry area of the province.
- Frustration with work from home combined with online education on sub-standard connectivity.
- Cannot keep young people in Robson Valley because of poor connectivity.
- Need to leverage relationships in order to get service improved.
- Line of sight creates challenges for wireless services.
- Concerns over inequities that arise for children trying to do homework where service at home is insufficient for the purpose.

- There are areas within the municipalities that have reasonable service and in some cases anchor institution have access to fibre infrastructure. Most do not.
- Poor home service has workers driving to areas along the highway where sufficient service can be obtained to do their work such as online teaching.
- Challenging topography is an issue.
- Public safety worries from wildfires in area.
- Access to remote healthcare is simply unavailable to certain people.

6.3.4 ISED Map, Survey and CIRA Testing

The RED triangles on the map below illustrate locations in RDFFG where the ISED Map shows available service levels higher than those reported through the CIRA performance tool. This is important to understand because the ISED Map dictates eligibility for certain funding. In locations where the ISED Map shows service available at 50/10, those locations will not be eligible for certain funding. More detailed comparison data for the Municipalities is provided later in this document.



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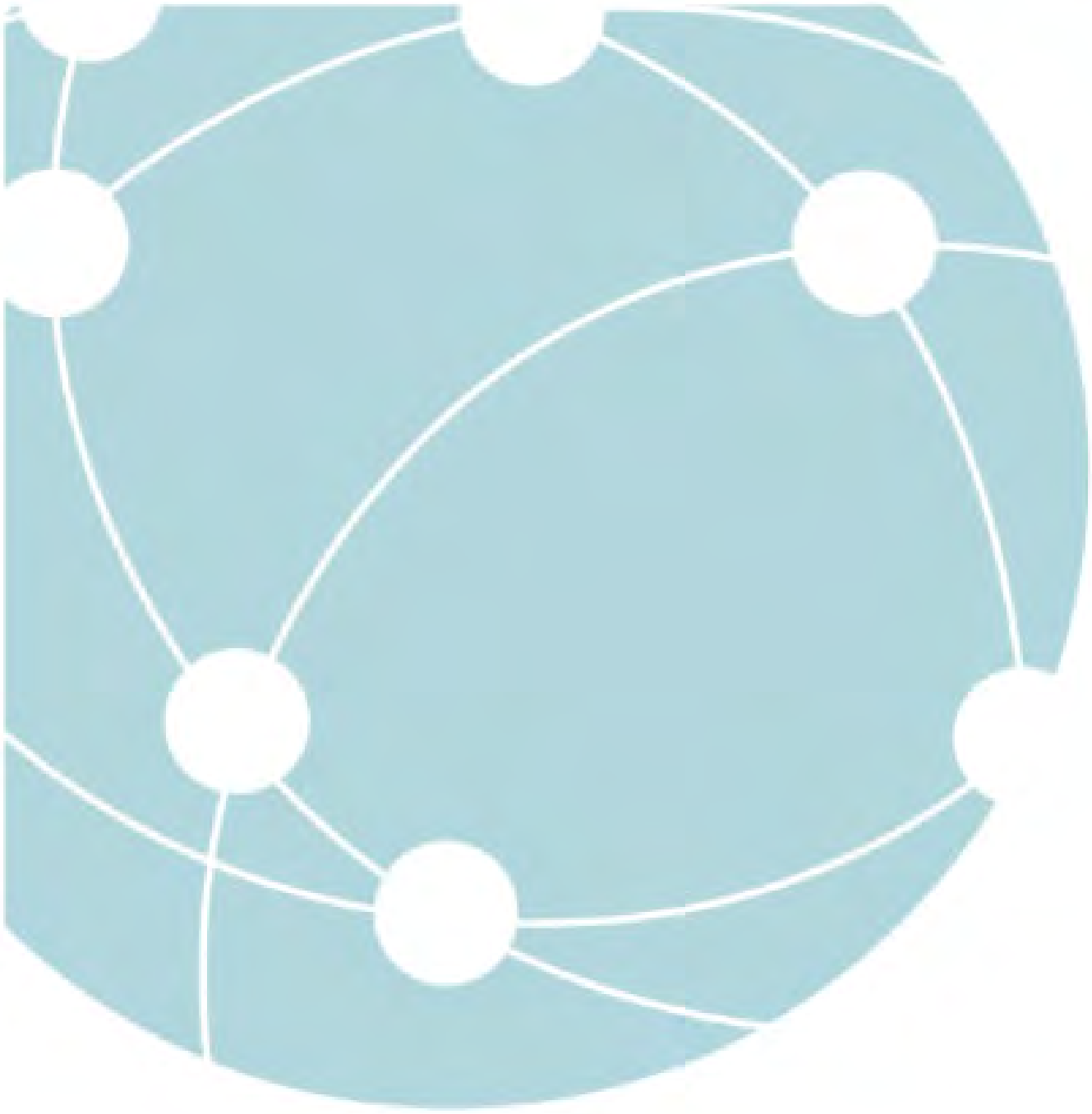

7 SITUATIONAL ANALYSIS

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7.1 Moving from Current State to Vision

In order for the Local Governments to move from their current state of connectivity to what they envision for the future, a number of steps are required. Earlier in the report, an assessment of the current state was completed, and a vision was enunciated. The third step is to understand what the

7.2 Understanding the Gap

7.2.1 Regional Connectivity Factors

Understanding the RDFFG connectivity situation and creating a strategy to address the gap between where requires the identification of the strengths and weaknesses of the region from a connectivity perspective. Strengths, weakness, opportunities, and threats have been summarized below:

STRENGTHS
• Major provincial transportation corridors run through the Regional District, including the John Hart Highway (#97) running north/south as well as the east/west corridor along Highway 16. • These corridors also have rail line and energy transport facilities including electrical power and pipelines for liquid petroleum products and natural gas. This corridor attracts and supports development. • Prince George is a major service and supply hub for the RDFFG and for Northern BC. • Regional District has existing related initiatives such as a regional data centre and centralized IT management for neighbouring Regional Districts that are underway. • The smaller municipalities have a mindset to serve the people living on the fringe. • Coordinated effort and proven cooperation between Regional District and the smaller municipalities. • There is existing presence by large providers in the major corridors of the region. • Existing initiatives by major providers (Shaw PG to Dawson Creek). • Diversity of industries that can benefit from improved connectivity such as forestry, manufacturing based on wood-based material, agriculture, service sector, mining, tourism, natural resources, transportation. • Fairly high density if rural clusters of Points. • Clusters are located along highway corridors with 43% of points within 1km of main highway corridors. • 93% of rural residents are permanent residents. • Competitive cellular coverage exists along major highways. • Within project areas, 43% of points are within 25m of another point. • Population is increasing. • Linear distribution of Points. • Higher median income than BC as a whole. • Financial strength of the Regional District has been steadily improving. • Current Economic Strategy in place. • Regional District human resources – strong team.

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WEAKNESSES

- Outside the larger communities on the major highway corridors (97 and 16), the population density is very low and scattered across a large geographic area. This means a challenging business case for rural broadband.
- No current regional growth strategy or economic development plan calling out connectivity as a strategic priority.
- Absence of large industry to assist in supporting high-capacity connectivity.
- Only 14% of anchors outside municipalities have access to 50/10.
- Limited number of providers outside the major highway corridors.
- Highway corridor between PG and Valemount has a single fibre provider (Telus).
- Only 29% of points outside Prince George have 50/10 service.

OPPORTUNITIES

- Valemount is located within the CBT service boundary and CBBC is a strong proponent of developing rural connectivity. CBBC has established expertise that may be leveraged for Valemount.
- TMX pipeline goes through the Regional District and there may be initiatives for connectivity infrastructure that can be leveraged.
- Surrounded by other Regional Districts with similar connectivity concerns who are actively pursuing connectivity strategies.
- Coastal Gaslink goes through the region.
- Potential to leverage Alberta projects including Trans Mountain.
- ISPs generally express willingness to cooperate and partner to improve service in under-served areas. Greater success can be achieved by leveraging resources and government subsidies to solve a bigger problem for more people.
- A variety of subsidy funding sources are available.
- The COVID-19 pandemic reinforces the important need for improved connectivity to rural and remote communities for services like education and medical care. The COVID-19 pandemic is reinforcing the need for improved connectivity to under-served areas.
- Over the next few years, the emerging availability of low earth orbit (LEO) satellite service should improve the quality of broadband service available to isolated locations in the RDFFG. Starlink is currently in beta testing in areas south of 53 degrees north. Early reports are positive with good coverage over the southern part of the Regional District. Service may extend north as the service evolves. Other LEO initiatives are also in various stages of planning and development.
- Prince George could be promoted as a key hub location for LEO providers.
- RD's central location allows it to facilitate greater cooperation among area stakeholders both in RD and outside.
- Use better connectivity to diversify the economy to reduce impact of mill closures.
- Many communities are along existing fiber optic transport facilities which may reduce the need for a new build.
- Major ISPs have a presence in the region.
- Telus infrastructure already placed along some major areas of concern.
- Expression of interest by external providers to deliver services in a partnership model.
- Large number of rural residents that need better service generating political influence for funding.
- People wanting to relocate to smaller centers at least in the short term.

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THREATS
• Economic impact of commodity market weakness in general, closure of major industry and COVID-19 related concerns impacting the business market. • Continuing economic stress from the collapse of forestry related markets. • Continuing economic stress from contraction of mining and mineral extraction related markets. • Although network operators have expressed a willingness to cooperate and complete transport fiber network rings and facilitate access networks, the difficulty of achieving cooperation should not be under-estimated when it involves other Regional Districts and multiple parties that usually do not cooperate or that are fundamentally competitors. • The incumbent may leverage its dominant position in the market to sabotage competition. • The COVID-19 pandemic may have significant near-term impact on tourism revenues. • Applications for subsidy funding are complex and involve significant effort. Further, applications to different funding sources often need to be combined in order to create a viable business case; increasing the complexity and effort required. • Competition for government subsidy funds and competition for network build resources may create a difficult construction market in the near term. • Regional District on its own does not qualify for existing funding opportunities. Lack of financial capability. • A minimum level of local operations and maintenance capability and commitment is necessary for community networks to be long-term sustainable. This can be difficult in smaller communities; particularly if the economic base is small, eroding, or has limited growth potential. • Split views on Regional District role in solving connectivity challenge. • Continued negative pressure on forest industry. Threats from climate change and natural disasters (mtn pine beetle, wildfires, flooding).

7.3 Summary of Regional Gap

To help understand the gap, it is important to quantify the size of the problem. The information following the table provides a summary for the entire RDFFG including the Municipalities. More detailed information for each Electoral Area and Municipality is provided later in the document.

Project Area Summary — Apr 12, 2021

			Project Definition					Current Service Levels			
Major Project Name	Sub-Project Name	Area	BB	Local Access	Total Subs	% of Total	Primary Svc	5/1	10/2	25/5	50/10
		Totals	10,951			100%		2,772	1,599	2,372	4,208
								25%	15%	22%	38%

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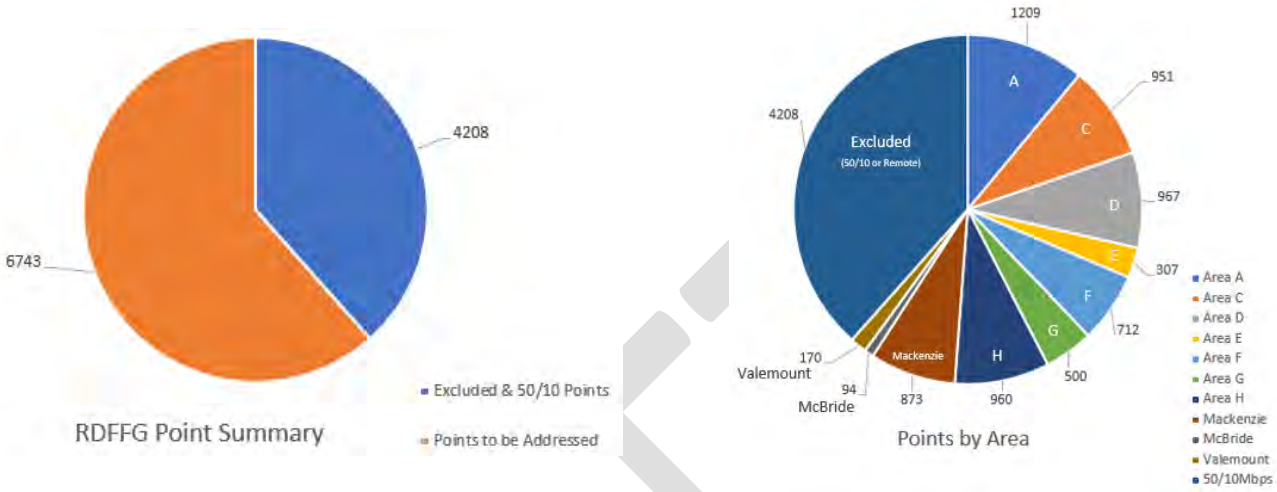
To provide further detail, the RDFFG has been broken down into project areas summarized by Electoral Area and Municipality.



Local Government Summary Conclusions

The above table and charts provide the following conclusions:

- There are nearly 11,000 Points not including First Nations or the City of Prince George in the RDFFG.
- Of these points, about 38% (total of 4,208) are shown on the ISED Map to have connectivity at the USO or have been excluded due to their remote nature.
- Remote Points will be good candidates for satellite service including the evolving LEO satellite service.
- While some of the Points that show as served at the USO according to the ISED Map this may not be consistent with public feedback and other performance data gathered. Additional detail is provided later in this document.
- Approximately 6,743 Points would be considered as those that require improved service that are shown as such on the ISED Map.
- Nearly 40% or almost 4,500 Points are considered poorly served with connectivity of 10/2 Mbps or less.
- Approximately 2,400 Points are served with technology suitable for 25/5Mbps representing decent service but falling short of the USO. While these are not the highest areas of need for solving the connectivity challenge, they should be considered when planning a solution.

7.4 Strategic Considerations

This section identifies strategic considerations for the Local Governments in advancing the connectivity solution.

7.4.1 Role of Local Government

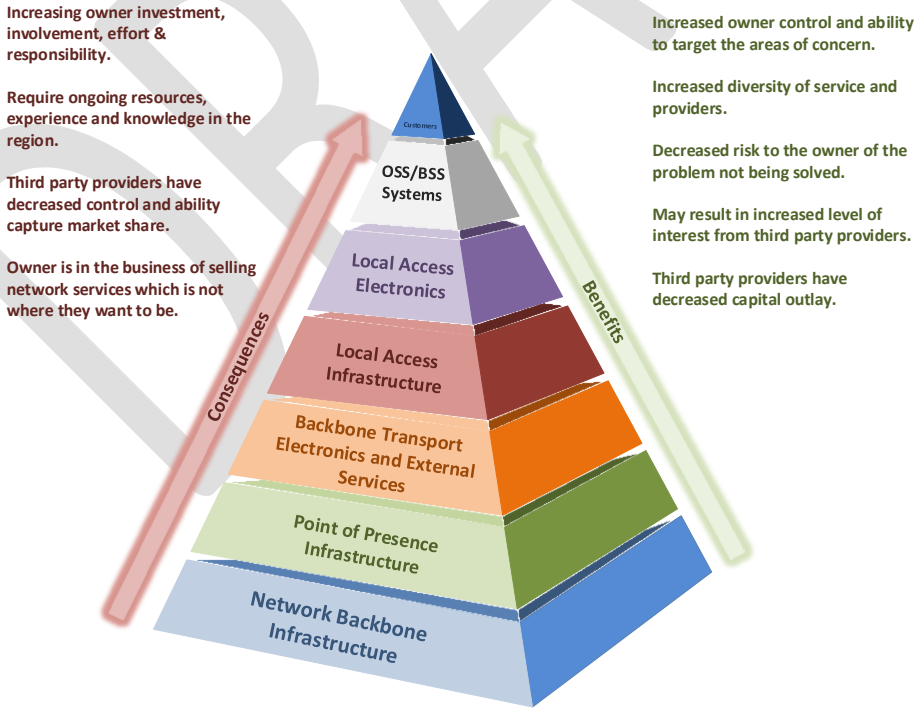
One of the first considerations is around the role, or roles that the particular Local Government will play in getting better connectivity for its constituents. The primary reason that connectivity is a challenge in the identified project areas is because those areas do not represent a viable business case for for-profit providers. As such, Local Governments may need to pay a more active role to address areas that may not be served by more conventional means. While the role that the Municipalities play in improving connectivity in the municipality will likely be consistent throughout its jurisdictional area, the role of the Regional District can vary from project area to project area and may not be the same for each project area.

A range of potential roles is depicted in the following diagram.

7.4.2 Technology

7.4.2.1 Broadband Service Delivery Pyramid

From a technical aspect, solving the connectivity challenge for rural and remote areas is the same as an urban environment and requires a service delivery model that encompasses a number of layers that all need to be provided. The following Service Delivery Pyramid ("SDP") provides a visual depiction of the layers of infrastructure that must be present to solve the connectivity issue:



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The diagram above outlines the SDP and delineates the individual layers that must be provided and the relative levels of responsibility the network owner must address to satisfy the goal of improved services to the residents and businesses. Solving the connectivity problem requires that all layers of the SDP be provided, either by one entity or by the collaborative efforts of numerous parties.

As the network owner commits to, and moves up the layers of the pyramid, increasing levels of complexity and involvement are required. Although this may seem intimidating, the benefit of increased control and influence on improvement of services may outweigh the hurdles.

The layers of the SDP are as follows:

Backbone Infrastructure: This is the physical infrastructure required to bring long distance connectivity to a community. For high-capacity modern networks, this would typically be fibre optic cable but in some cases, high-capacity microwave may also be suitable. The term backbone is also synonymous with "transport infrastructure".

Points of Presence: POPs are the infrastructure required in each community (or along the backbone route) used to locate the electronic components required to enable connectivity as well as act as a termination point for the backbone infrastructure. For example, in the case of a fibre optic backbone, the physical cable would be installed inside the POP and the cable connected to the electronic components within the POP. A POP houses sensitive electronic components so suitable environmental controls are including, but not limited to, air conditioning, battery, backup power, and security.

Backbone Transport Electronics and External Services: This layer represents the electronic components and services required for the POP to enable connectivity outside of the local area to other POPs and ultimately, the global internet.

Local Access Infrastructure: This includes the physical assets required to connect the local POP to the subscriber's home or business. There are numerous choices for technology, but for modern, high capacity, scalable networks, fibre optic connectivity is the preferred option. Different options for local access technology are more detailed in supplementary documentation.

Local Access Electronics: This layer of the SDP represents the electronic components required in the POP and in the subscriber's home or business that enable connectivity to underlying layers of the SDP. This is the final physical component required to enable connectivity.

OSS/BSS Systems: All the lower levels of the SDP, require management to ensure they are operating correctly and to provide the business operations of the network. These operations include, but are not limited to, network monitoring and management systems, billing, provisioning, technical support, customer service support, maintenance, among others.

Customers: The final layer to a successful broadband network is the existence of customers subscribing and paying for services on the network. In the case of rural and remote networks, anchor tenants or institutional customers can be particularly beneficial in supporting the sustainability of the network.

Greater detail on the technical aspects of the Service Delivery Pyramid and a comparison of technology can be found in Appendix.

7.4.2.2 Technology Overview

Broadband connectivity can be provided using a number of different technologies each having various advantages and disadvantages. While a more thorough comparison of different technologies in contained in the Appendix of this document, it is important to understand a few technologies for delivering high quality connectivity in rural areas.

7.4.2.2.1 Fibre Optic Technology

For delivering high capacity, scalable and very reliable connectivity over long distances, fibre optic technology is the only viable technology available. Long distance fibre optic backbone networks are critical to enabling almost all other technologies to deliver services in a manner that provides the high capacity needed to deliver the USO now and in the future. Fibre-optic backbones combined with local access delivery using Fibre to the Premise ("FTTP") provides the best possible fixed service currently available with virtually unlimited ability to offer a variety of services in the most reliable fashion and lowest ongoing operational costs. With the disadvantages of high up front capital cost and lack of mobility, fibre is the preferred alternative for all broadband connectivity. However, when considering the lifetime of fibre optic infrastructure is 25+ years, the capital cost over the lifetime of the asset makes the cost fibre comparable to other technologies.

7.4.2.2.2 Wireless Technology

Wireless technology is desirable because of its relatively low cost and quick deployment time. While wireless can be considered suitable for some areas, it may not be as desirable as other technologies due to its lack of scalability, product lifecycle and susceptibility to interference when using unlicensed wireless technology. Despite its disadvantages, this technology does have a place in creating connectivity to rural locations particularly in areas where there are fewer users or where a decision is made to deploy wireless to improve connectivity where the budget is insufficient for a fibre-based solution. Service at the USO may not be achieved however in all situations.

7.4.2.2.3 Cellular Technology

Cell networks began as a means of delivering mobile telephone service but have evolved to include text messaging and access to most of the communications, information, and other services available over the Internet. Cell phones have displaced fixed line telephone service as the preferred way to communicate with individuals. The smart phone has become an essential personal appliance, providing communication, access to information and many other services and applications for personal convenience, productivity, safety, and entertainment. Safety and security are often cited as a primary use for cell phones. In many areas, over 80% of emergency calls to 911 are from cell phones[26].

The cellular mobile system is a separate network with cell sites that connect forward with radio to user terminals, typically smartphones. The cell sites are backhauled to a core network, typically over fiber. The core network has gateways into other networks including the public switched telephone network and the public internet as well as, in many instances, secure gateways to specific enterprise and private networks. The technology is governed by open global standards, enabling cell phones to generally "roam" world-wide. Access to spectrum (radio frequencies) is an essential ingredient which is regulated by national governments and cell spectrum is usually auctioned to mobile network operators who have the financial backing to afford the spectrum.

The current generation of cellular network in Canada is the fourth generation or 4G - commonly referred to as Long-Term Evolution (LTE). The LTE network was designed from the ground up to support the

[26] Local21News – *"How accurate is your cell phone location data in an emergency?"*

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Internet Protocol suite with high data rates. Although not designed to compete with FTTP data speeds and monthly usage levels, where several user devices, including big screen TVs are accessing the internet, the cell network provides good internet access given the small form factor of most mobile devices. In the home, Wi-Fi is used to connect mobile devices to the internet, offloading usage from the cellular system.

Next generation cell, 5G, has rolled out to urban centers across Canada and is generally expected to gradually extend to smaller centers and rural areas over the next few years. The 5G network features improved efficiency, capacity and capabilities that are intended to support additional use cases, including fixed wireless broadband access. The new frequency bands to support fixed broadband will only be released in Canada through government auction processes over the next few years.

7.4.2.2.4 Low Earth Satellite Technology

Satellite based communications have been characterized as "distance-insensitive" because there is no linear chain of terrestrial cables or radio sites between the end points, only the radio link through the satellite network. Satellite networks designed to serve directly to the customer's premises combine the transport and access (last mile) network functions into a single network. Xplornet is an example of such a network based on geostationary earth orbit satellites. Unfortunately, transmission delay and the relatively high cost for normal consumer broadband usage levels are significant limitations for these satellite networks.

A new generation of satellite networks are being planned and deployed into low earth orbit (LEO). These networks improve the delay performance and may address the data usage affordability issue. Instead of each user connecting to a single satellite, each LEO satellite network is a "constellation" of hundreds (or thousands) of small fast-moving satellites that are only visible for a few minutes at a time. To have continuous service, a second satellite must rise above the horizon before the first sets.

The Starlink system being launched by SpaceX is the first-to-market LEO service. As of the writing of this report (April 2021), beta test service is available from Starlink in northern US and southern Canada (as well as the UK). Over the next few months, northern coverage may improve and extend throughout the Regional District. The beta service is proving popular for isolated customers and is available in Canada for approximately $800 for the terminal (self-installed) after shipping and taxes and then $130 per month. So far, the beta test results support Starlink claims of 50 - 150 Mbps downlink speeds and 10 - 30 Mbps uplink speeds with round trip delay in the 20 - 40 msec range. Whether the system will retain these performance figures as the system and subscriber base scales up is unknown at this time. Other broadband LEO systems are also planned (such as OneWeb, Telesat LEO and Amazon Kuiper), but service is at least one or two years out and these may not provide services at the consumer level (e.g. such system may focus on providing backhaul access networks for cell sites, remote camps and remote communities).

Satellite internet systems consist of user satellite terminals with small antennas, satellites, ground stations and the internet. The ground stations are "gateways" between the internet system based on Earth and the satellite network. Starlink and most planned LEO satellite systems require a network of ground stations to minimize delay. Specifically, the more gateway ground stations a system has, the lower the number of inter-satellite hops necessary to get to the terrestrial internet resulting in a reduction in overall service delay. This also reduces the "load" on the inter-satellite network, minimizing the risk of the inter-satellite network becoming congested and slowing down the service.

The need for gateway ground stations for LEO satellite systems may be an opportunity for locations that have good internet connectivity and can effectively serve remote regions. Prince George has potential to be such a location because of its central location in the province and its robust path diverse

internet connectivity (i.e., more than one fiber transport route to different internet exchange points in Vancouver and Edmonton).

7.4.3 Establishing Project Priorities

The Local Governments' project areas need to be prioritized at the minor project level to establish a logical sequence for implementation and realistic goals. Considerations for establishing priorities include:

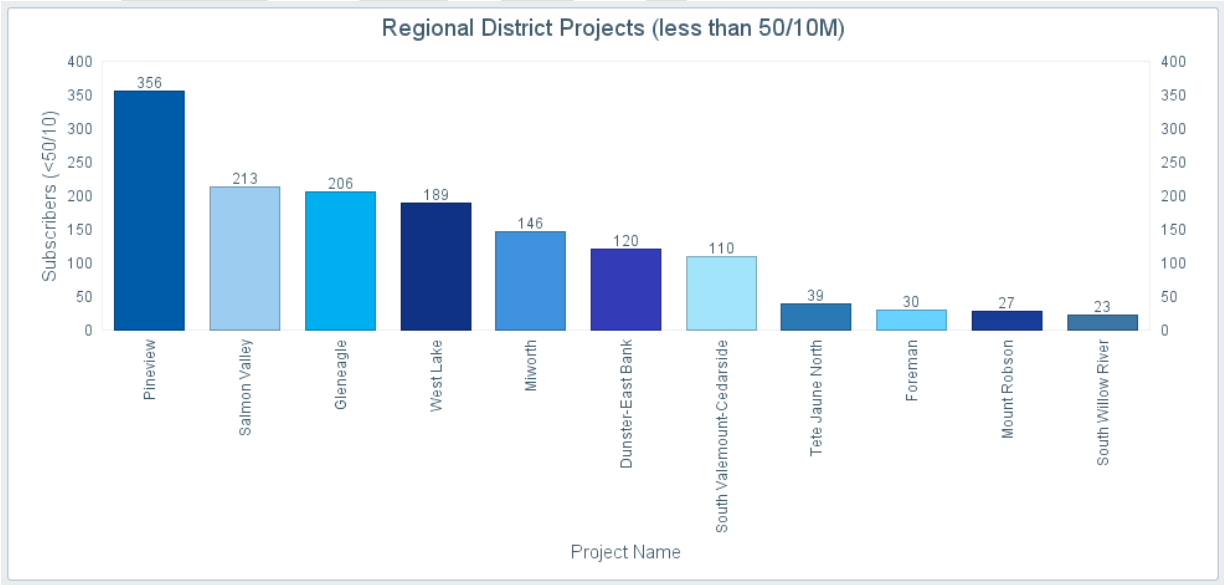
- Logical sequencing of construction.
- Largest impact for the highest number of residents.
- Largest need for improvement. Areas that have the worst service may need it the most.
- Easiest to implement. Look for the quick wins.
- Lowest cost per subscriber.
- Areas that are eligible for federal and provincial funding.
- Focus on areas that are unlikely to be constructed by third parties.

To provide a starting point for this discussion, this study defined many project areas of varying numbers of Points. To establish priorities, consider the following:

Prioritize by Logical Construction Sequence

Networks need to be constructed in a logical sequence. This usually means that services are constructed in a fashion from the core of the network outward as there is little point in constructing a network that cannot connect to anything. The project areas defined have been ranked by dependencies which assists in establishing a logical build sequence.

The following minor project areas identify those that are likely to be constructed first as they allow future projects to leverage the infrastructure. In the case of the RDFFG, projects with no dependencies mostly aggregate back to Prince George as the major center of connectivity in RDFFG.



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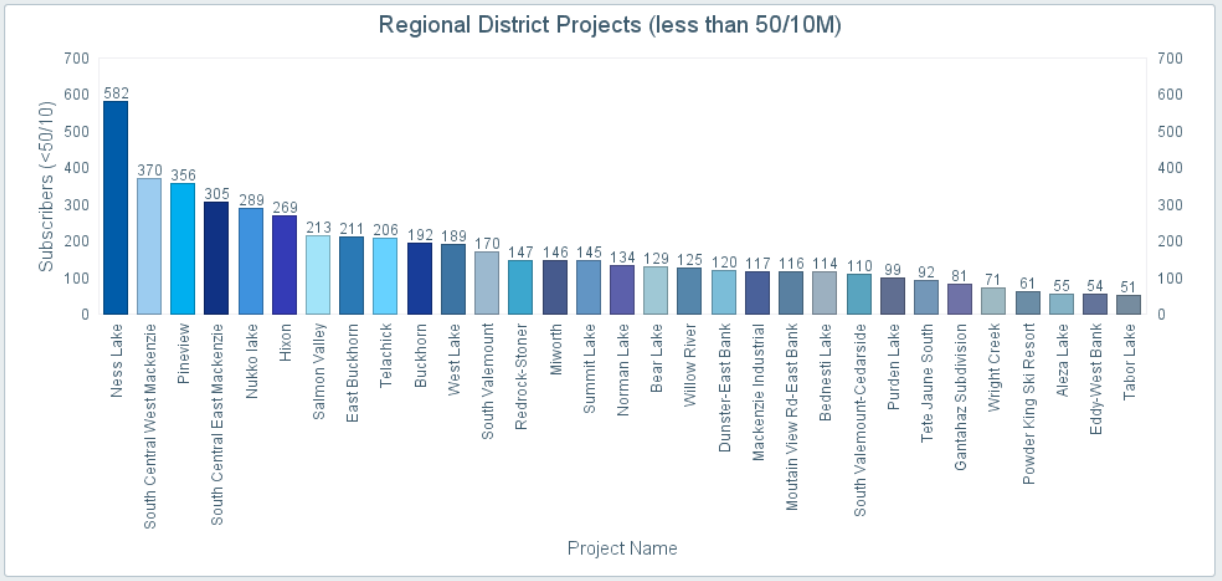
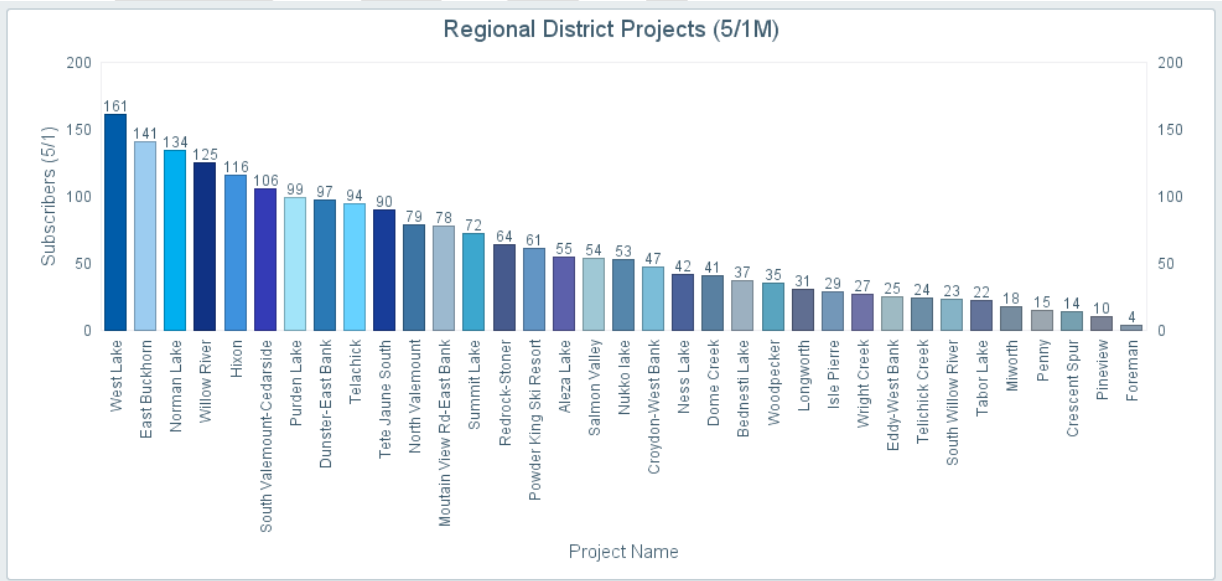
Prioritize by Largest Number of Points Served

The following minor project areas represent the minor project areas with the highest total number of Points at speeds identified by the ISED Map as less than 50/10Mbps and that have more than 50 Points. These project areas present the largest opportunity to solve the connectivity problem for the highest number of homes.



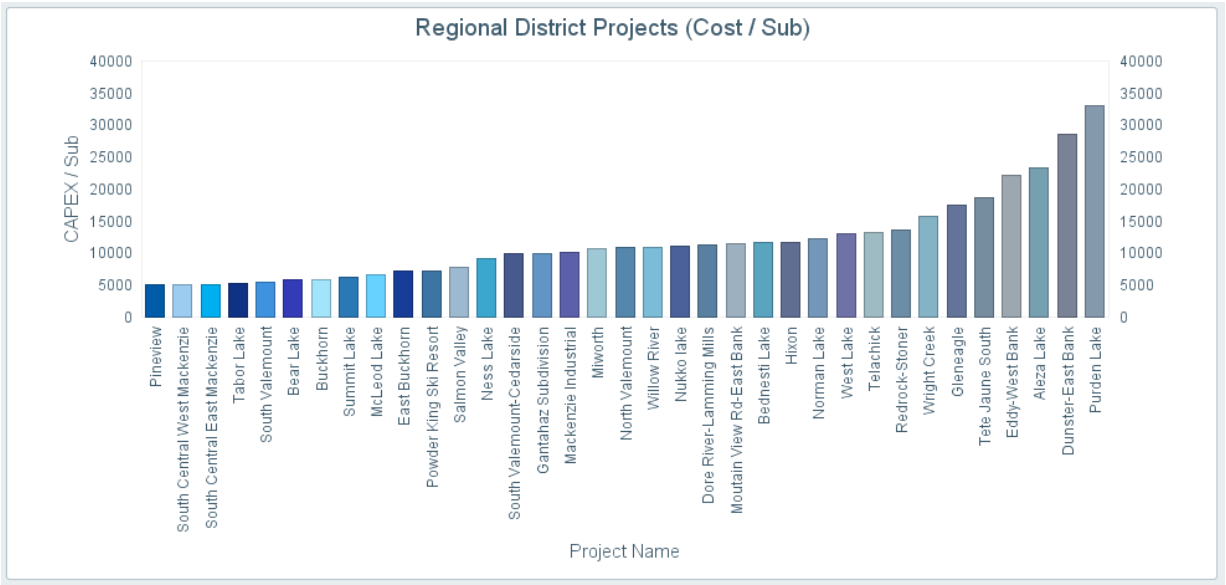
Prioritize by Poorest Existing Service

The following minor project areas represent those with the highest total number of Points at the lowest speeds of 5/1Mbps or less.



Prioritize by Lowest Cost per Subscriber

The following graph illustrates minor project areas that have more than 50 Points in order of lowest cost per subscriber. This has been created using the cost assumptions outlined in the ancillary document.



7.4.4 Establish Resourcing

Like most initiatives, making tangible progress towards the goal requires dedicated effort by the stakeholders. Like many organizations, Local Governments suffer from a problem of many competing regional needs and a lack of time and resources to complete them. In order to effectively move the connectivity challenge forward however, Local Government need to consider a dedicated resource that can manage the priorities and ensure progress to the goal. There may be potential to share such a resource between the Local Governments. Among others, some of the tasks for this resource may be as follows:

- Determining the role and establish working parameters to guide the effort.
- Establishing priorities.
- Communicating the priorities to external providers, partners, and other stakeholders.
- Creating a method to measure and ensure progress.
- Create a connectivity working group with area First Nations and municipalities.
- Participate in existing connectivity working groups.
- Researching, gathering information and obtaining access to funding.
- Resolving discrepancies in the ISED map to maximize the number of eligible areas for funding.
- Working with other experts to create solutions.
- Gaining community support for initiatives.
- Focusing and responding to letters of support by providers to ensure the proposed solutions address the goals of the RDFFG.
- Potentially advancing the creation of service areas depending on the RDFFG direction.

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7.4.5 Correct / Confirm ISED Funding Eligibility

Like most initiatives, making tangible progress towards the goal requires dedicated effort. One of the roadblocks that communities face is the inability to access large funding opportunities particularly from the federal sources, due to the fact that they are considered served at the USO based on ISED data that is used to determine funding eligibility. Each of the Municipalities is shown largely as served at the USO on the ISED Map but survey and outreach results bring that into question. In order to obtain access to federal funding programs, this discrepancy must be corrected and while there is a defined process to do so, it is labor intensive and will require local coordination. This is critical going forward and a very practical task for a dedicated resource.

The process of addressing the ISED eligibility includes:

- Complete the required template provided by ISED.
- Collect speed test measurements as outlined that must contain:
  - Internet service provider's name
  - GPS coordinates of the speed test (latitude/longitude)
  - Civic address
  - Last mile technology
  - Subscribed download service package
  - Subscribed upload service package
  - Measured download speed
  - Measured upload speed
  - Date and time of test and measurement.
- In order to substantiate the speed test results, screen captures must be provided as acceptable evidence to demonstrate the requirements mentioned above.
- Provide official correspondence with an Internet service provider as a connectivity evidence.

7.4.6 Collaboration and Grass Roots Support

The federal, provincial and other local regional and municipal governments have initiatives underway to improve rural and remote connectivity. Neighbouring Regional Districts who are actively addressing the same kinds of issues include Thompson Nicola, Bulkley Nechako and the Peace River Regional District. While there may be jurisdictional Regional District boundaries, connectivity is not contained within these boundaries and effective solutions will cross these jurisdictions. Collaboration across local, Regional and First Nations governments where possible, may assist in speaking with a single voice, accessing multiple funding sources and aggregating the problem to a more significant size and solving a larger problem for more people. When considering the cost of implementing connectivity, the number of Points included in the cost base is a critical component to spread the infrastructure costs across as many subscribers as possible.

Further, solving the connectivity challenges in remote and rural communities cannot be considered one community at a time as the business will likely never make financial sense for private industry. Local Governments can play an important role in understanding and communicating the areas of concern to solution providers to make the most effective use of the effort and capital required to solve the problem.

Finally, it is very important that areas have a local community champion that is passionate about advancing a solution. Areas with such a person can be prioritized because without such a person,

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initiatives often wither and lack community buy in. Where there is a strong community champion who provides leadership towards the solution, better traction is often seen. Those community members will be vital to the project's success.

7.4.7 Present Project Priorities to Providers

As pointed out above, minor project areas must be prioritized and communicated to providers that can participate in solving them. Providers such as Telus, are applying for funding subsidies based on their own defined areas of interest and may not be considering all the priorities. Using the information outlined in this report, Local Government is better positioned to understand areas of need and communicate its priorities to external third parties.

An advocacy role makes cooperative participation with providers a key action. Providers engaged as part of this project expressed interest in working with Local Government to resolve its areas of focus through a variety of business models from supporting funding applications, to capital contribution through funds raised and deployed where a viable business case simply cannot be made.

Letters of support are often requested by providers and these letters need to be considered carefully to ensure the proposed project aligns with the goals and priorities of the Regional District. Further, funding programs often have eligibility criteria and care needs to be taken to ensure that projects are positioned for future scalability and do not provide marginal improvement which has the result of disqualifying the area from future funding by establishing an improved service but not consistently throughout the community at the USO.

Investments in infrastructure, particularly if Local Government funding is required, should be scalable to meet the current USO and position appropriate technology for current and future requirements particularly if public funding is deployed.

Considerations for the letter of support should include:

- Definition on the specific projects area(s).
- Inclusion of other surrounding project areas and priorities that may not be the intended focus but could be addressed more efficiently by inclusion in the requested scope.
- Defined project timelines.
- Defined levels of service and technology. Projects seeking funding should implement technology that meets or exceeds the current USO as while this may be considered sufficient for today's needs, technology continues to evolve and requirements for connectivity are likely always increase.
- Definition of the services desired. This is discussed more in the next section.
- Support for infrastructure to be constructed in a manner that promotes competitive services and provides where the providers is seeking public funds.

In addition to communicating project priorities and support for third party initiatives, Local Government may be able to contribute assets that can be leveraged by providers to reduce the barrier to entry in the priority areas. Local Government may have access to buildings, locations, rights of way, etc that may be available to contribute to a project. Firehalls provide a good example of an asset that could be used as a Point of Presence ("POP") required in delivery improved connectivity.

All Local Governments should inventory available assets to understand how to the Local Government could reduce the barrier to entry for a provider by leveraging those assets.

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7.4.8 Establish a Timeline for Improvement

Local Government should establish a timeline for noticeable action and improvement. Federal and provincial funding programs have an inherent problem of slow response. Often, funding programs are announced, time is given to obtain funding applications, time is allotted for evaluation, announcements are made, clarifications and questions are required, funding is deployed, detailed construction plans are drafted, approvals are required for access to existing infrastructure and finally construction begins. The problem is that the time to complete this is measured in years rather than months. Further contributing to this problem is that federal, provincial, and local government changes in leadership may stop advancing the solution due to differing priorities.

Establishing milestones which provide a checkpoint for completion with a predefined action and escalation plan if the milestone is not reached when expected. Once each project priority has been established, clear established milestones for engaging service providers, assessment of options, decision on the path forward, etc have been developed. For example, a timeline may be established that if provider engagement has not been achieved within 3 months of initial engagement, a plan to escalate the initiative to what might eventually be a more active role for Local Government in obtaining the solution.

The RDFFG has numerous defined project areas and in defining a timeline for each priority, projects can be prioritized, and progress can be measured. A complete list of all defined projects in the RDFFG has been provided in the ancillary document.

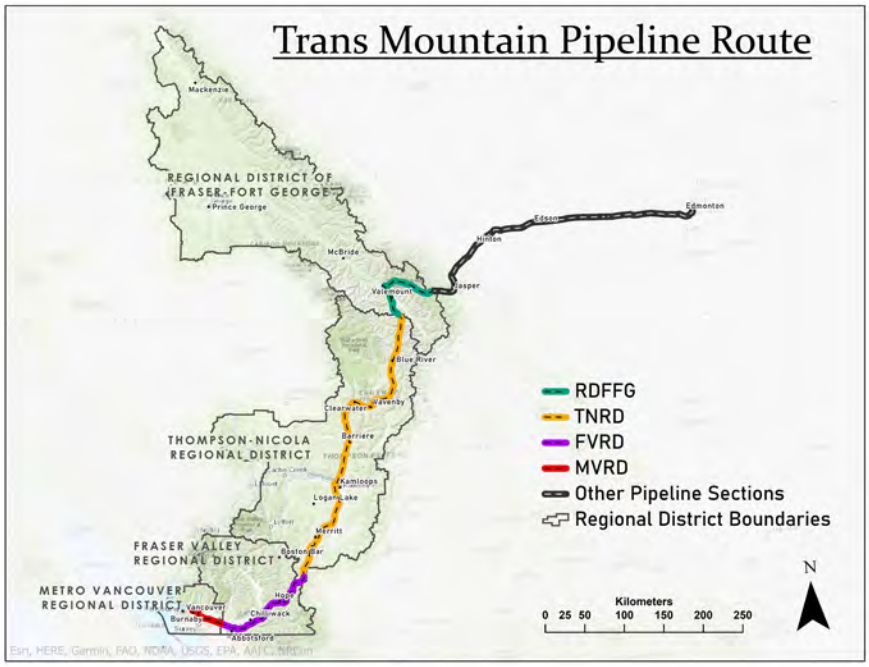
7.4.9 Leveraging Trans Mountain

As part of the pipeline expansion, Trans Mountain is required to construct infrastructure for monitoring and leak detection as a condition of the Certificate of Public Convenience and Necessity (CPCN) issued by the Canada Energy Regulator (CER)[27]. Fibre optic infrastructure is a logical solution to that requirement and constructing fibre optic infrastructure for the purpose of serving rural connectivity should be considered at the same time.

[27] National Energy Board, Certificate OC-065, Trans Mountain Pipeline Application

As identified in the SDP, “backbone” or “transport” fibre is critical for delivering internet and cellular services to rural areas because it provides high-capacity external connectivity to those communities, other communities, the province, Canada and globally. Without reliable, cost effective backbone capacity, a provider is unable to bring service to these communities in a way that makes business sense.

As part of the regional connectivity strategy, TANEx views the ability to obtain access to backbone capacity along the Trans Mountain right of way as a major opportunity for the RDFFG. Leveraging every opportunity to remove major cost barriers is critical to achieving connectivity for rural and remote areas. Local governments need to organize to speak with a single voice to advocate for a publicly controlled fibre optic communications backbone along the Trans Mountain pipeline. To do this, local government needs to work collaboratively with other stakeholders including neighbouring Regional Districts, interested municipalities, First Nations and industry where possible, to solve a bigger problem for more people. As a federal Crown corporation, Trans Mountain represents an opportunity to leverage the existing project to advance other federal government priorities such as rural and remote connectivity.



As a preliminary overview, TANEx completed a brief study to understand the potential benefit of obtaining access to backbone capacity along the Trans Mountain Pipeline right of way. To quantify the benefit, potential subscribers were plotted along the pipeline right of way within 10, 20 and 30 km buffer zones. The point count depicted in the map below includes the total points (not including First Nations or municipalities) located within the buffer zones in the RDFFG as well as a subtotal of those points that have been included in a potential project area.

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Fibre optic connectivity along the Trans Mountain right of way, especially if positioned in a manner that supports the greater good, has the ability to impact a significant number of potential subscribers across a number of neighboring regional districts along the pipeline route. Not only does this represent a significant capital and operating cost component to the solution, but it provides an opportunity for rural subscribers and service providers along the pipeline route to obtain connectivity to the major centers of Kamloops, Vancouver and Edmonton that provide access to an Internet Exchange critical to connecting to the global internet and providing cost effective internet connectivity.

Third parties may already be in discussions with Trans Mountain to obtain access to fibre optic capacity along this important route. While this may indicate progress, how, or if, it benefits the RDFFG rural and remote connectivity challenge remains to be seen and will be determined by those third parties. A fibre backbone through many of these communities already exists through some major providers but that does not mean that those rural communities get appropriate connectivity. Communities along this route continue to suffer from poor to no connectivity. To solve the connectivity challenge, the business opportunity must be opened for competitive providers to obtain access to the potential market without being encumbered by high-cost backbone connectivity.

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At a minimum, the opportunity presented by the Trans Mountain expansion must be explored further at the earliest possible opportunity by the Fraser-Fort George, Thompson-Nicola, Metro Vancouver and Fraser Valley Regional Districts. Combined, these government organizations represent a significant presence with a direct interest in the Trans Mountain construction. The opportunity presented with access to the Trans Mountain right of way may benefit not only the local governments in their quest to address the rural connectivity challenge but a potential win for all parties including Trans Mountain.

7.4.10 Seek P3 Partners

One of the options that is becoming more readily available for local governments to utilize in solving the connectivity challenge is the engagement of Public Private Partnerships ("P3'). While Local Government may not have considered these opportunities in solving the connectivity challenge, there are some very real possibilities that need to be explored with varying degrees. These can range from well established incumbent providers to more creative models involving private funding and in a variety of forms. This may also include a simple financial contribution with no established method for sharing of revenue, control, or ownership, to a more active role of participating in the ownership and sharing of the revenue to make the investment sustainable.

7.4.11 Establish Critical Infrastructure

As discussed earlier, fibre optic backbone infrastructure is a critical component to all service delivery technology whether it be via cellular, wireless, DSL, coaxial cable or FTTP. Establishing fibre backbone, ideally with multiple providers and diverse paths is critical to reliable, high-capacity connectivity regardless of the technology. Local Government needs to ensure that infrastructure placed and perhaps financially supported is available to as many providers and services as possible. Having to duplicate this infrastructure is very costly and inefficient and rightly so, providers view this kind of infrastructure as strategic to their business. When being asked for letters of support or other items regarding backbone fibre, or any other infrastructure for that matter, they should ensure that it is being constructed with a view to future providers and capability especially when it is being constructed using public funding or Local Government capital. All infrastructure paid for using public or Regional District provided funds should be available for any provider in a manner that provides a suitable business case for all parties. Think highways, not railways as the model where possible. Everyone with a car can drive on a highway but railways are only for the use of its owner.

For more information on the Open Access concept, refer to the appendix.

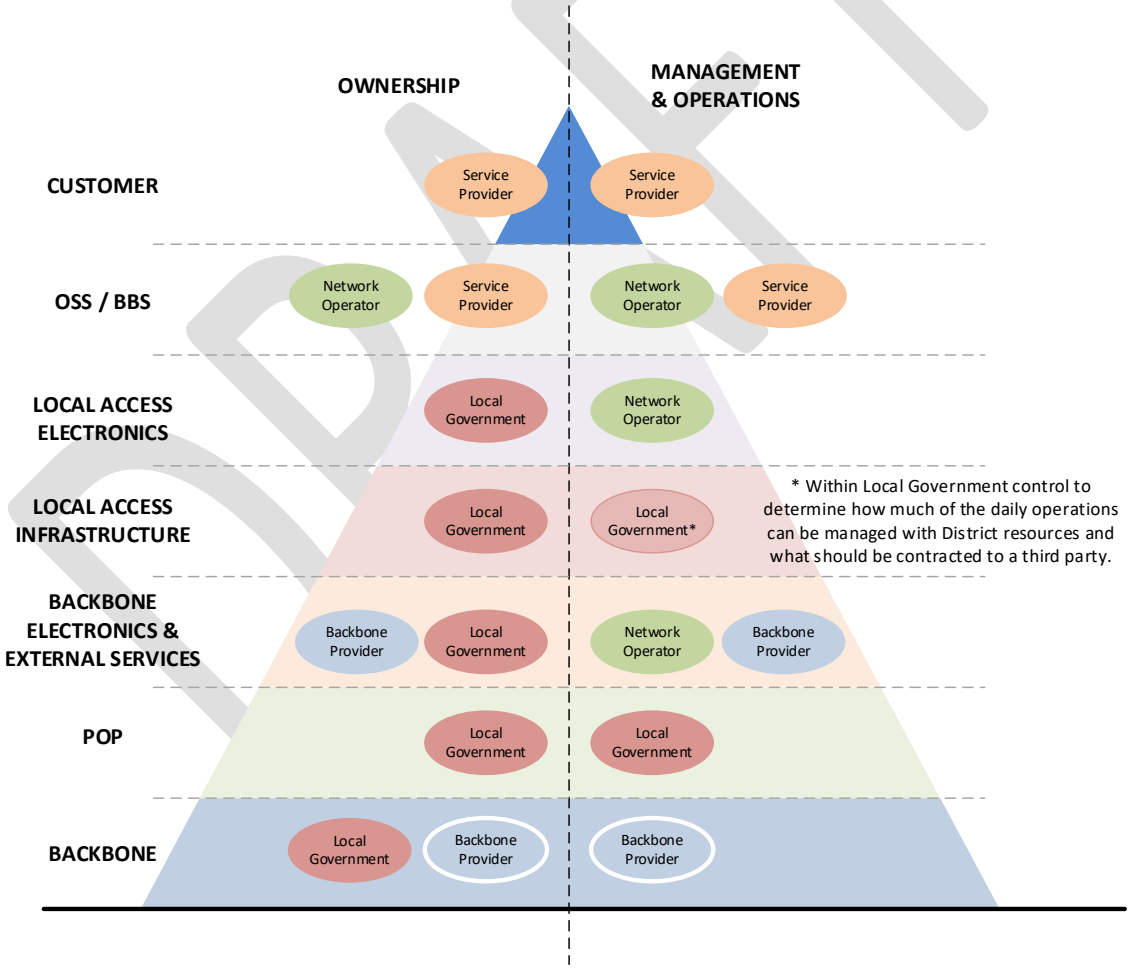
7.4.12 Active Involvement

As discussed earlier, solving connectivity challenges requires that all layers of the SDP be solved. This does not mean that Local Government must own and manage every layer of the pyramid or have a detailed understanding of telecommunications and network troubleshooting, but rather that it actively participates in a model in which multiple parties collaborate to resolve the pyramid each bringing a set of skills and resources.

To solve the pyramid, there are four main parties involved each with a discrete role and responsibility. A single organization may fill multiple roles or, different aspects may be fulfilled by more than one party. The business model may vary but assuming the possibility to take a more active role in the solution, the main parties to consider are:

- Local Government – Owns (either by itself or together with others) the network and has ultimate control over it. To provide service, Local Government contracts with the parties below to provide the specified parts of the network.
- Backbone Provider – Third party that provides the backbone and global connectivity to the network.
- Network Operator – Third party that manages, operates, and maintains the network on behalf of the Local Government and can provide technical escalation path to Service Provider.
- Service Provider(s) – Third party that provides the customer facing services, operations, billing, collections, and technical and customer support.

This structure is overlaid on top of the SDP that was introduced earlier in this report and provides a conceptual view of a business model, but there are several variations that can be considered depending on the role of Local Government.



7.5 Funding

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Funding for rural broadband is a priority item for government, particularly considering the on-going COVID-19 pandemic. Remote and rural broadband projects are unlikely to be implemented by service providers without financial support as those service providers have business requirements that drive where and when they will invest their own funds to construct additional network capacity. Rural and remote capacity simply does not meet those requirements so there will be a financial gap between what a provider is willing to invest and what it costs to provide the service. This financial gap will need to be filled if service is to be provided in those areas.

Sources of funding in place at the time of writing for projects of this nature have been identified below. Funding programs have been included even if there is no currently open intake to identify places to look for funding options once a project moves forward. **A detailed review of the application guide materials will be necessary to identify the specifics of the proposed project and the requirements for applying.** That detailed review should be a priority item so that appropriate work is commissioned in time to be "shovel ready," if, and when, a decision is made to proceed with a project either through the Regional District itself or through a third-party provider or some combination of the two. It should be noted that as program intakes close, there are sometimes iterations of the funding requirements that apply in subsequent intakes so each phase or intake should be reviewed closely.

- Universal Broadband Fund (the "UBF") is a $1.75 billion fund through ISED for the expansion of affordable, reliable, high-speed internet service in areas of Canada that have been identified by ISED as not having access to service at the USO or for mobile projects primarily benefitting Indigenous peoples. Funding is available until March 31, 2027. Applicants can request funding for up to 75% (or 90% in the case of highly remote areas or mobile projects primarily benefiting Indigenous peoples) of total eligible costs as defined in the program. The first intake recently closed on March 15, 2021.

- Connecting British Columbia is a BC government funding program administered by the Northern Development Initiative Trust which is open to local, regional, or national service providers, local governments; First Nations or BC not-for-profits. The program has a number of focus points described below.

    - Last-Mile, Transport Infrastructure:

        - This program is in its third phase and has, as its objective, the acceleration of the delivery of internet connectivity at the USO to homes and businesses in rural and Indigenous BC communities. The program will accept applications through successive intakes until funds are exhausted. The fifth intake just closed on March 15, 2021. Projects that are already ready to go will rank more favourably than ones which rely on other steps to be taken first. A pre-screening process is required which ensures that an applicant either has the experience requirement (3 years' experience deploying and operating the proposed broadband infrastructure in Canada) for an application or will work with an ISP that does. In addition, the applicant must agree to own, operate, and maintain the resulting network for 3 years after the project is complete otherwise some repayment of the funds will be required.

            - Transport Infrastructure – 50% of eligible costs for transport infrastructure. Fibre project are highly preferred over other transport technologies such as microwave. In some cases, project will require a partnership with a facilities-based provider that provides confirmation that the proposed network design meets their standards for future expansion of cellular coverage along the route. Transport projects should achieve at least one of the following:

- new or upgraded transport infrastructure that provides open-access for transport and internet gateways at affordable wholesale rates to last-mile service providers in those underserved regions;
- improve network resiliency and provide redundancy;
- provide future services such as cellular, public Wi-Fi or future technology;
- increase competition in areas with high prices and low capacity;
- enable government services in rural areas.

▪ Last-Mile Project - 50% of eligible costs to improve last mile connectivity in underserved rural and Indigenous areas in BC but follows a baseline funding level of $250,000 per community. Last mile infrastructure is to provide potential for long-term usage and expansion through technologies such as fibre, coaxial cable and fixed-wireless LTE. The project is to align with the region's plans to show that the project is a priority for the communities it serves. It should be noted that the application documentation provides a list of BC rural and Indigenous communities along with whether that community does or does not have connectivity at the USO. The application guide states however, that if a project is also seeking funding from a federal connectivity fund, then the federal program will dictate whether the project is qualified. This is important to note as there are examples where the Connecting BC list includes a community, but the federal map shows it as served in some fashion.

o Core UBF:
▪ An intake intended to leverage the main federal Universal Broadband Fund. Now closed to intake.

o Rapid Response UBF:
▪ An intake intended to leverage the Rapid Response Universal Broadband Fund. Now closed to intake.

▪ The Broadband Fund (the "BBF"). – In connection with upgrading infrastructure to meet the USO, the BBF was established by the CRTC to provide funding of $750 Million over five years. The second call for applications closed on June 1, 2020 so this fund is not currently open for applications at the time of writing. This fund provides funding for backbone projects, local access projects and mobile wireless projects.

CRD can apply to the BBF directly or as a member of a joint venture, partnership, or consortium with other eligible entities – eligible entities include other regional districts, first nations, municipal governments and private for-profit or not for profit service providers. BBF requires that "**the applicant, or at least one member of a partnership, joint venture, or consortium must have at least three years of experience in deploying and operating broadband infrastructure and must be eligible to operate as a Canadian carrier**." If this criterion is not met by the applicant or a member of the consortium, the applicant must enter contract with an entity that does.

- Gas Tax Fund – permanent funding normally provided twice a year by Infrastructure Canada. In BC, there is a tri-partite agreement between Canada, BC and the Union of British Columbia Municipalities ("UBCM"). Infrastructure Canada flows the funds to UBCM who then flows them to local governments for investment in local infrastructure priorities, specifically including use for broadband and connectivity.

- Trusts or non-profits that have support for CRD as part of their mandate.

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- Private industry partners that may support a public/private partnership infrastructure project.
- Lenders such as the Canada Infrastructure Bank which has $2 billion in loans and equity for new broadband infrastructure projects.
- Local government taxation where possible.

7.6 Broadband Cost Estimate

Cost estimates for identified projects are found in the project summary ancillary document and are intended for internal Local Government staff and not intended for sharing with third parties including service providers.

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8 RDFFG

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8.1 Public Feedback on State of Connectivity

Of the 175 Rural RDFFG respondents, 95% stated internet service is either very important or critical to them. Almost every respondent has some form of internet access currently with most of those who do not, indicating that the service is not available to them.

63% of respondents said Telus is their service provider. Most respondents have either wireless, DSL or satellite internet service. 87% of respondents stated that their download speed is less than 50 Mbps and 69% had upload speeds of less than 10 Mbps. 83% stated their internet speed is less than they require and 65% cited higher speeds being unavailable as the reason why. More than half of respondents expressed negative sentiments about quality, speed, overall cost/value, choice of provider, and reliability of their internet service. Around 40% said they would likely be willing to pay $50 more per month for internet with higher speeds.

"As an RDFFG citizen, it would be a huge benefit to have better internet service at home."
***-** Rural Survey Respondent*

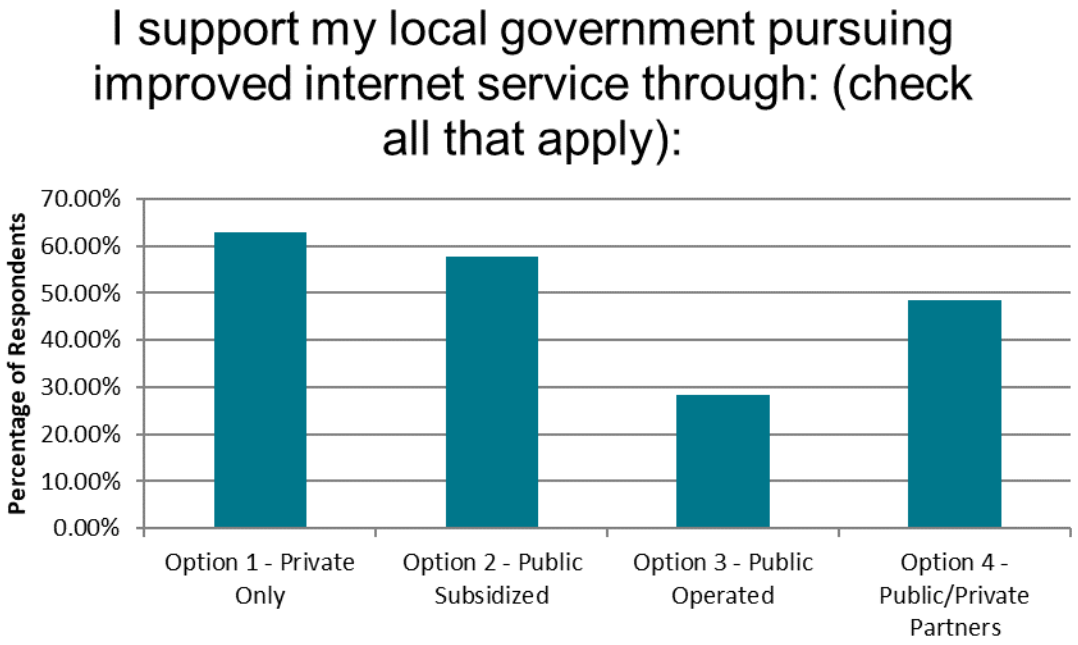
95% or more of respondents said they agree internet service is an essential service, that there is a need to improve such service, and that such improvements will have benefits for the area such as attracting residents/businesses. Nearly 90% agreed that improved internet will result in greater economic activity in the region. Rural RDFFG respondents supported options to get better internet as follows:

1) "Internet service provider (like Telus) builds the infrastructure to provide service and owns it. All control and future responsibilities are the responsibility of the provider." – 63%

2) "RDFFG and/or my municipality subsidizing the cost (through federal grants, ie. gas tax or other) to help the service provider. The service provider still owns the infrastructure and all control and future responsibilities are the responsibility of the provider." – 58%

3) "RDFFG and/or my municipality owns and maintains an internet utility (through federal grants, ie. gas tax or other). A new ongoing taxpayer funded service would be established and control and future responsibilities are the responsibility of the RDFFG and/or municipality." – 28%

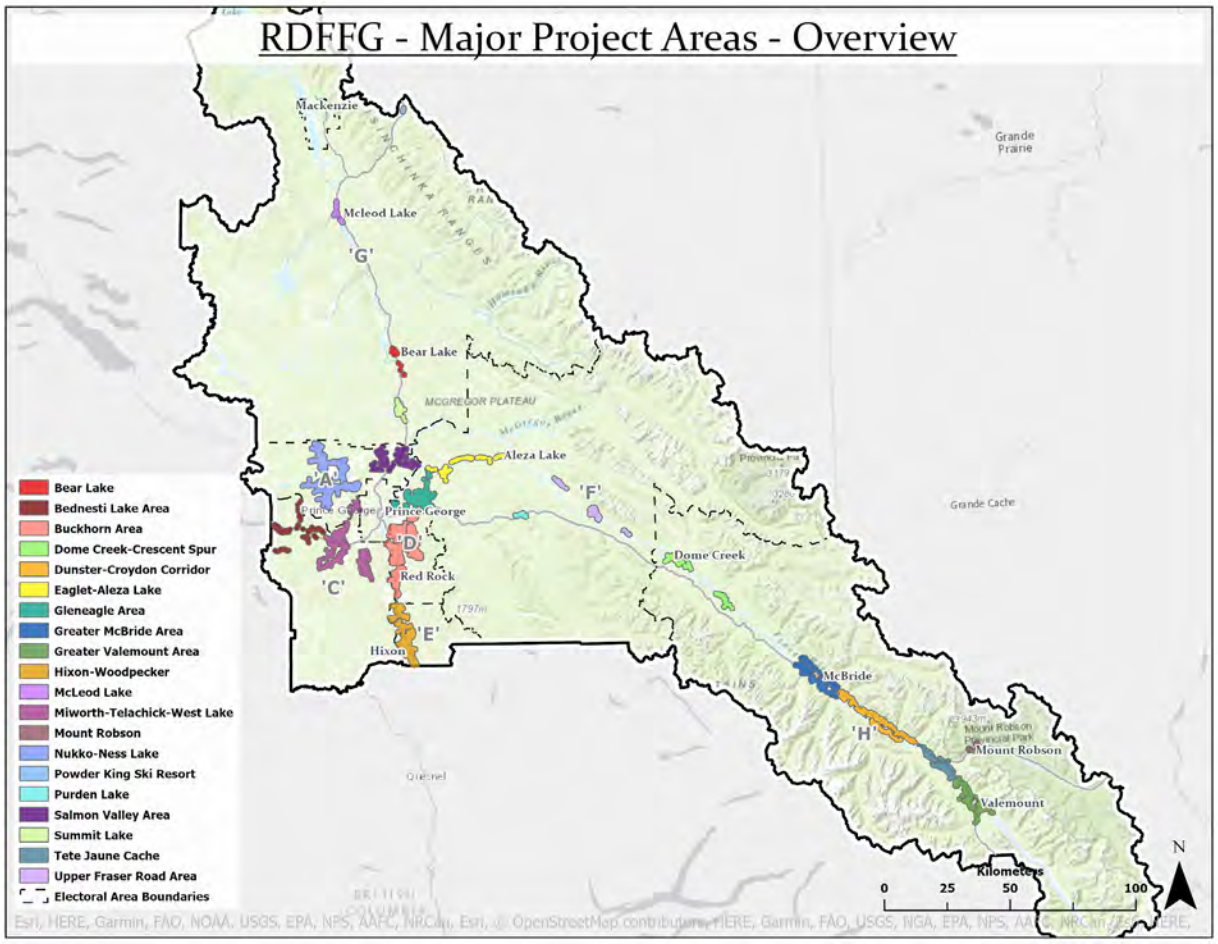
4) "RDFFG and/or municipality partnership with private industry partners and shares costs, control and responsibility." – 48%



8.2 RDFFG Project Definition

Considering the connectivity challenge on a large region wide scale is overwhelming and to understand the magnitude of the problem and ultimately achieve RDFFG's vision, it is helpful to break down the rural RDFFG connectivity gap into smaller components so that projects can be understood and prioritized.

The following provides a summary map showing all the major project areas identified according to the methodology described earlier in this document.



The map above provides a visual depiction of the project areas identified that are considered under served and identify the gap that needs to be addressed. The map represents approximately 20 major project areas that each contain a number of smaller sub-projects. There are approximately 50 sub-projects identified in the RDFFG. Sub-projects may have any number of potential subscribers from as few as a few dozen or up to several hundred. Combined, these project areas represent just over 5,600 identified Points that would be considered served at less than the USO of 50/10Mbps.

8.3 RDFFG Summary

The following table is a summary of the Points in the rural RDFFG. The graphic following the table shows the total Point summary and then how it breaks down by Electoral Area summary of the entire RDFFG is as follows:

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Project Area Summary

Apr 11, 2021

Major Project Name	Sub-Project Name	Area	Project Definition: BB	Project Definition: Local Access	Project Definition: Total Subs	Project Definition: % of Total	Primary Svc	Current Service Levels: 5/1	Current Service Levels: 10/2	Current Service Levels: 25/5	Current Service Levels: 50/10
			Totals		8,157	100%		2,772	1,599	1,235	2,551
								34%	20%	15%	31%

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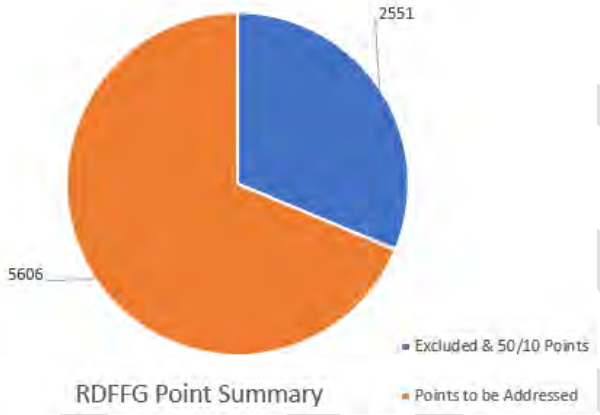
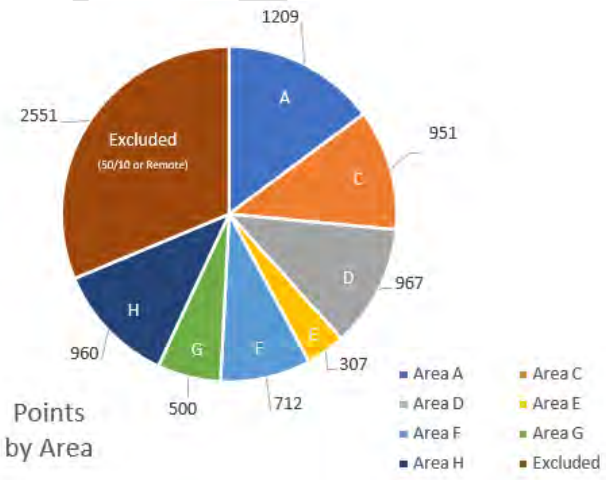
To provide further detail, the rural RDFFG has been broken down into project areas summarized by Electoral Area.





Project Area Summary Conclusions

The above table and charts provide the following conclusions:

- There are just over 8,100 Points not including municipalities and First Nations in the RDFFG.
- Of these points, about 31% (total of 2,551) are shown by ISED to have connectivity at the USO or have been excluded due to their remote nature.
- Remote Points will be candidates for satellite service including the evolving LEO satellite service.
- Approximately 5,600 Points would be considered as those that require improved service.
- Nearly 55% or just about 4,400 Points are consider poorly served with connectivity of 10/2 Mbps or less.
- Approximately 1,300 Points are served with technology suitable for 25/5Mbps representing decent service but not at the USO. While these may not be the highest priority for solving the connectivity challenge, they should be considered when planning a solution.

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8.4 RDFFG Specific Strategic Considerations

Collaboration

Among the strategic considerations outlined earlier in this document, the RDFFG must continue to have connectivity as a strategic priority and look for opportunities to push improved connectivity out to the rural areas. Solving this problem on a community-by-community basis is difficult. Taking a collaborative approach within the RDFFG and across Regional District boundaries to aggregate the problem into larger serving areas must be considered.

While the following map does not provide all the fibre infrastructure available throughout the province of BC, it does provide a high-level overview of some major fibre corridors that need to be considered when evaluating the critical fibre backbone infrastructure required to deliver all services. Of particular importance is the creation of redundant paths or fibre rings. Diversity is critical to providing reliable connectivity especially when considering events such as forest fires that can severely damage this critical infrastructure.

One consideration that becomes very apparent when looking at the following map is the heavy dependency on the fibre route along Highway 16 for not only RDFFG, but also the neighbouring Regional Districts of Bulkley Nechako and Kitimat Stikine. A major fibre failure along this will have a significant impact to connectivity in these regions. By working with neighbouring Regional Districts, progress can be made to improve the resiliency for the province as a whole.

It is also very apparent that Prince George is a major hub location for a number of fibre routes making it a critical location in the provincial backbone infrastructure.

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9 MACKENZIE

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9.1 Public Feedback on State of Connectivity

The following provides a brief summary of the survey results from the District of Mackenzie:

99% of the 142 Mackenzie respondents stated internet service is either very important or critical to them and all but one have internet access currently. 87% of respondents said Telus is their provider and most have either wireless or DSL types of internet service. 97% of respondents stated that their download speed is less than 50 Mbps and 55% had upload speeds of less than 10 Mbps. This clearly conflicts with the ISED Map.

The few that had download speeds of 50 Mbps or higher had Telus DSL service that costs between $50 to $150 per month. 75% stated their internet speed is less than they require and the reason why being that higher speeds are unavailable to them.

"Internet is unfair in Mackenzie, some get fast internet while others are unable to upgrade"
- *Mackenzie Survey Respondent*

Well over half of respondents expressed negative sentiments about cost, quality, speed, service reliability, choice, and other measures of internet service in Mackenzie and over 50% said they would be willing to pay $50 more per month for internet with higher speeds.

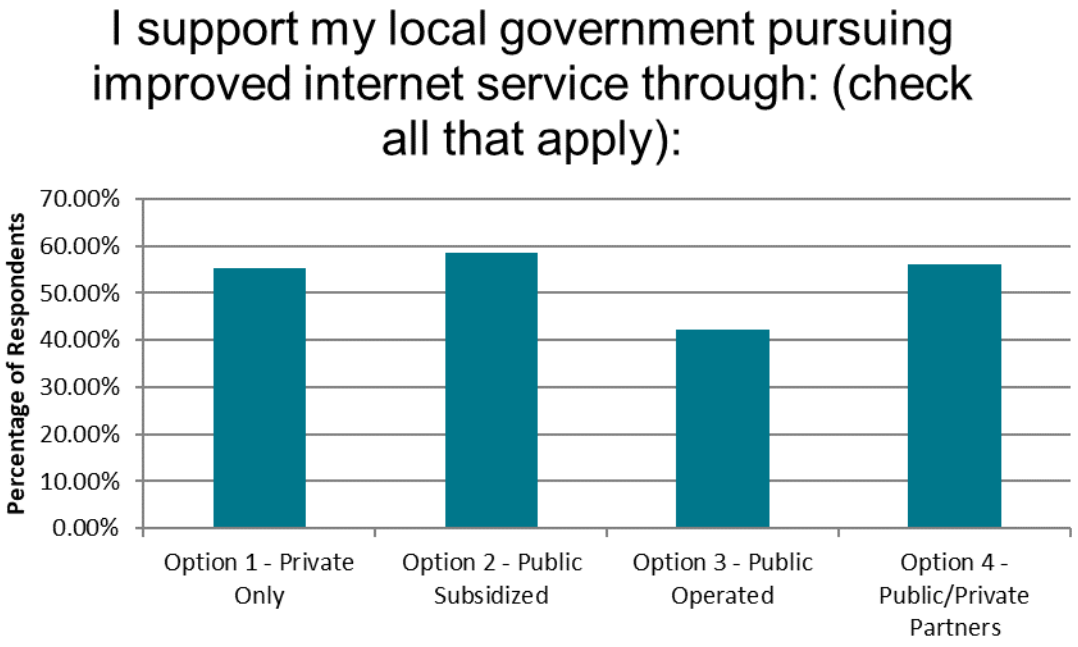
90% or more of respondents said they agree internet service is an essential service, there is a need to improve such service and that such improvements will have benefits for the area such as attracting residents/businesses, improving economic activity, and other benefits. Mackenzie respondents supported the four following options when it comes improving internet access in the area as follows:

1) "Internet service provider (like Telus) builds the infrastructure to provide service and owns it. All control and future responsibilities are the responsibility of the provider." – 55%

2) "RDFFG and/or my municipality subsidizing the cost (through federal grants, ie. gas tax or other) to help the service provider. The service provider still owns the infrastructure and all control and future responsibilities are the responsibility of the provider." – 59%

3) "RDFFG and/or my municipality owns and maintains an internet utility (through federal grants, ie. gas tax or other). A new ongoing taxpayer funded service would be established and control and future responsibilities are the responsibility of the RDFFG and/or municipality." – 42%

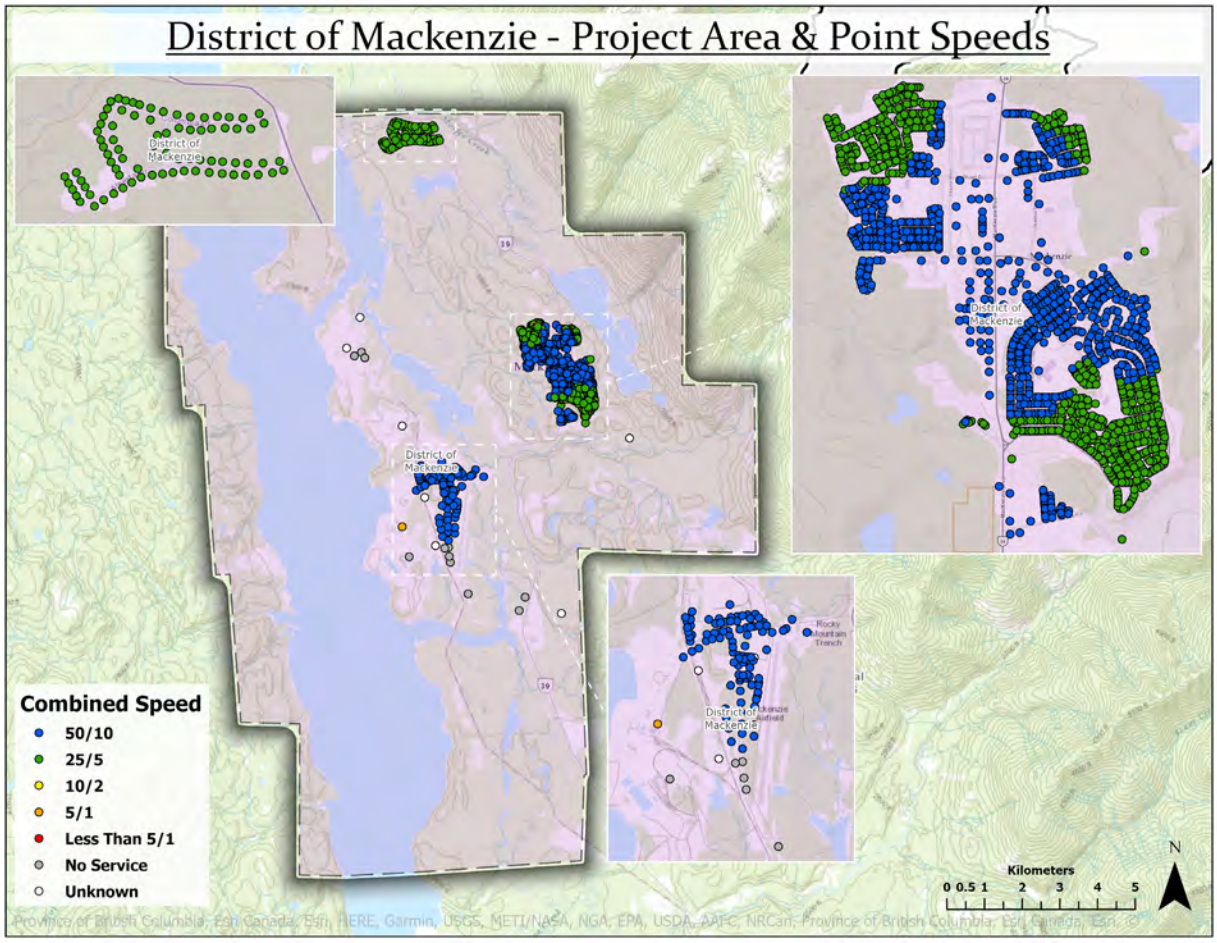
4) "RDFFG and/or municipality partnership with private industry partners and shares costs, control and responsibility." – 56%



9.2 Mackenzie Project Definition

Despite the ISED Map showing the vast majority of the District of Mackenzie at 50/10 or 25/5, that accords neither with the experience of most of the stakeholders interviewed nor the survey respondents. The map below shows the ISED Map assessment of service in Mackenzie.

Cost estimates for a FTTP project within the municipal boundaries have been provided in the ancillary document. While the costs outlined are still considered to be an estimate, they are more refined than cost estimates for the entire RDFFG because the service area can be better defined at this early stage. Cost estimates are based on a preliminary fibre design specific to Mackenzie and the resulting bill of materials based on that design.



The clear project for Mackenzie would combine a backbone along Highway 39 from Highway 97 to provide redundancy and choice as well as an FTTP project last mile project within Mackenzie itself.

Collaborating governments could include McLeod Lake Indian Band, RDFFG and Mackenzie. Such a project would provide a connectivity solution for the 1500 subscribers plus those located on the McLeod Lake Indian Band lands and the backbone could be leveraged to facilitate improved cellular along Highway 39.

9.3 Mackenzie Summary

The following table is a summary of the Points in Mackenzie.

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Project Area Summary

Apr 11, 2021

Major Project Name	Sub-Project Name	Area	BB	Local Access	Total Subs	% of Total	Primary Svc	Current Service Levels 5/1	10/2	25/5	50/10
Mackenzie	Gantahaz Subdivision	Mac	No	Yes	81	5.40%	25/5	0	0	81	0
Mackenzie	Mackenzie Industrial	Mac	No	Yes	117	7.80%	25/5	0	0	117	0
Mackenzie	South Central East	Mac		Yes	305	20.33%	25/5	0	0	305	0
Mackenzie	North Central Mackenzie	Mac	Yes	Yes	627	41.80%	50/10	0	0	0	627
Mackenzie	South Central West	Mac	No	Yes	370	24.67%	25/5	0	0	370	0
	Area Mackenzie SubTotal				**1500**	**100%**		**0**	**0**	**873**	**627**
	Totals				**1,500**	**100%**		**0**	**0**	**873**	**627**
								0%	**0%**	**58%**	**42%**

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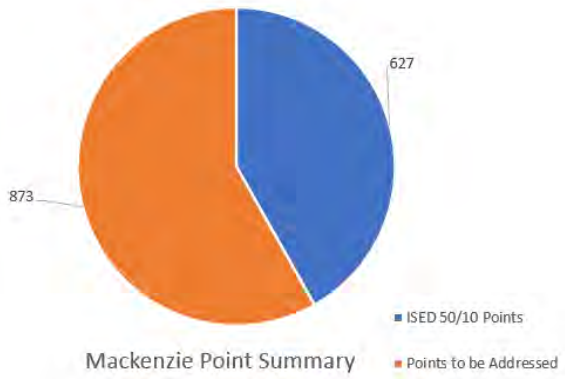
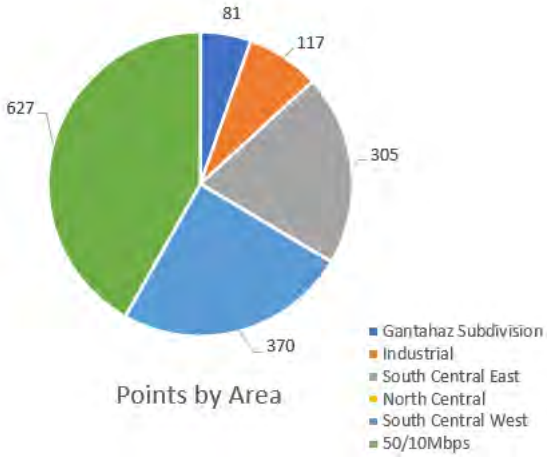




Mackenzie Conclusions

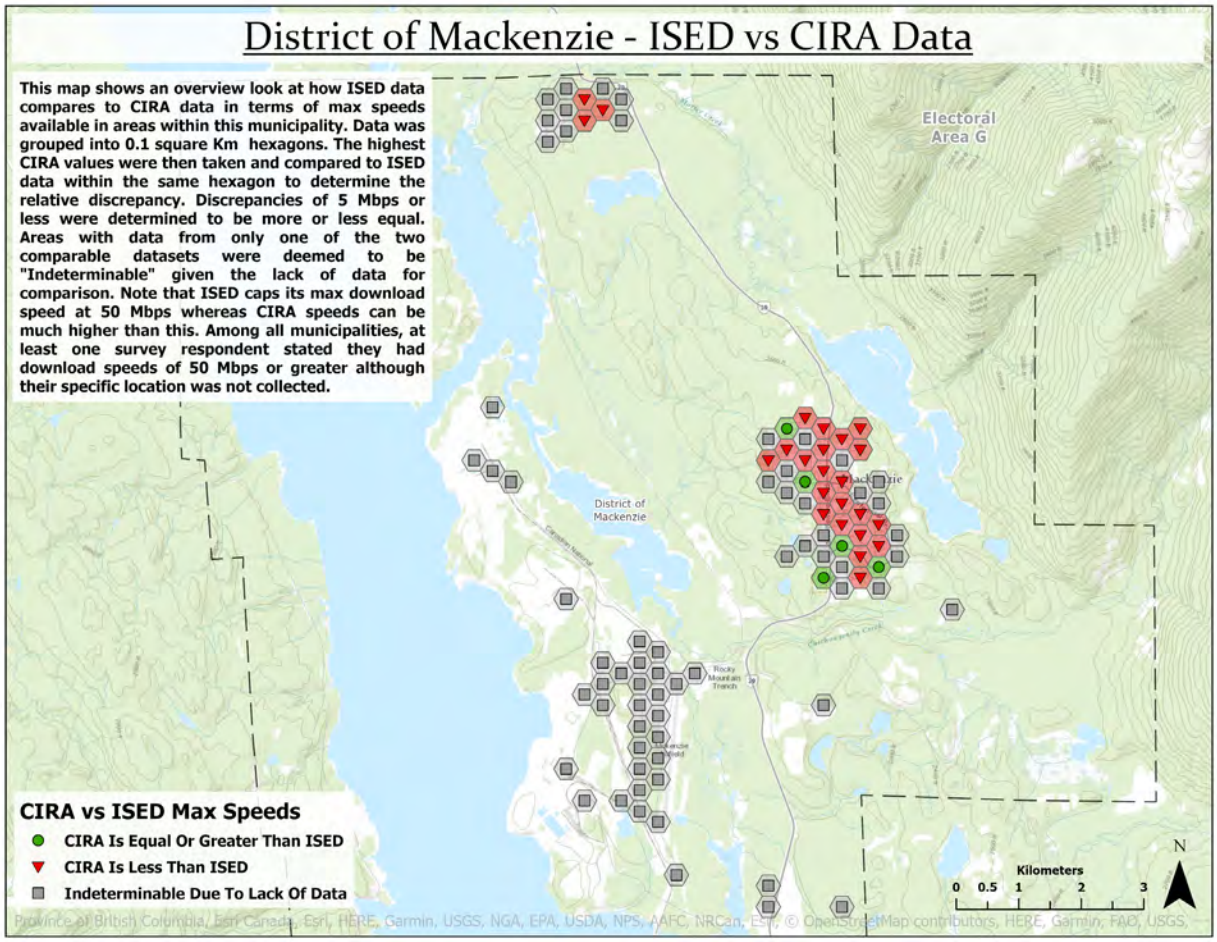
The above table and charts provide the following conclusions:

- There are approximately 1,500 Points within Mackenzie.
- About 42% (total of 627) of the Points are shown by the ISED Map to have connectivity at the USO and approximately 873 Points reflect service levels below the USO. As noted previously,

reports during stakeholder outreach and CIRA speed tests are not consistent with that level of connectivity.

As part of the project, actual performance data was gathered using an online application from CIRA which indicates that a significant portion of the speed test results from Mackenzie did not show internet service at or above the USO. The following map provides a snapshot comparison of CIRA test results relative to ISED data for Mackenzie.

RED shading on the map identifies areas in Mackenzie where the ISED Map reflects higher available service than the highest reported service through the survey data and the CIRA speed tests.



9.4 Mackenzie Specific Strategic Considerations

While this report provides some recommendations and next steps for all Local Governments, the following provides a summary of the considerations that are specific to Mackenzie.

ISED Map Validation

As funding for projects is often dictated by the ISED Map service levels, it is important that these maps reflect an accurate assessment of connectivity. Mackenzie should continue to promote the use of the

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CIRA performance test to ensure as many tests as possible are available. Further, Mackenzie should work to follow the process to have the ISED Map verified and corrected as required to ensure full access to funding for areas within Mackenzie that do not have service at the USO. Any solution to improve connectivity will require funding and Mackenzie needs to ensure it has access to all federal and provincial funding programs.

Leverage Shaw Backbone

Shaw recently completed the fibre backbone construction along Highway 97 leaving a connection point at the junction of Highway 39. Mackenzie should prioritize discussions with alternate providers such as Rogers, Shaw and City West to complete the remaining backbone into Mackenzie to bring competitive FTTP services into Mackenzie. The addition of a fibre backbone that connects to the newly constructed Shaw backbone from Prince George to Dawson Creek, provides the opportunity for alternative providers to offer services in Mackenzie whether such service is provided directly by a third party provider, Mackenzie itself, or in some partnership arrangement between Mackenzie and an industry partner.

Seek Proposals for FTTP

Throughout the project, discussions with providers were completed. Almost all providers indicate that they would encourage a more detailed discussion and cooperative relationship for solving the connectivity challenge. As fibre is the preferred connectivity option for a community such as Mackenzie, it should seek a proposal to bring FTTP connectivity to all homes within the municipal boundary. While other providers have the ability to complete this, Telus may be well positioned due to its ability to quickly deploy FTTP given its ability to leverage the available aerial and underground infrastructure. Telus has indicated that with an appropriate capital contribution from Local Government, FTTP upgrades are realistic, and this approach appears to have some support in the community. In order to understand all the options available, Mackenzie may consider releasing a RFI with specific requirements to understand all the potential options for alternative providers. This may provide a more informed basis of the specific FTTP solutions that exist. In any case, access to funding will be required and addressing the funding eligibility and options for financial contributions must be prioritized. Once more information is available about the actual project, financing options will need to be explored including grant funding, P3 partnerships and infrastructure loans supported by taxation.

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10 MCBRIDE

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10.1 Public Feedback on State of Connectivity

Of the 68 responses for McBride, 93% stated internet service is either very important or critical to them. All respondents but two have internet access currently and those people stated unavailability as the reason why. 91% of respondents said Telus is their main provider and most have either Wireless, DSL, or Cellular types of internet service. 93% of respondents stated that their download speeds is less than 50 Mbps and 45% had upload speeds of less than 10 Mbps. The few that had download speeds of 50 Mbps or higher had either Telus DSL or Monashee Wireless service.

69% stated their internet speed is less than they require and most cited higher speeds being unavailable as the reason. Around half of respondents expressed negative sentiments about quality and choice and even more – 70% – expressed dissatisfaction about the overall cost/value of their internet service in McBride.

"Thank you for doing this survey. Internet speed badly needs to improve in the Robson valley"
- *McBride Survey Respondent*

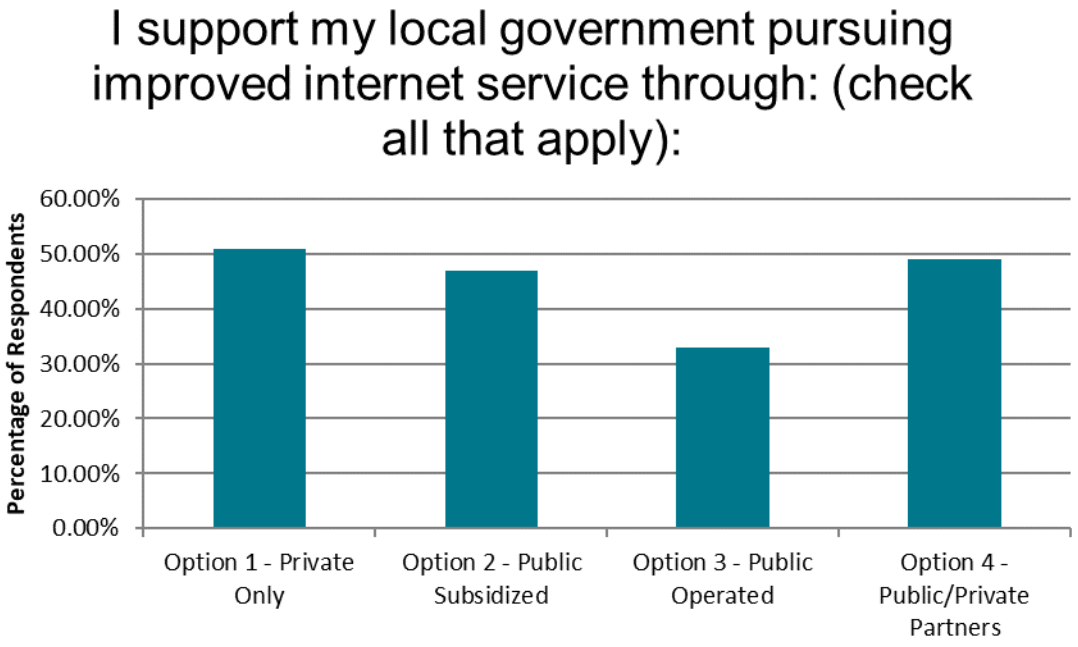
Only 23% said they would be willing to pay $50 more per month for internet with higher speeds. 80 - 90% of respondents said they agree internet service is an essential service, that there is a need to improve such service, and that such improvements will have benefits for the area such as attracting residents/businesses, improving economic activity, and other benefits. McBride respondents supported options 1, 2, and 4 below for improving internet access in the area but support for public provision of service was notably lower.

1) "Internet service provider (like Telus) builds the infrastructure to provide service and owns it. All control and future responsibilities are the responsibility of the provider." – 51%

2) "RDFFG and/or my municipality subsidizing the cost (through federal grants, ie. gas tax or other) to help the service provider. The service provider still owns the infrastructure and all control and future responsibilities are the responsibility of the provider." – 47%

3) "RDFFG and/or my municipality owns and maintains an internet utility (through federal grants, ie. gas tax or other). A new ongoing taxpayer funded service would be established and control and future responsibilities are the responsibility of the RDFFG and/or municipality." – 33%

4) "RDFFG and/or municipality partnership with private industry partners and shares costs, control and responsibility." – 49%



10.2 McBride Project Definition

Based on feedback from survey and outreach data, some areas of McBride are served well but improved connectivity needs to be expanded throughout. McBride has expressed a view that the Robson Valley as a whole needs to be part of that service area. To do so will require collaboration between McBride and RDFFG to obtain better connectivity for the whole valley.

The following maps provides an overview of the potential project areas for the Village of McBride and the larger Robson Valley.

Cost estimates for a FTTP project within the municipal boundaries have been provided in the ancillary document. While the costs outlined are still considered to be an estimate, they are more refined than cost estimates for the entire RDFFG due to the fact that the service area can be better defined at this early stage. Cost estimates are based on a preliminary fibre design specific to McBride and the resulting bill of materials based on that design.

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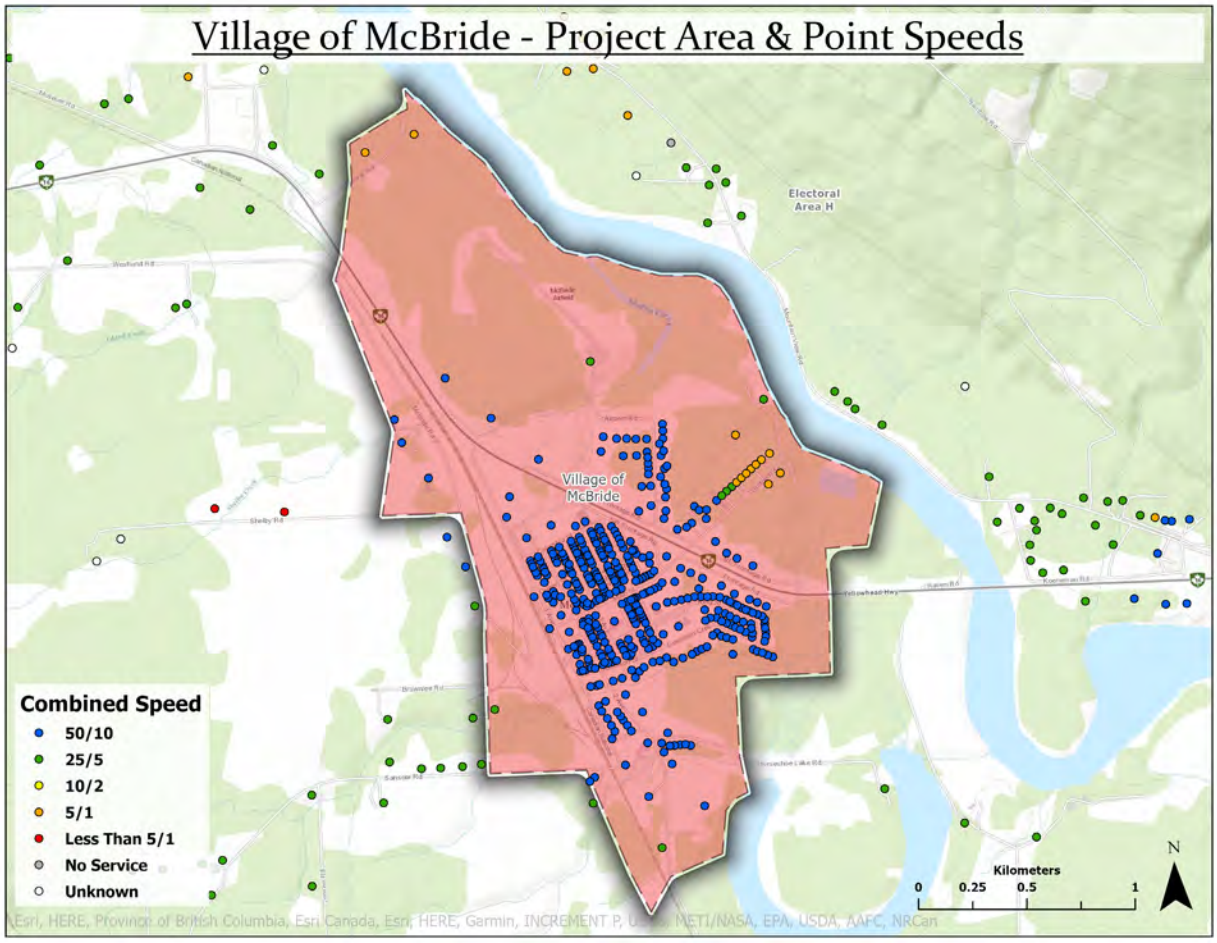

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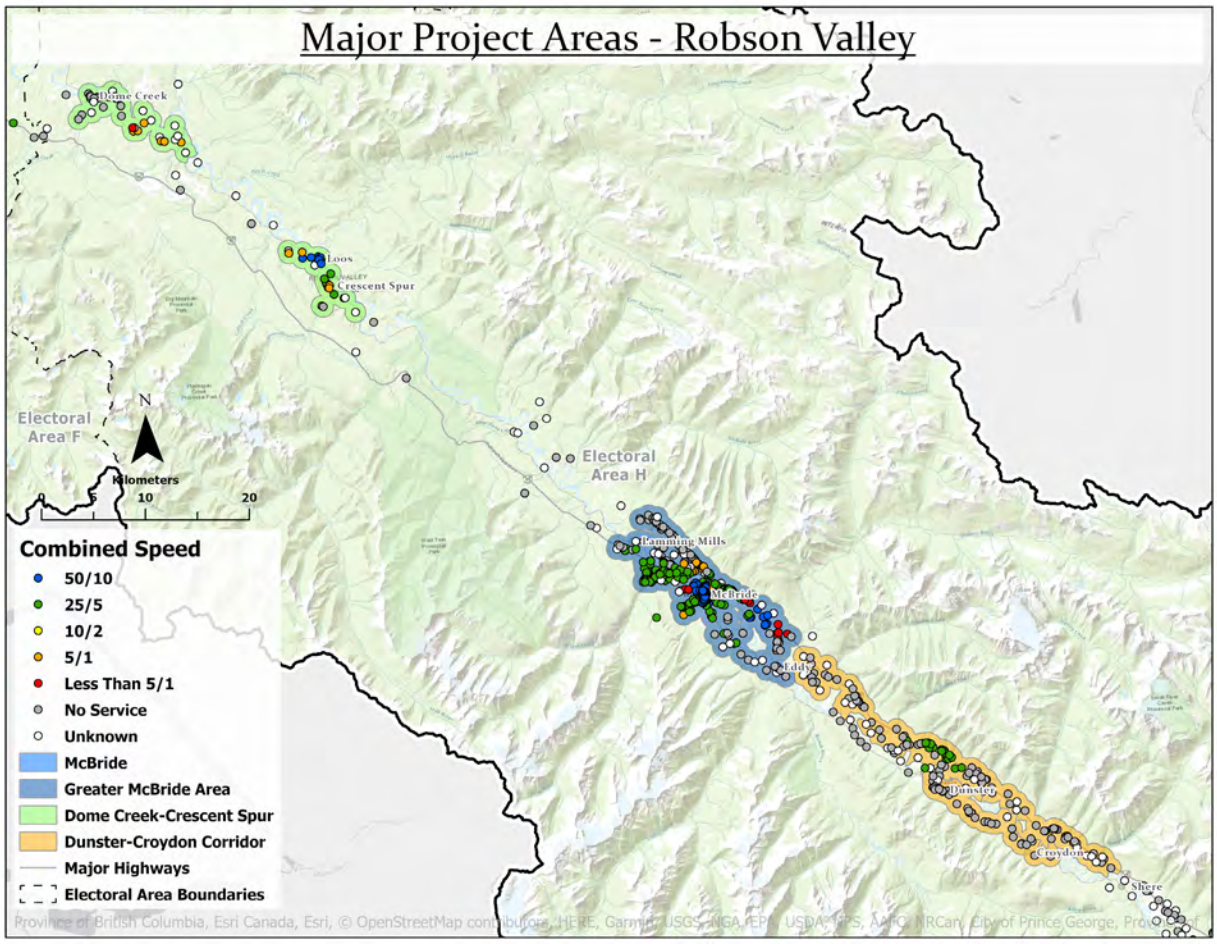

10.3 McBride Summary

The following table is a summary of the McBride Points.

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Project Area Summary

Apr 11, 2021

			Project Definition					Current Service Levels			
Major Project Name	Sub-Project Name	Area	BB	Local Access	Total Subs	% of Total	Primary Svc	5/1	10/2	25/5	50/10
McBride	Central McBride	McBr	Yes	Yes	339	78.29%	50/10	0	0	0	339
McBride	East McBride	McBr	No	Yes	16	3.70%	25/5	0	0	16	0
McBride	North McBride	McBr	No	Yes	50	11.55%	25/5	0	0	50	0
McBride	South McBride	McBr	No	Yes	28	6.47%	25/5	0	0	28	0
		Area McBride SubTotal			**433**	**100%**		**0**	**0**	**94**	**339**
		Totals			**433**	**100%**		**0**	**0**	**94**	**339**
								0%	**0%**	**22%**	**78%**

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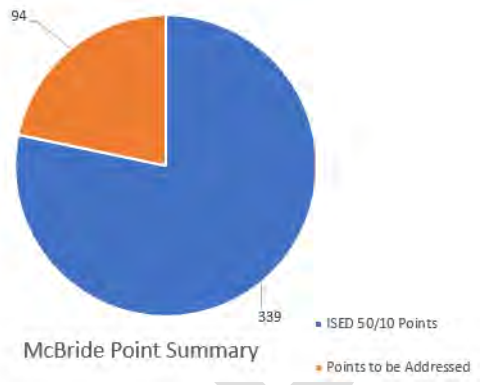
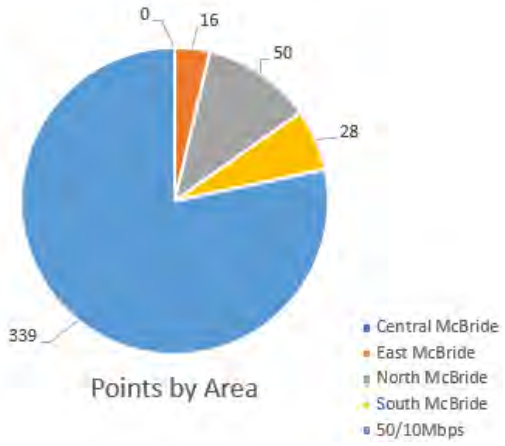


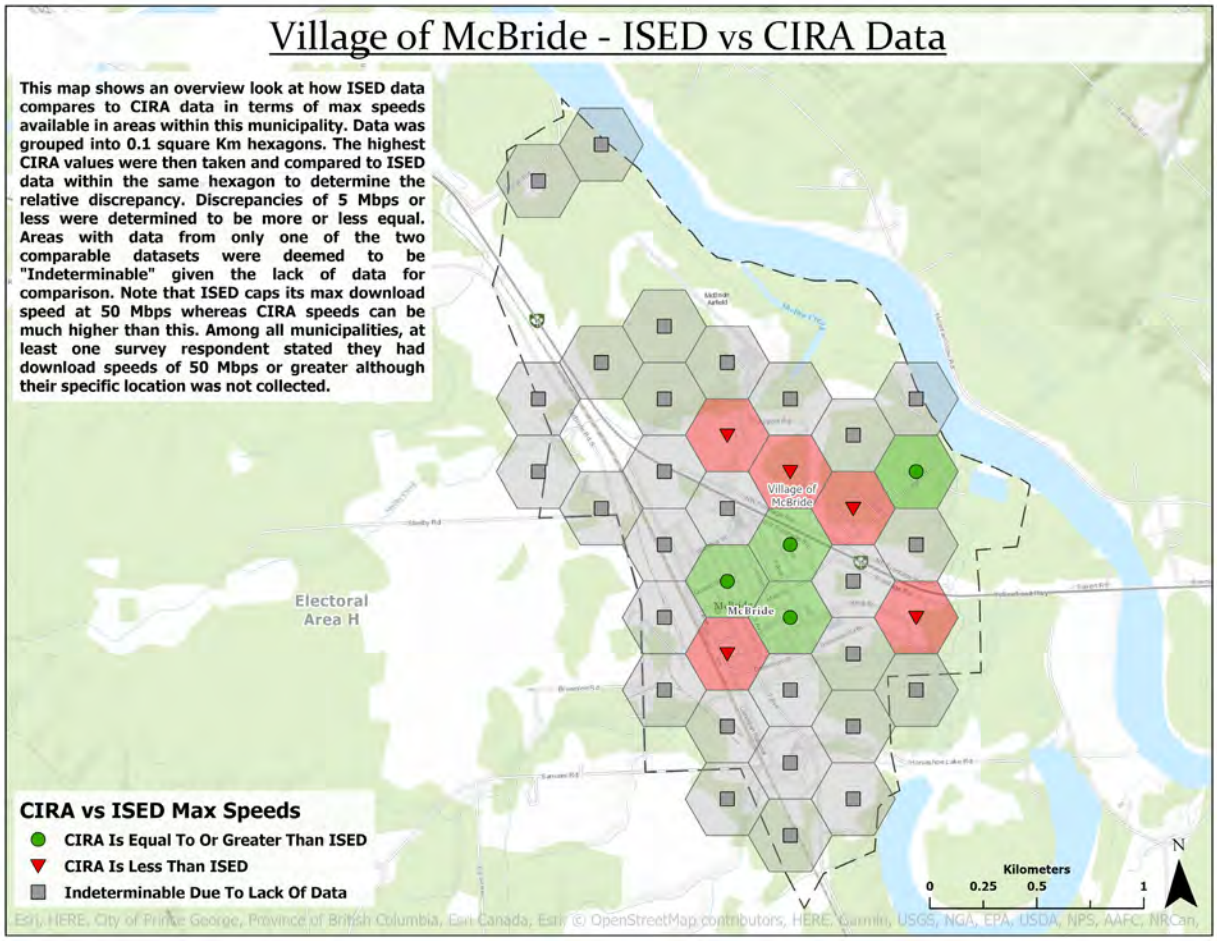


McBride Conclusions

The above table and charts provide the following conclusions:

- There are approximately 450 Points within McBride.
- Of these points, about 78% (total of 339) are shown on the ISED Map to have already have connectivity at the USO.
- According to the ISED Map, approximately 100 Points would be considered as those that require improved service or are not at the USO.

Despite the ISED suggesting that nearly 80% of the Points are served at the USO, performance data gathered with actual test results suggest that well below that are served at that level. Although there were fewer tests completed in McBride, the following provides a snapshot comparison of CIRA test results relative to ISED data for McBride.



10.4 McBride Specific Strategic Considerations

While this report provides some recommendations and next steps for the entire Regional District, the following provides a summary of the considerations that are specific to McBride.

ISED Map Validation

As the ISED Map drives eligibility for much of the available funding, it is important that these maps reflect an accurate assessment of connectivity. McBride should continue to promote the use of the CIRA performance test to ensure as many tests as possible are available. Further, McBride should work to follow the process to have the ISED Map verified and corrected as required to ensure that funding is available to support improved connectivity in all areas in McBride that do not have service at the USO.

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Support Existing Providers

As part of this project, outreach was completed to all providers operating in the region. In the case of McBride and the Robson Valley, Monashee Communications has actively been investing in improved wireless infrastructure. While the long-term goal in McBride is, fibre is more difficult to deploy throughout the valley due to the high capital cost. In this case, wireless may be a more optimal solution, especially in the short term, given the extensive distance and cost of deploying a fibre solution. McBride should encourage this investment and support these providers to remove as many barriers as possible to bring improved services as quickly as possible.

Seek Proposals for FTTP

Fibre is the goal standard when it comes to connectivity within a community like McBride. In the case of the Robson Valley, providing fibre over long distances is technologically possible but the business case and capital cost makes it difficult to achieve without significant financial contributions. Almost all providers indicated that they would encourage a more detailed discussion and cooperative relationship for solving the connectivity challenge. In McBride, like most municipalities in BC, Telus has a long history of providing services and has years of established infrastructure that can be leveraged in making a FTTP solution possible although they often desire a financial contribution from Local Government to close the gap between their level of investment and the actual cost. While a cost estimate has been provided as part of this project, a solution that results in McBride owning, operating, maintaining and providing service is not supported very strongly within the community at this time so a third-party provider will likely need to be engaged. A solution will likely require some form of partnership between McBride and an industry partner. Decent short term wireless solutions are available in certain areas, but without access to financial contributions, bringing improved services to areas that have a marginal business case is difficult. Fibre within McBride should be the long-term goal and as with the other Municipalities, in order to understand the specific options it has available, McBride may consider an RFI calling out FTTP as the preferred option to fully understand the specific parties and alternatives available to meet this strategic goal.

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11 VALEMOUNT

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11.1 Public Feedback on State of Connectivity

Of the 50 Valemount respondents, 90% stated internet service is either very important or critical to them. Almost every respondent has internet access currently.

87% of respondents said Telus is their main provider and most have either wireless or DSL types of internet service. 87% of respondents stated that their download speed is less than 50 Mbps and 65% had upload speeds of less than 10 Mbps. 76% stated their internet speed is less than they require and most cited either higher speeds being unavailable or poor quality as the reason. 75% or more of respondents expressed negative sentiments about quality, speed, overall cost/value, and reliability of their internet service. Slightly less – 65% – expressed dissatisfaction about the choice of internet providers in Valemount. Around 40% said they would be willing to pay $50 more per month for internet with higher speeds.

85 - 95% of respondents said they agree internet service is an essential service, that there is a need to improve such service, and that such improvements will have benefits for the area such as attracting residents/businesses, improving economic activity, and other benefits. Unlike the RDFFG broadly and the other two Municipalities, Valemount respondents most strongly favoured leaving the solution to an internet service provider.

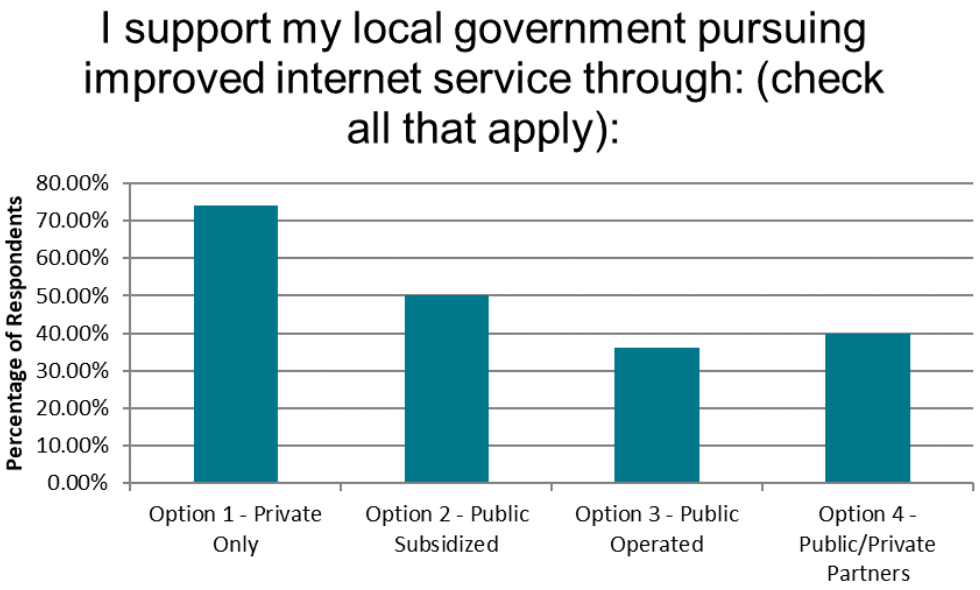
"We definitely need something done by someone to improve this service"
- *Valemount Survey Respondent*

1) "Internet service provider (like Telus) builds the infrastructure to provide service and owns it. All control and future responsibilities are the responsibility of the provider." – 74%

2) "RDFFG and/or my municipality subsidizing the cost (through federal grants, ie. gas tax or other) to help the service provider. The service provider still owns the infrastructure and all control and future responsibilities are the responsibility of the provider." – 50%

3) "RDFFG and/or my municipality owns and maintains an internet utility (through federal grants, ie. gas tax or other). A new ongoing taxpayer funded service would be established and control and future responsibilities are the responsibility of the RDFFG and/or municipality." – 36%

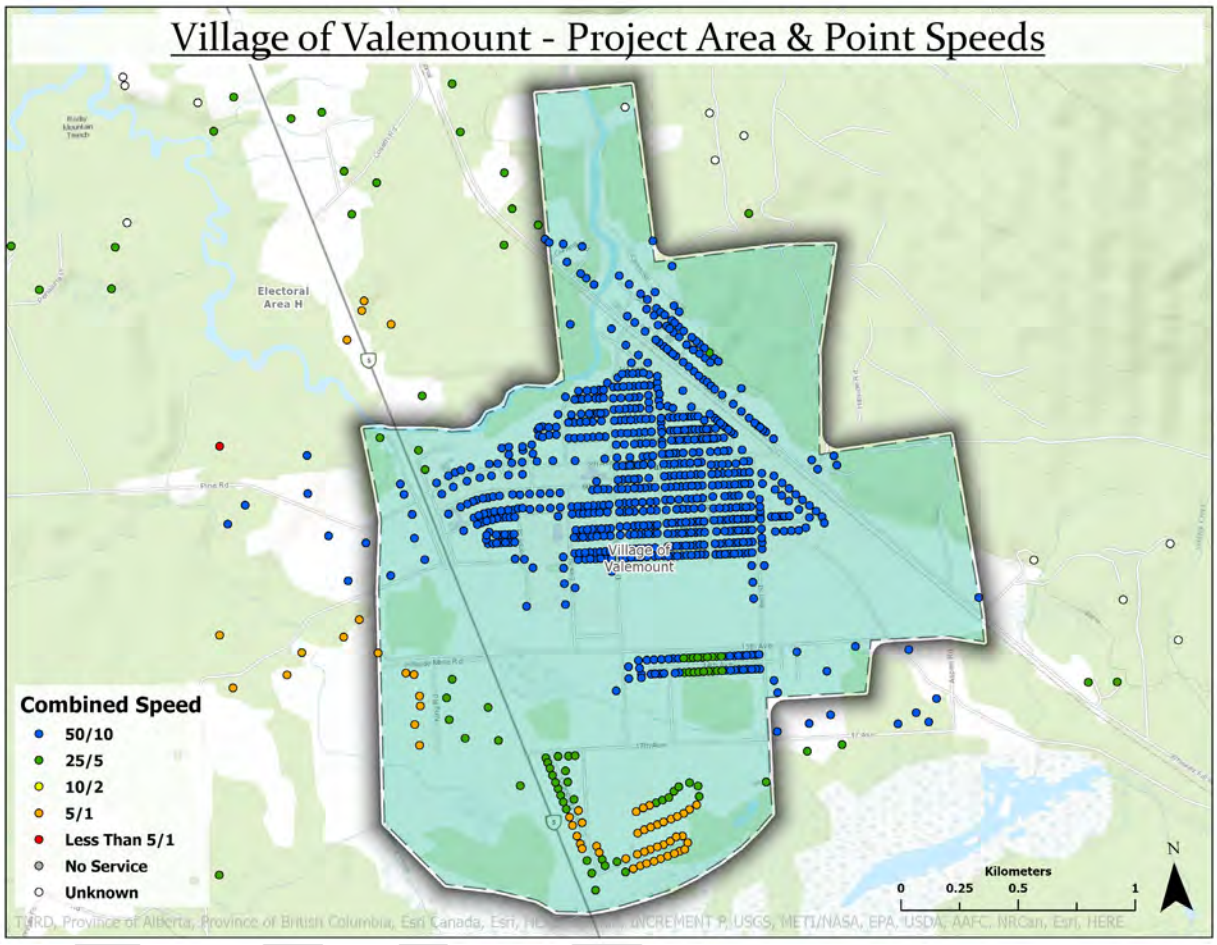
4) "RDFFG and/or municipality partnership with private industry partners and shares costs, control and responsibility." – 40%



11.2 Valemount Project Definition

The following maps provides an overview of the potential project areas for Valemount.

Cost estimates for a FTTP project within Valemount have been provided in the ancillary document. While the costs outlined are still considered to be an estimate, they are more refined than cost estimates for the entire RDFFG because the service area can be better defined at this early stage. Cost estimates are based on a preliminary fibre design specific to Valemount and the resulting bill of materials based on that design.



11.3 Valemount Summary

The following table is a summary of the Valemount Points.

Project Area Summary

Apr 11, 2021

			Project Definition					Current Service Levels			
Major Project Name	Sub-Project Name	Area	BB	Local Access	Total Subs	% of Total	Primary Svc	5/1	10/2	25/5	50/10
Valemount	Central Valemount	Vale	No	Yes	608	70.62%	50/10	0	0	0	608
Valemount	East Valemount	Vale	No	Yes	7	0.81%	50/10	0	0	0	7
Valemount	North Valemount	Vale	No	Yes	76	8.83%	50/10	0	0	0	76
Valemount	South Valemount	Vale	No	Yes	170	19.74%	25/5	0	0	170	0
	Area Valemount SubTotal				**861**	**100%**		**0**	**0**	**170**	**691**
	Totals				**861**	**100%**		**0**	**0**	**170**	**691**
								0%	**0%**	**20%**	**80%**

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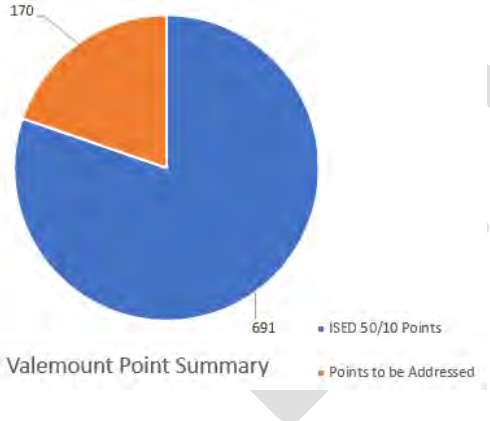
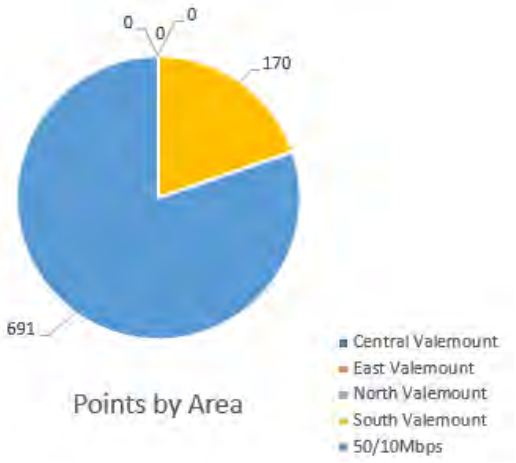




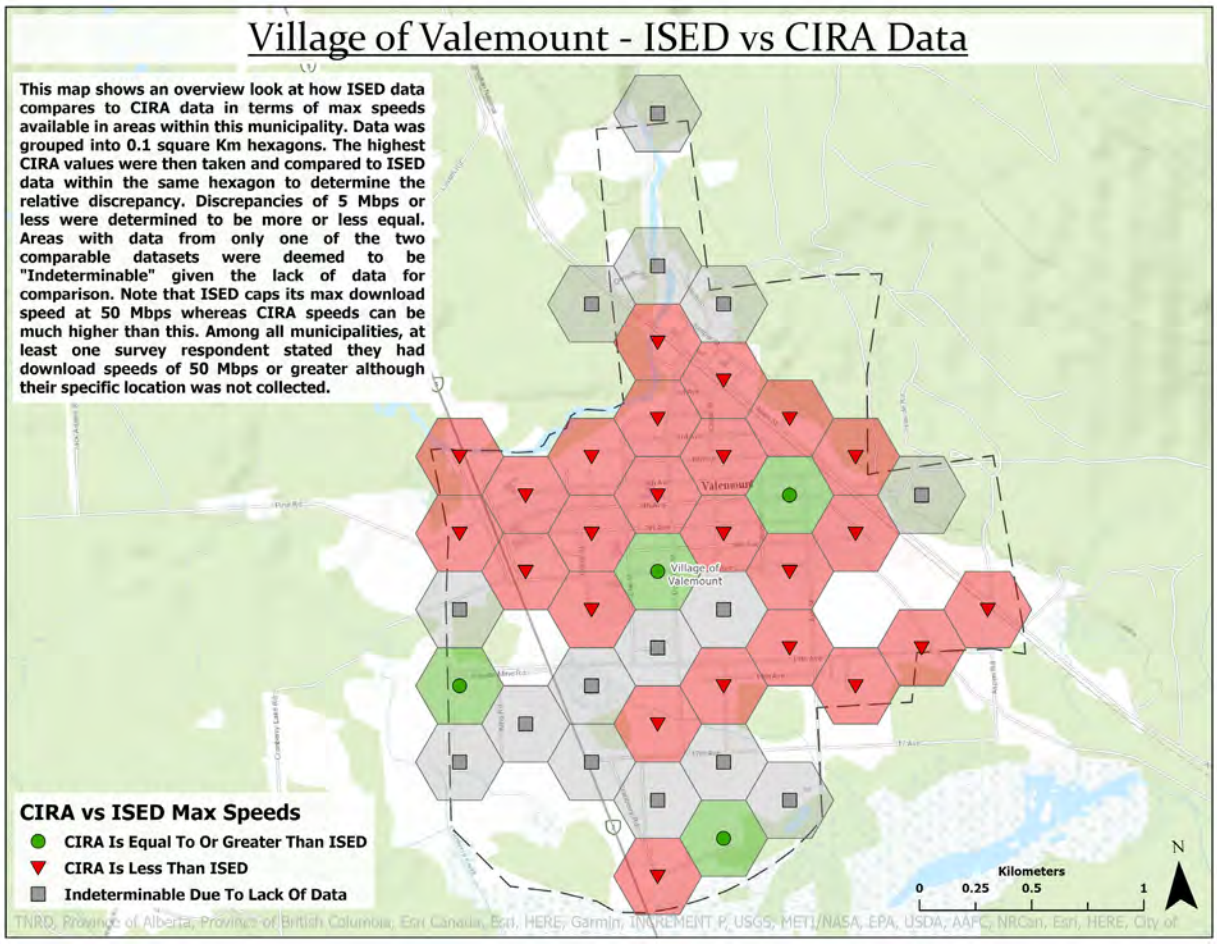
Valemount Conclusions

The above table and charts provide the following conclusions:

- There are approximately 861 Points within Valemount.

- Most of the identified areas show as served at the USO with the exception of South Valemount identified abov.
- Of the identified Points, about 80% (total of 691) are shown by the ISED Map to have connectivity at the USO although reports during that stakeholder outreach and available through CIRA provided data indicate that this may over represent the level of connectivity in Valemount.
- According to the ISED data, approximately 170 Points would be considered as those that require improved service or are not at the USO.

Despite the ISED Map suggesting that 80% of the Points are served at the USO, performance data gathered through CIRA speed tests are inconsistent with that. The following provides a snapshot comparison of CIRA speed test results and ISED data for Valemount.



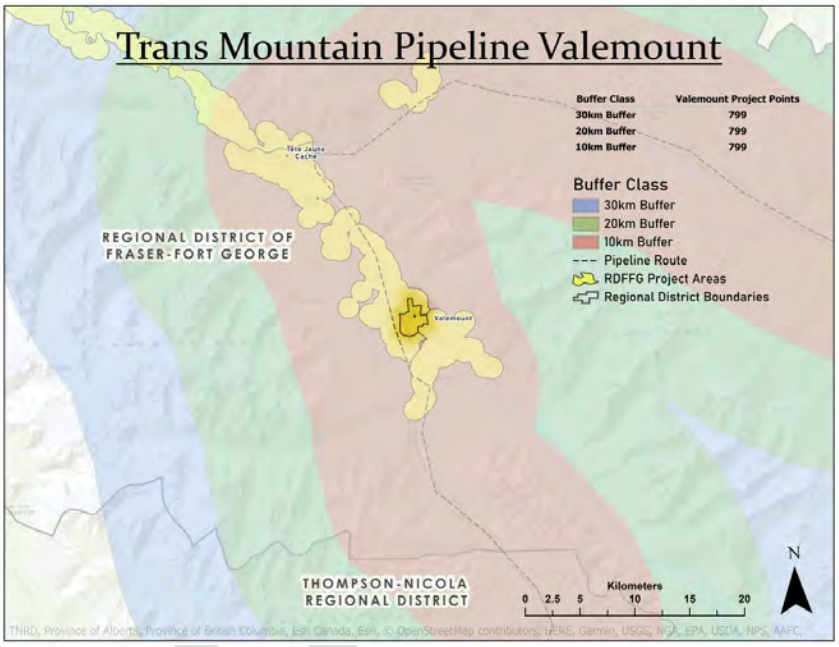
11.4 Valemount Specific Strategic Considerations

While this report provides some recommendations and next steps for the entire Regional District, the following provides a summary of the considerations that are specific to Valemount. Valemount is in a unique position and must seriously explore all opportunities presented.

TransMountain Pipeline

For Valemount specifically, the Trans Mountain pipeline construction and the potential for a fibre optic backbone represents a significant opportunity to obtain access to alternate backbone capacity and the potential for competitive service providers.

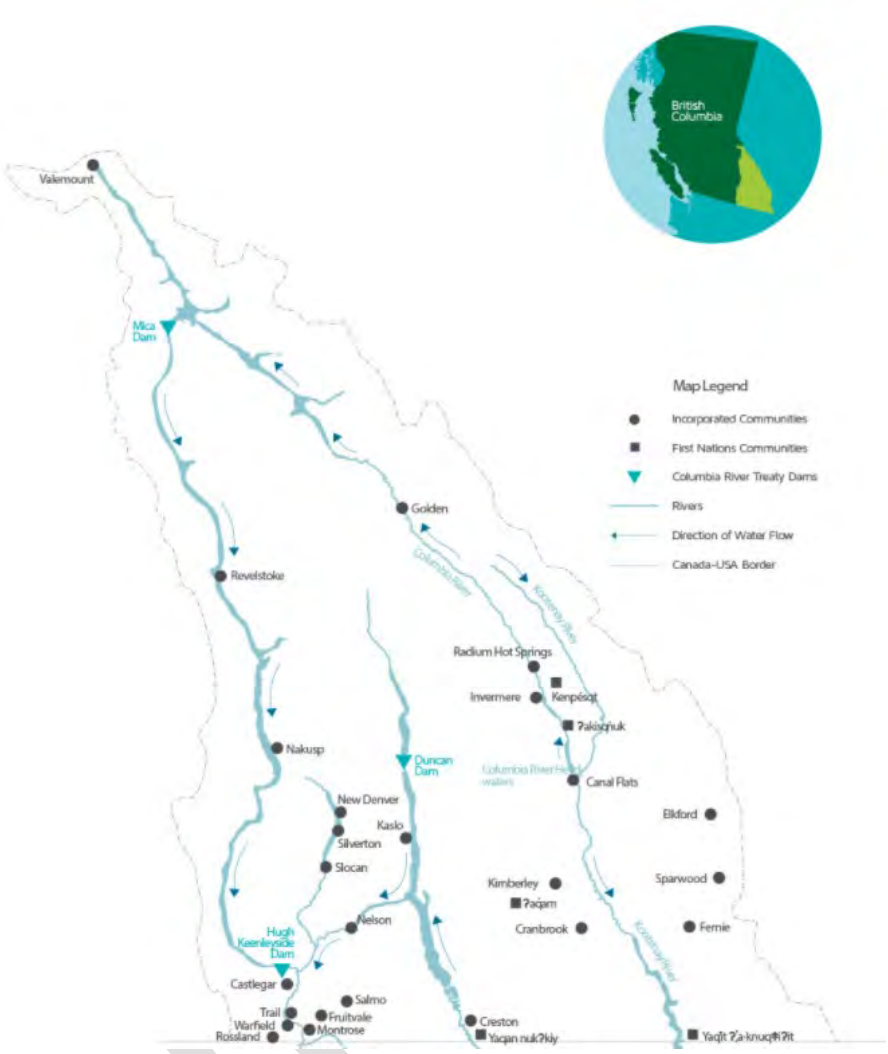
As shown below, the Trans Mountain right of way will be constructed very close to Valemount and has the potential to create alternatives to costly backbone connectivity required to support improved connectivity.



Valemount must stay close to this construction to leverage any opportunity for additional fibre connectivity and competitive service offerings.

Columbia Basin Trust

Valemount is unique to the other Municipalities because it is located in the northern portion of the Columbia Basin Trust service area (the “Basin”) and as such, it falls within a potential service area for Columbia Basin Broadband Corporation (“CBBC”). Over the past number of years, CBBC has worked to improve connectivity within the Basin, by constructing communications infrastructure to support service providers that wish to improve Basin connectivity.



Seek Proposals for FTTP

Like the other Municipalities, FTTP must be the long-term goal for scalable, high capacity and reliable connectivity. No other technology can match the capabilities of a fibre solution for residential and business connectivity. Valemount has a unique advantage from other communities given its proximity to the Trans Mountain project and the opportunities that it may bring. In addition, it is located within the Columbia Basin and sets itself apart from other municipalities by having access to alternatives that are simple not available to others. While most providers are supportive of more detailed discussions and cooperative relationships, given the advantages presented, Valemount must leverage these unique opportunities to not only improve its level of connectivity, but to bring an example of what is possible for other areas of BC. All options need to be explored and Valemount should seek proposals to bring FTTP connectivity to all potential subscriber locations within the municipal boundary. Given its unique advantages of being in the Basin and along the Trans Mountain expansion path, Valemount has some tangible opportunities to explore.

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12 RECOMMENDATIONS

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12.1 Next Steps for Broadband

Based on the information gathered during the course of this project, the following provides a summary of the recommended next steps for the Local Governments.

Fundamental Tasks

- Establish an internal broadband working group focused on the connectivity challenge.
- Continue to prioritize connectivity from a resourcing point of view to strengthen the already available expertise and identify a lead internal staff resource to manage and advance connectivity initiatives.
- Establish Regional District's priority areas using the identified projects.
- Inventory RDFFG assets that may lower barriers to service delivery.
- Reach out and collaborate with other local governments, including municipalities, other Regional Districts and First Nations to identify and solve a larger problem for more people. Seek opportunities to partner or complete joint initiatives as often costly infrastructure can be leveraged if the costs are rolled into a single initiative.
- Align with other Regional District initiatives that may be ongoing.
- Actively provide intervenor feedback to the CRTC in collaboration with other local governments.
- If not already, become a member of the BC Broadband Association.
- Participate in broadband conferences, especially those focused on rural and remote communities.
- Prioritize correcting the ISED Map.

Determine the Role of the Regional District

- Identify what contribution the Local Government will make to solving the connectivity challenge. These may include:
    - Advocate/facilitate/lobby.
    - Contribute capital to third party. Establish a method and Regional District commitments and guidelines for facilitating this. While federal and provincial funding programs are available, they often have requirements, timelines, heavy participation and are often over-subscribed.
    - Partnership with a service provider.
    - Construct and own infrastructure.

- Determine specifics of how that role will be fulfilled:
    - If, for example, RDFFG or a Municipality decides that its role is to contribute capital, how will that be accomplished.

Prioritize the Project Areas

- RDFFG should create criterion for prioritizing the potential projects identified in this report
    - A list of criteria that identify how each potential project will be assessed which should include identification of projects where collaboration with the Municipalities, First Nations or neighbouring Regional Districts is available.

- Complete the prioritization of the potential projects.
- Seek proposals for FTTP projects from providers where feasible.

Create an Action Plan

- Identify project specific steps to address each priority area

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- Communicate priorities to service providers
- Provide specific information about RDFFG's priority areas to providers for both internet and cellular
- Develop a process and minimum service levels for responding to requests for letters of support to ensure that RDFFG's priorities are being addressed
- Identify the specific barriers to service delivery in each priority area and determine whether the RDFFG can do anything to lower or remove them
- Obtain proposals with pricing for priority project areas.
- Particularly for Municipalities, consider an RFI to obtain specific proposals for FTTP solutions.

Leverage Opportunities

- Leverage opportunities such as Trans Mountain to bring additional backbone services into the region and promote additional competitive providers.
- Continue to promote initiatives such as a Prince George datacenter and potentially expand this for opportunities such as a northern LEO hub for new providers entering the market.

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12.2 About TANEx Engineering

TANEx is a professional engineering firm located in British Columbia, Canada focused on providing engineering consulting services specializing in telecommunications and networking. TANEx provides design, commissioning and operational services to its clients from varied industries and has a wide variety of expertise in connectivity technologies, infrastructure and services. For more information, please refer to our website at www.tanexengineering.com.

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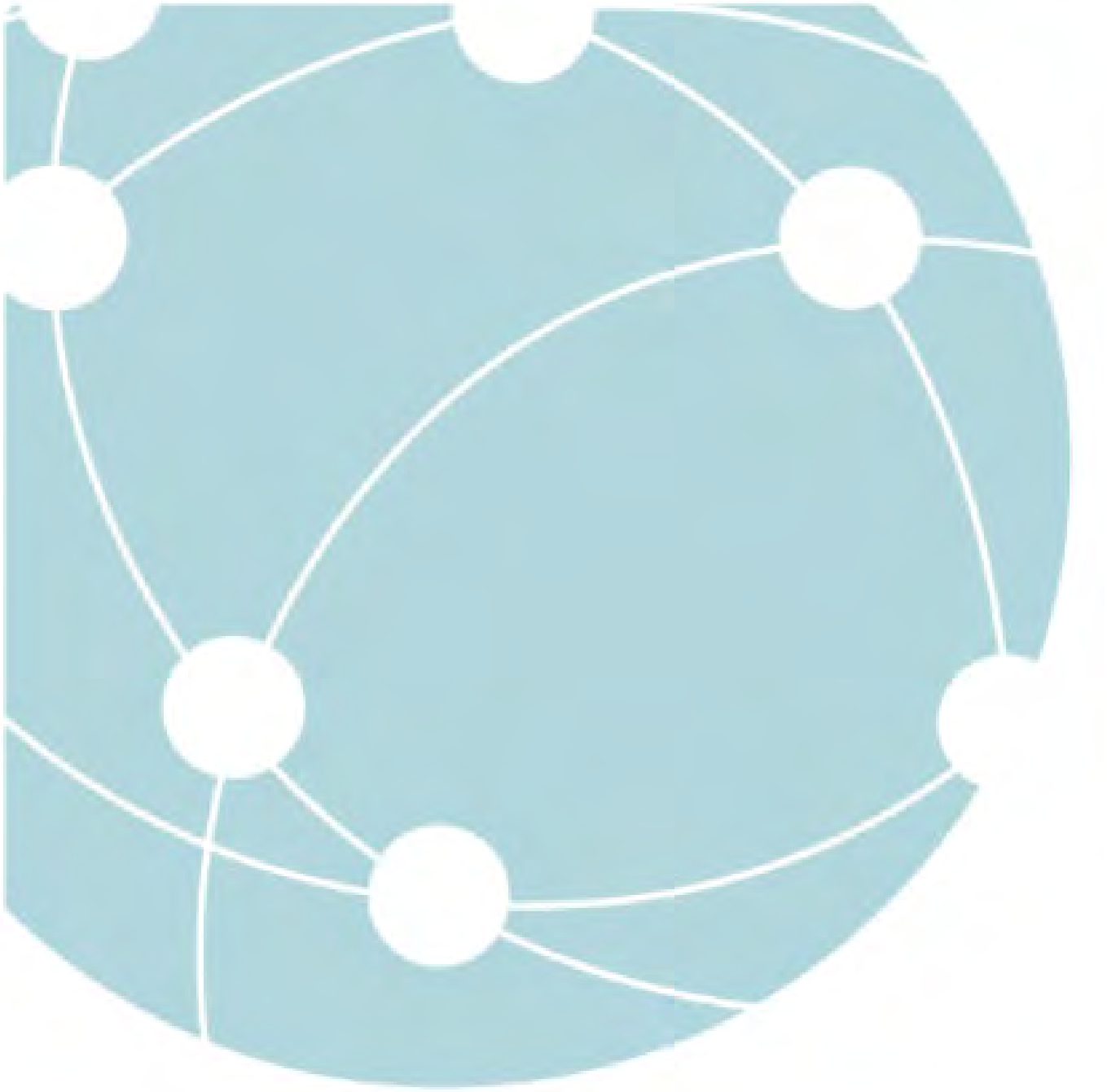

13 Appendices

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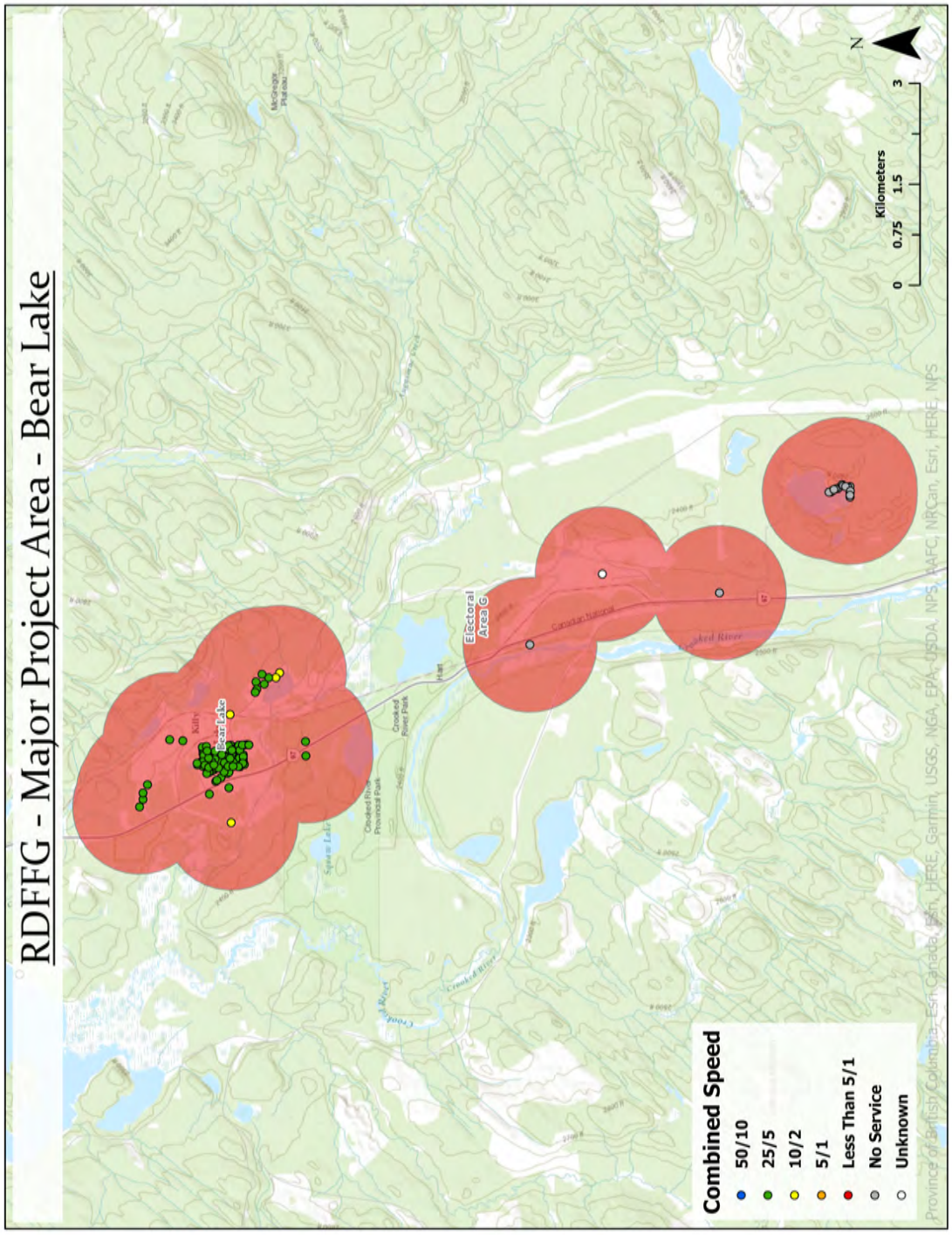
Appendix A – Project Area Maps



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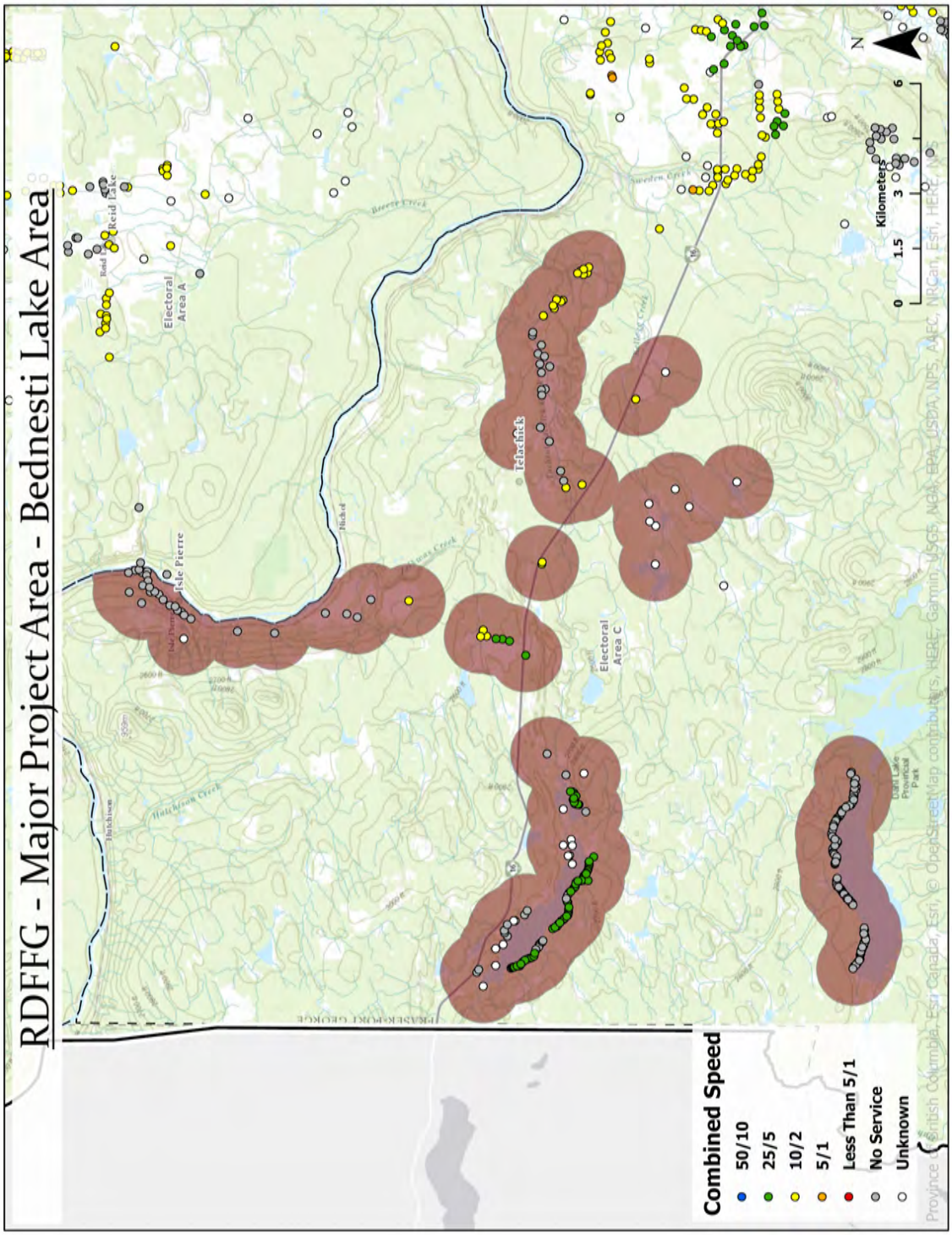

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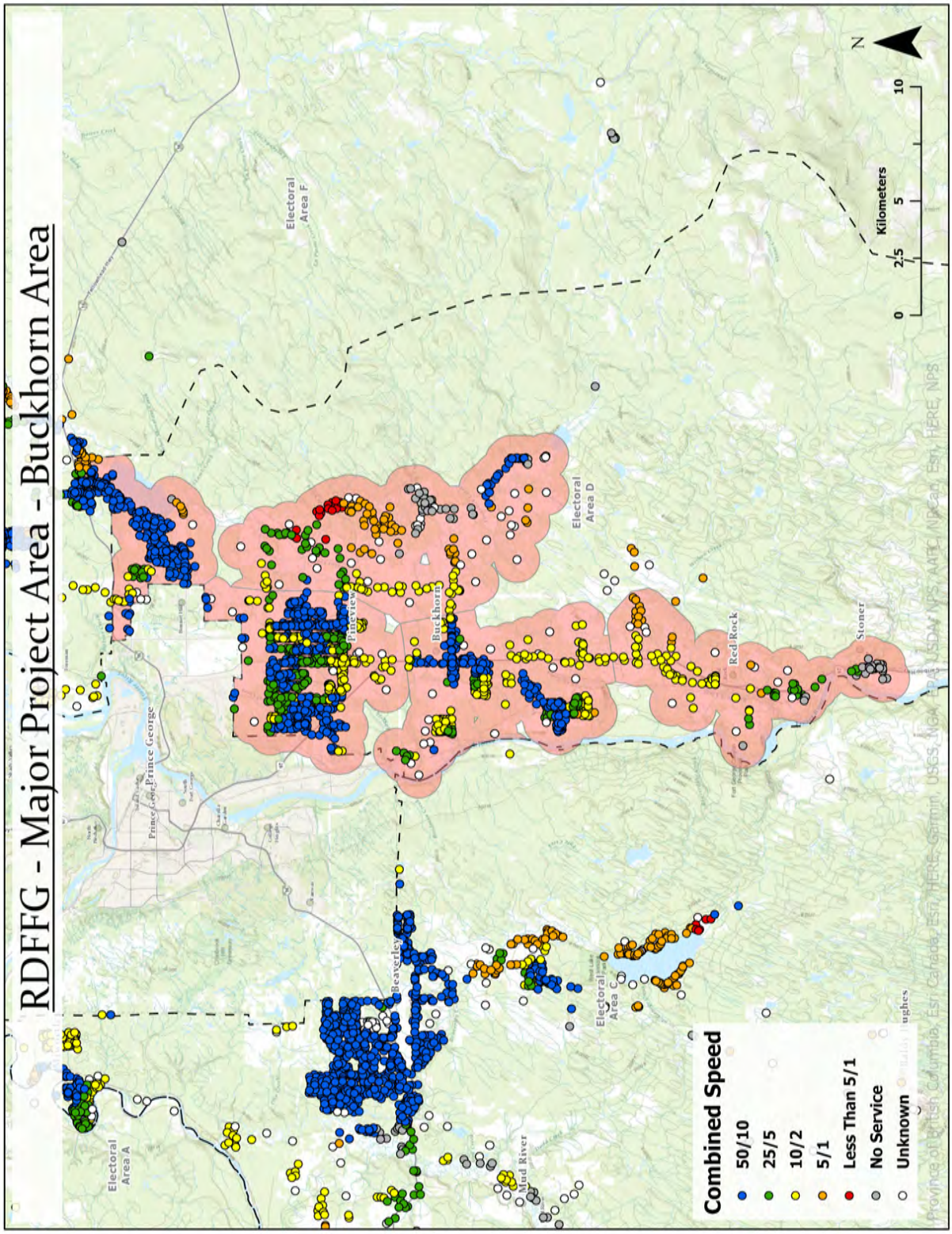

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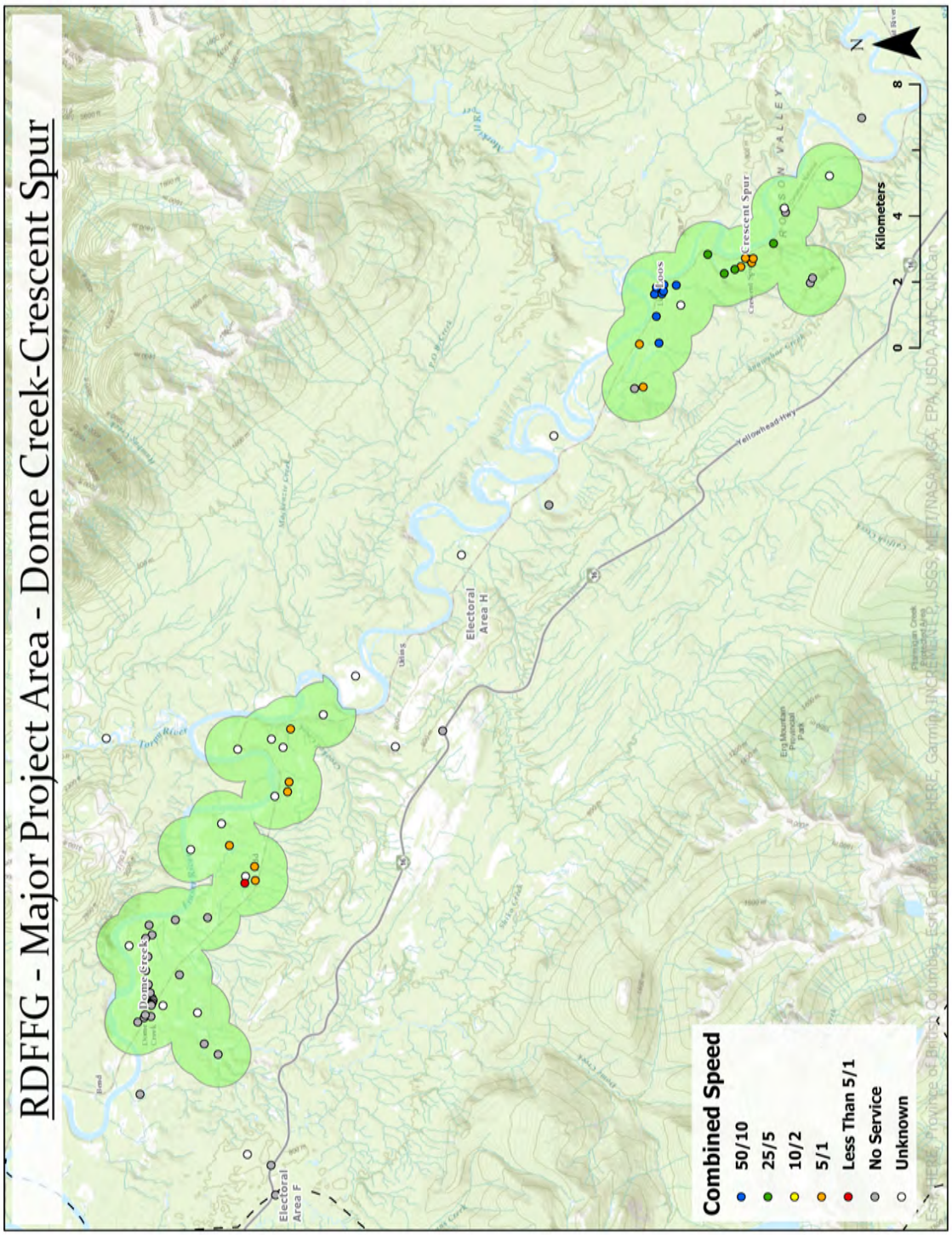

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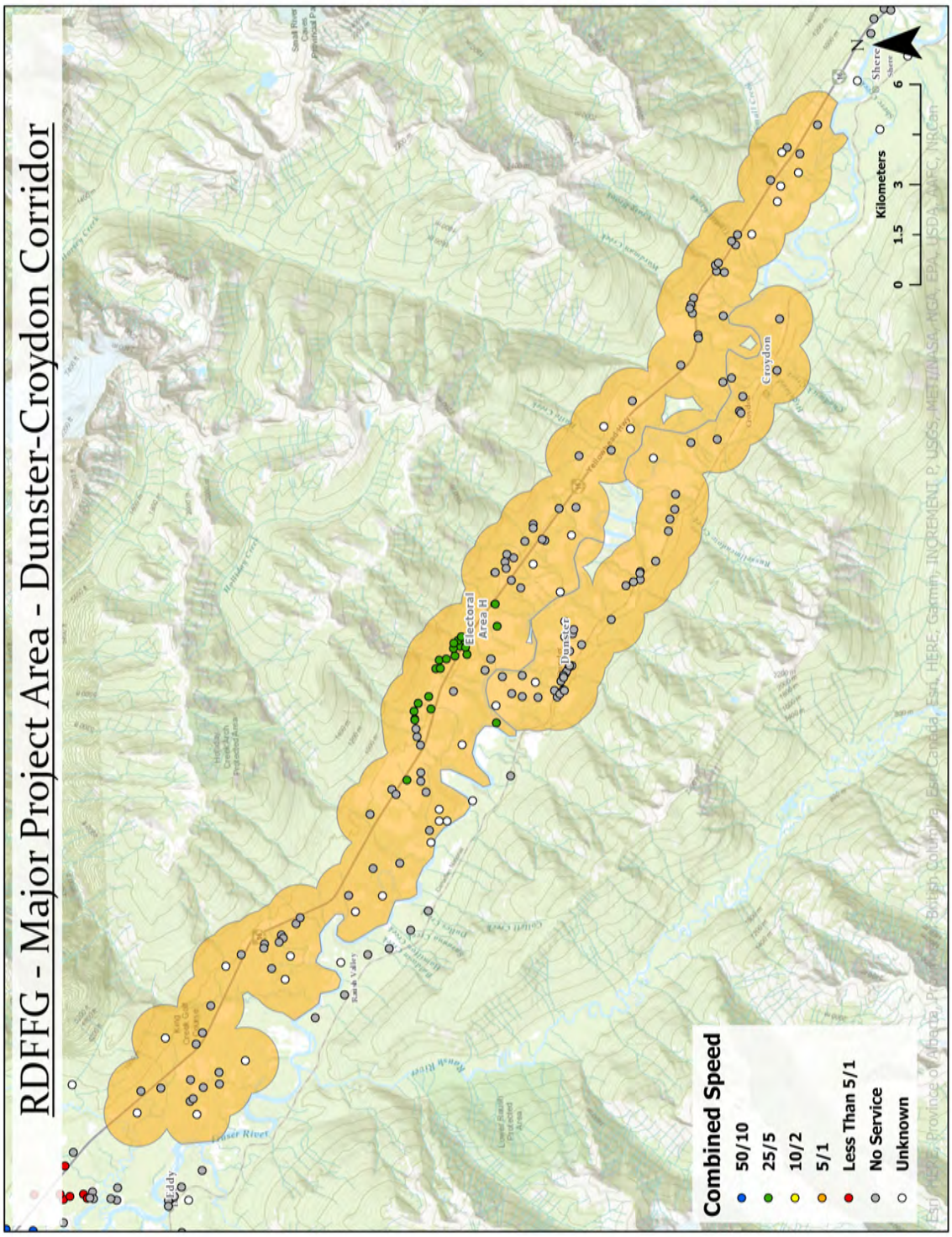

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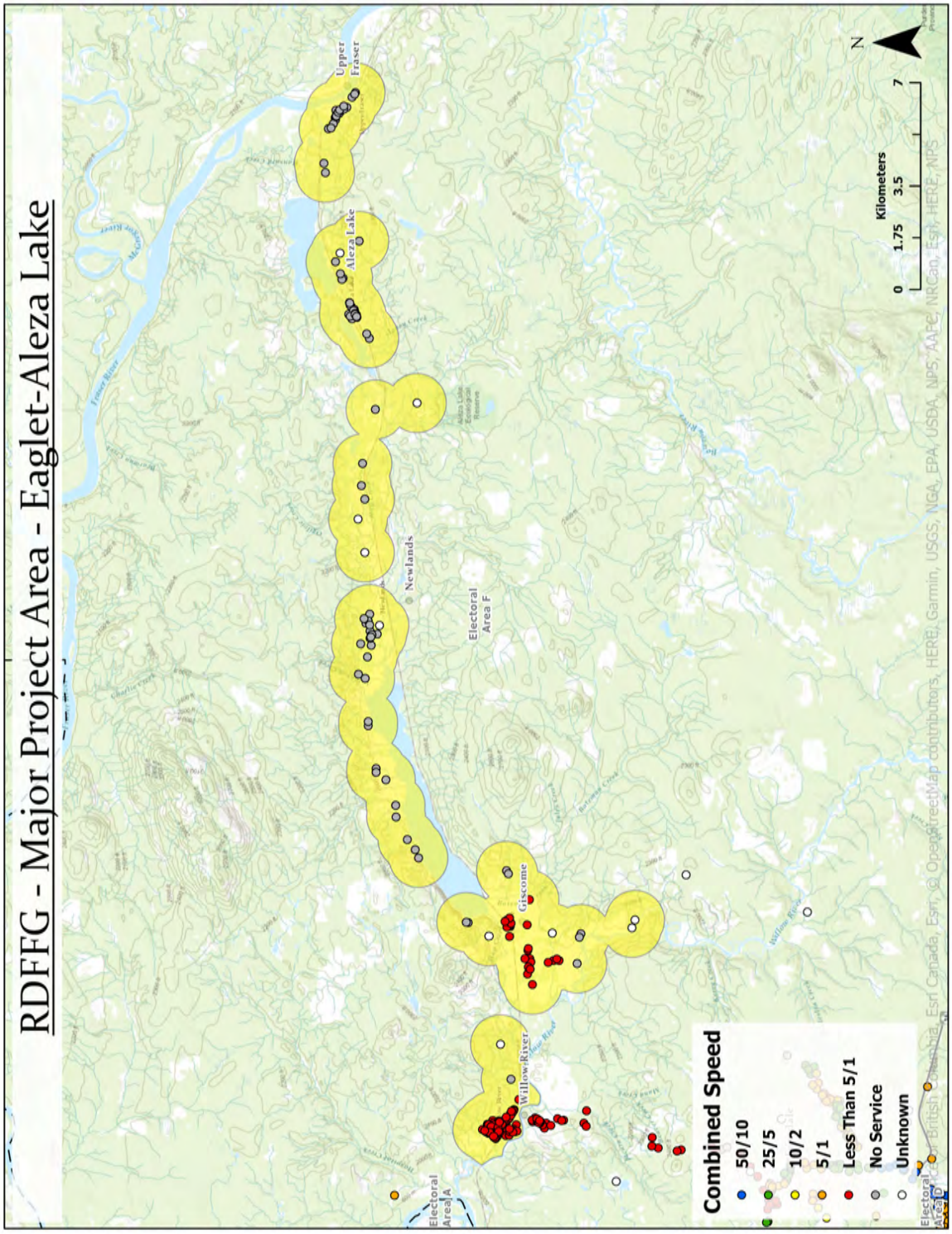

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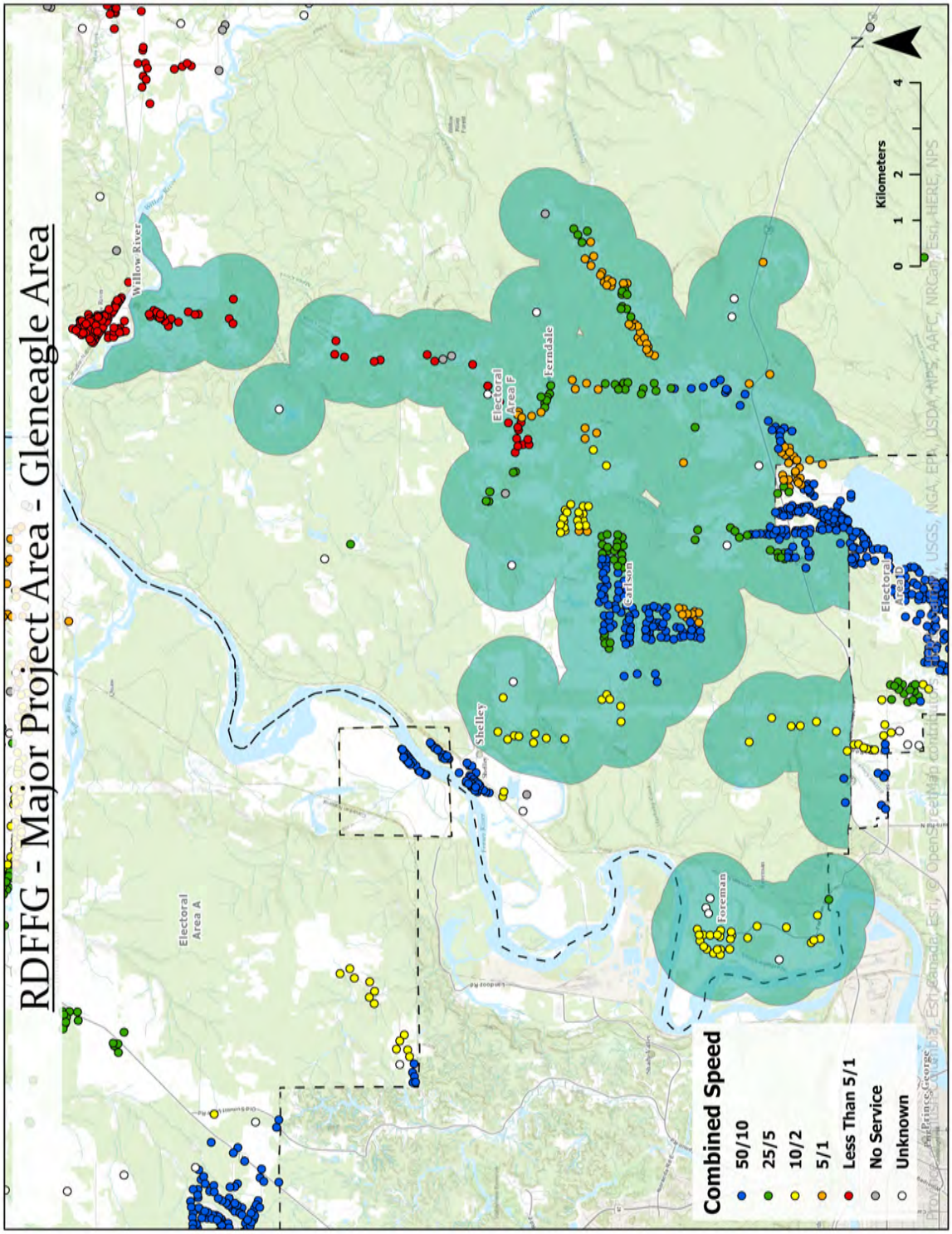

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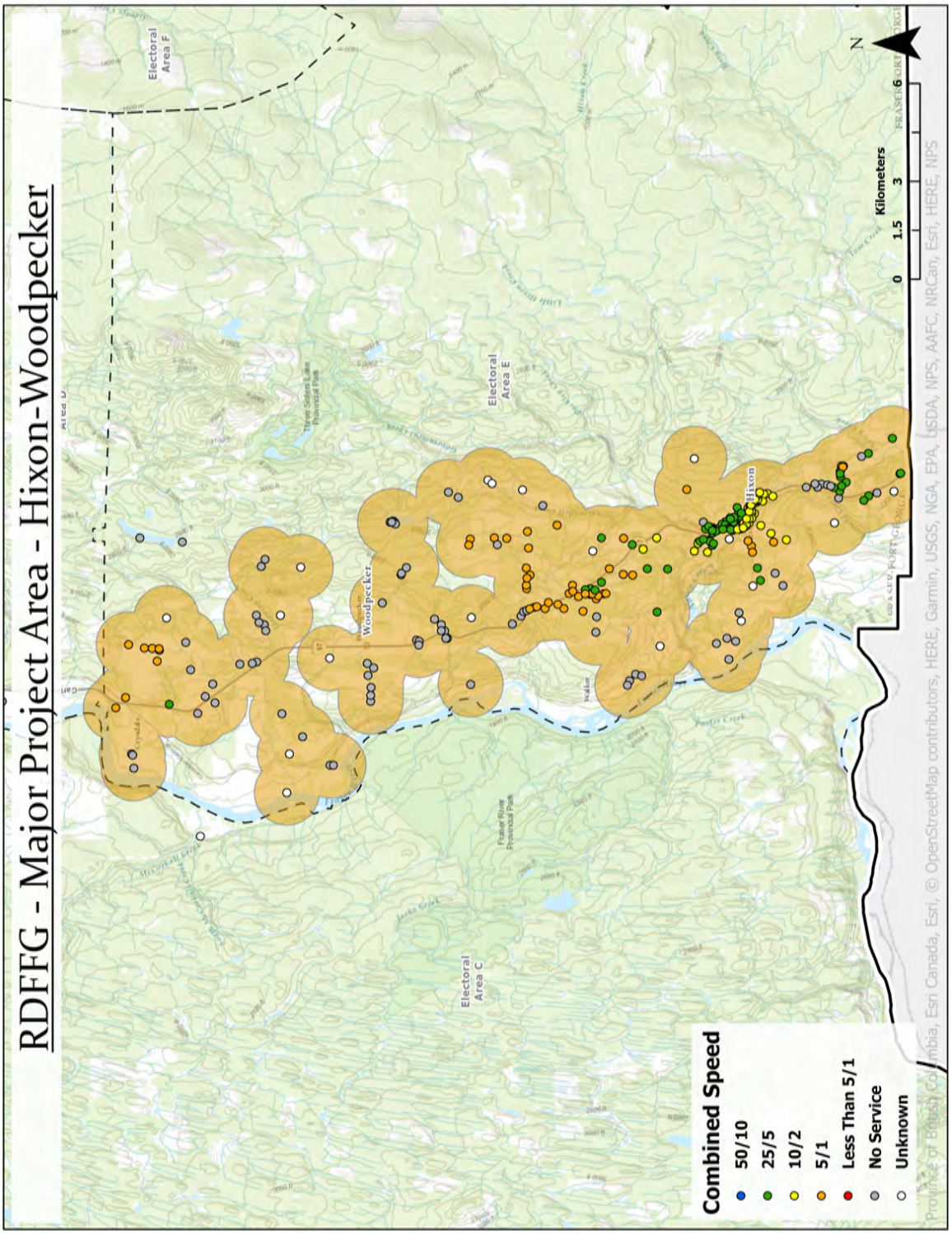

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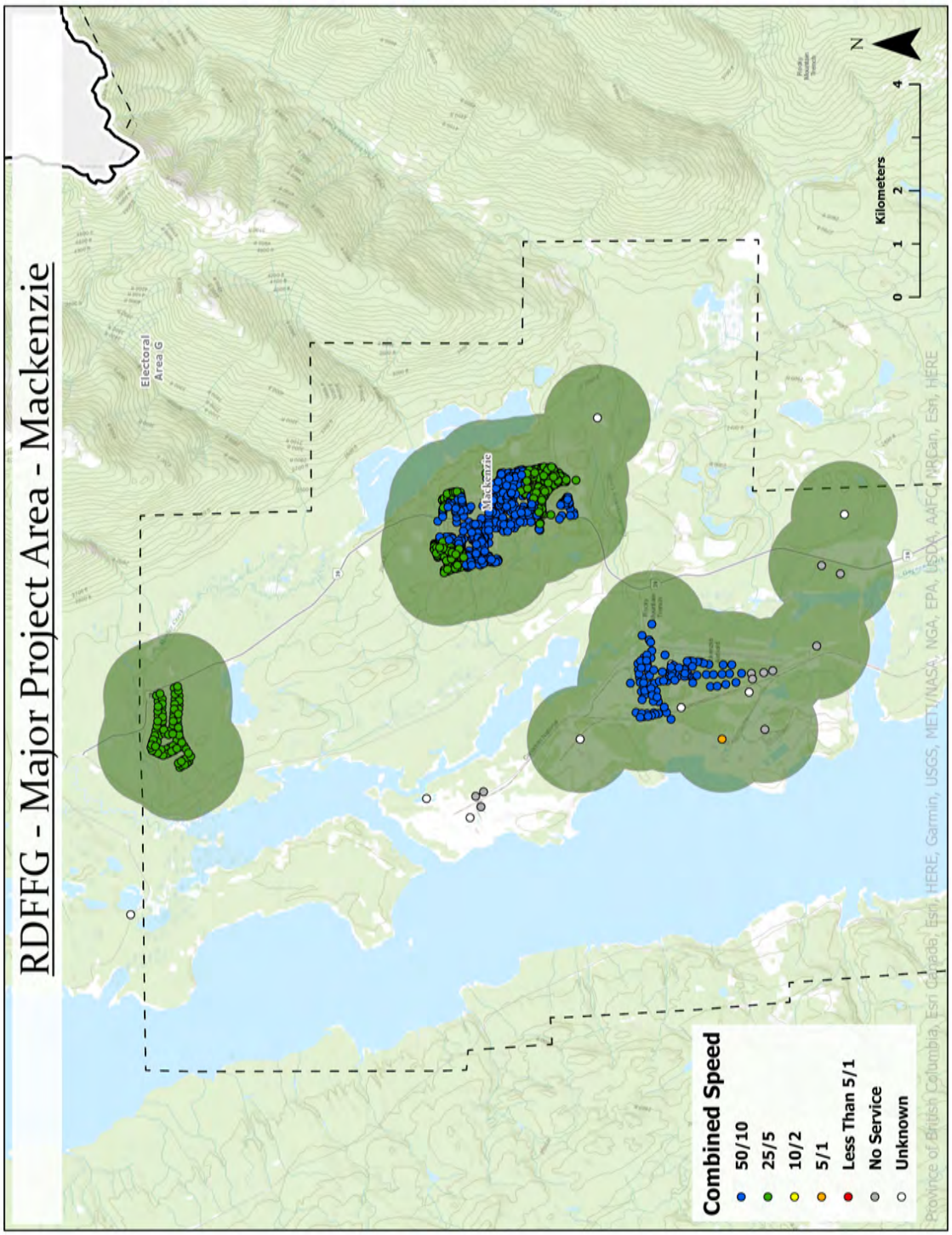

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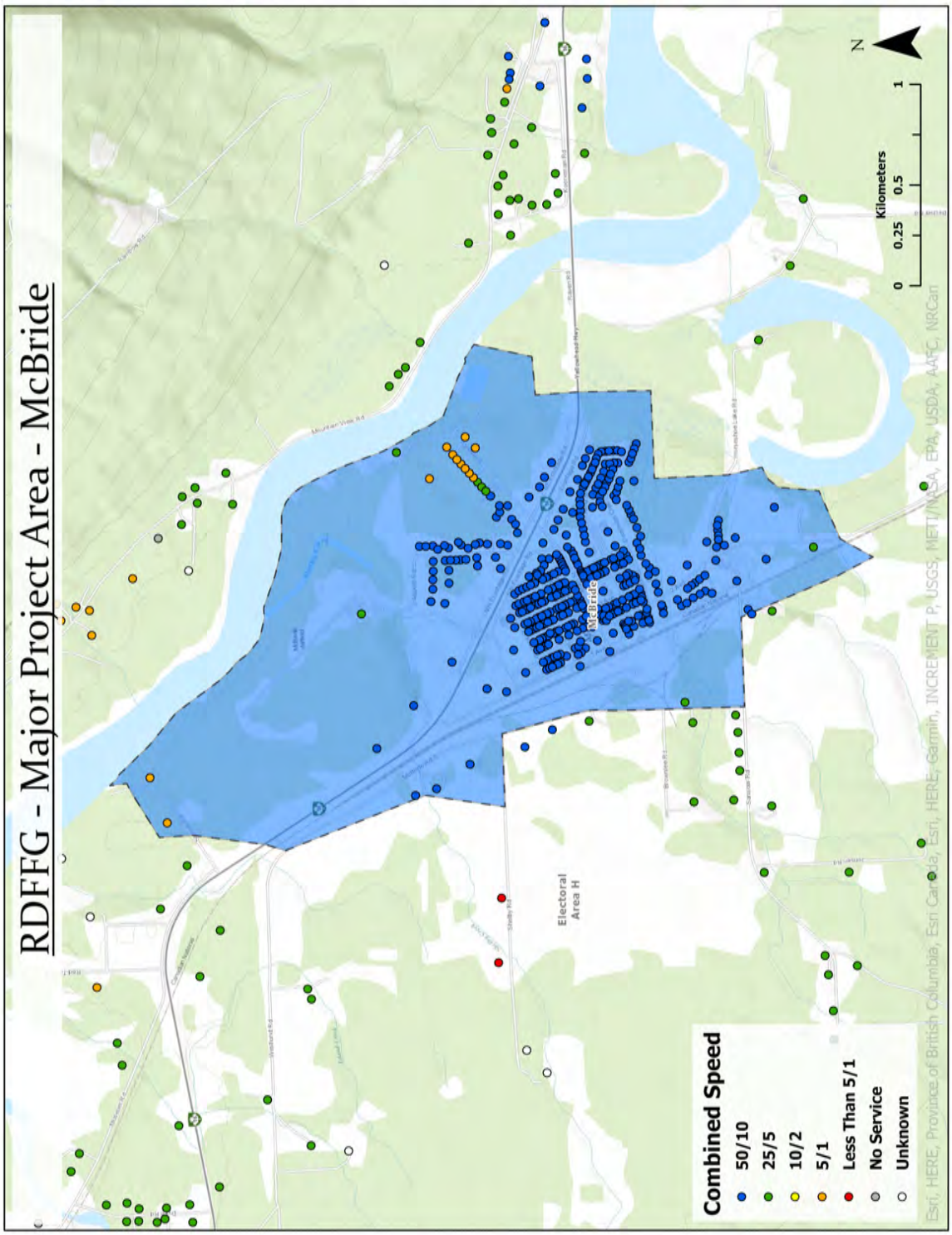

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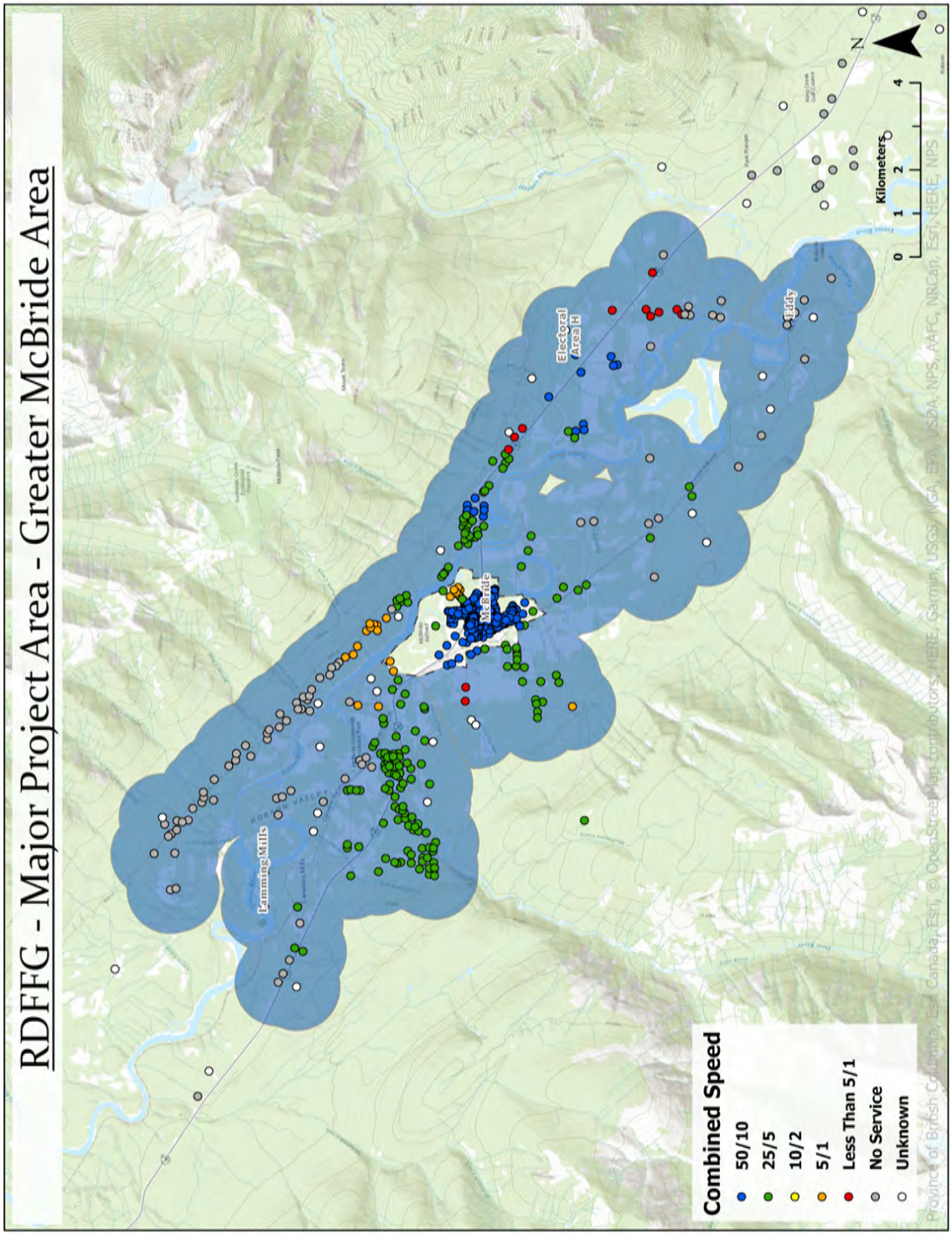

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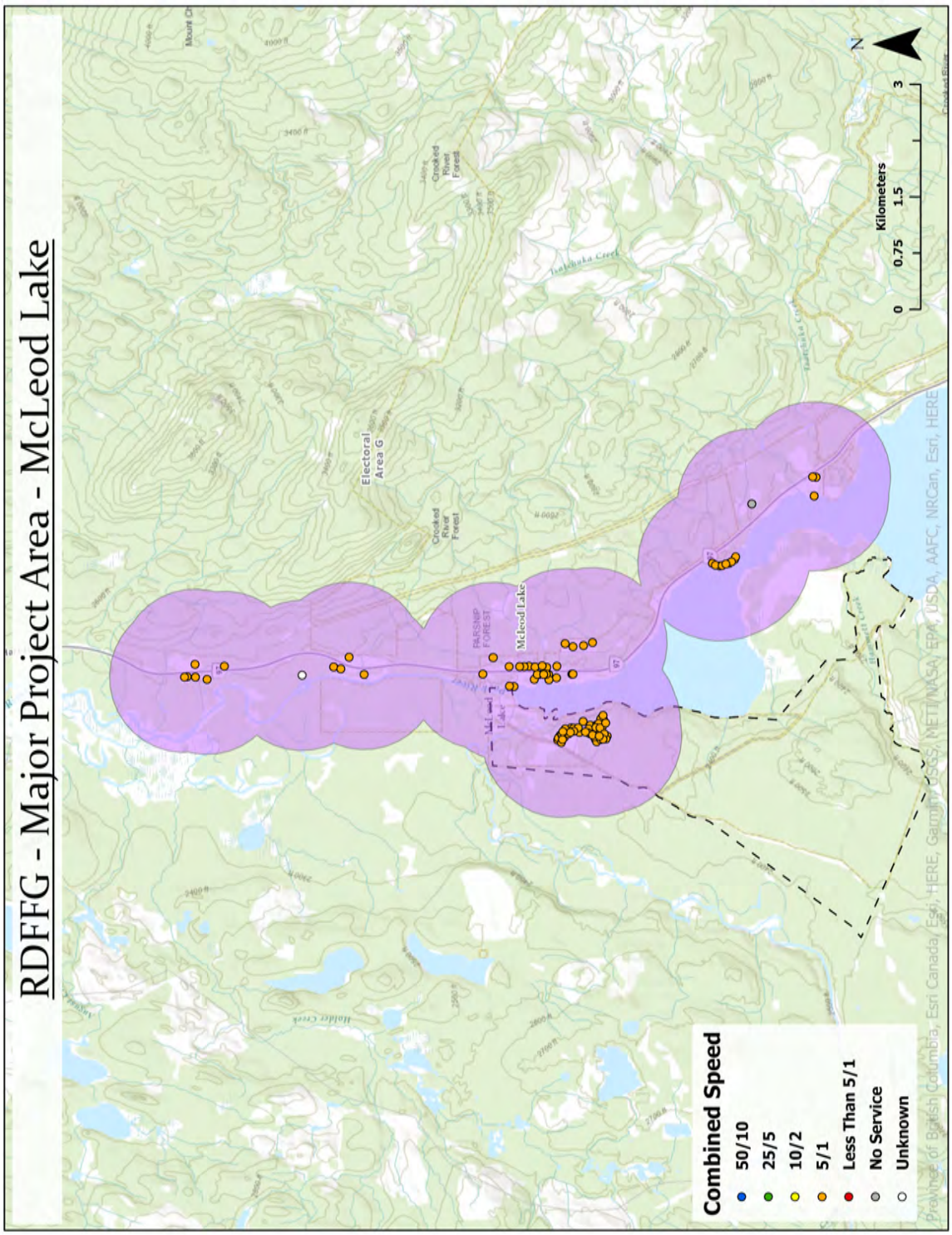

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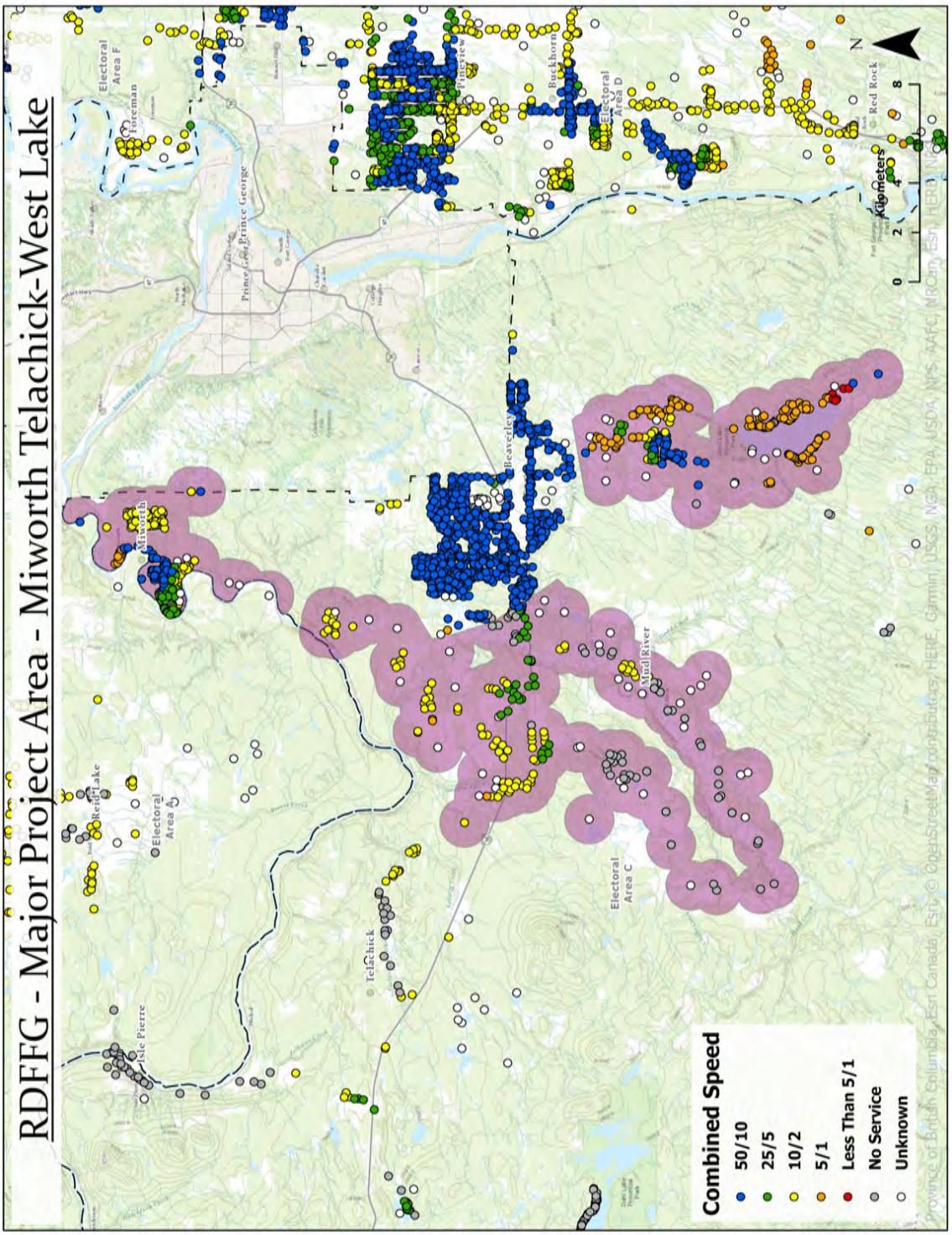

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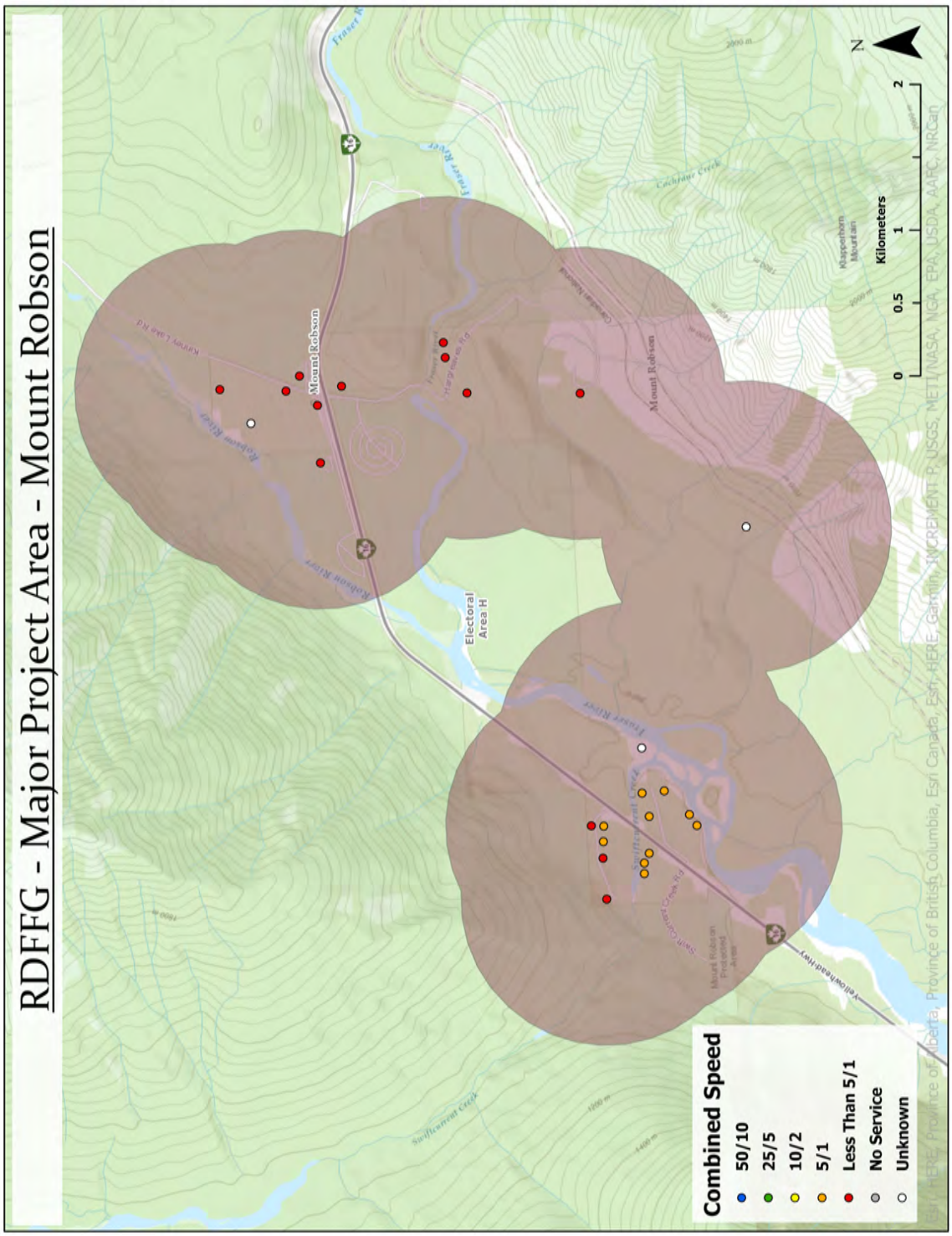

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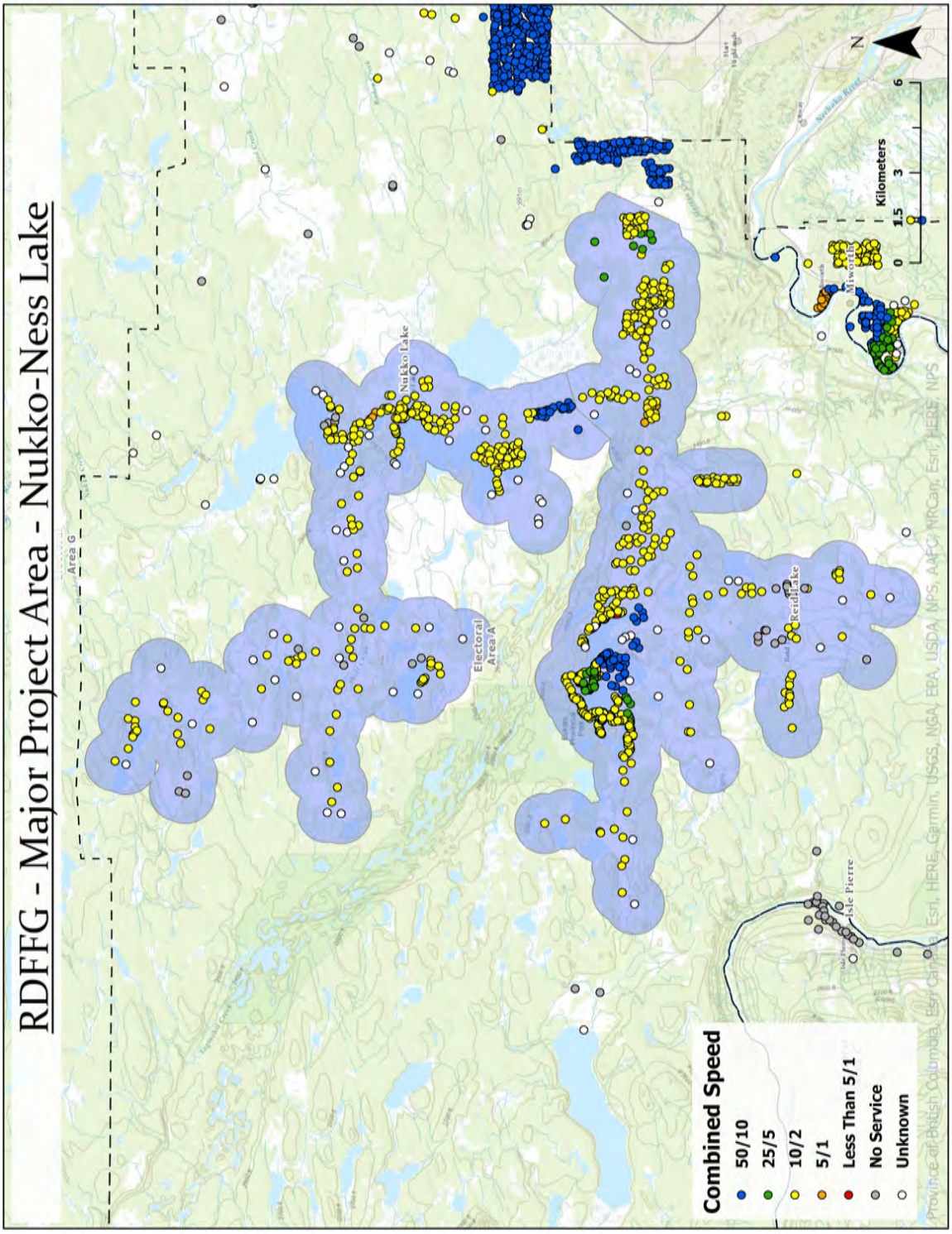

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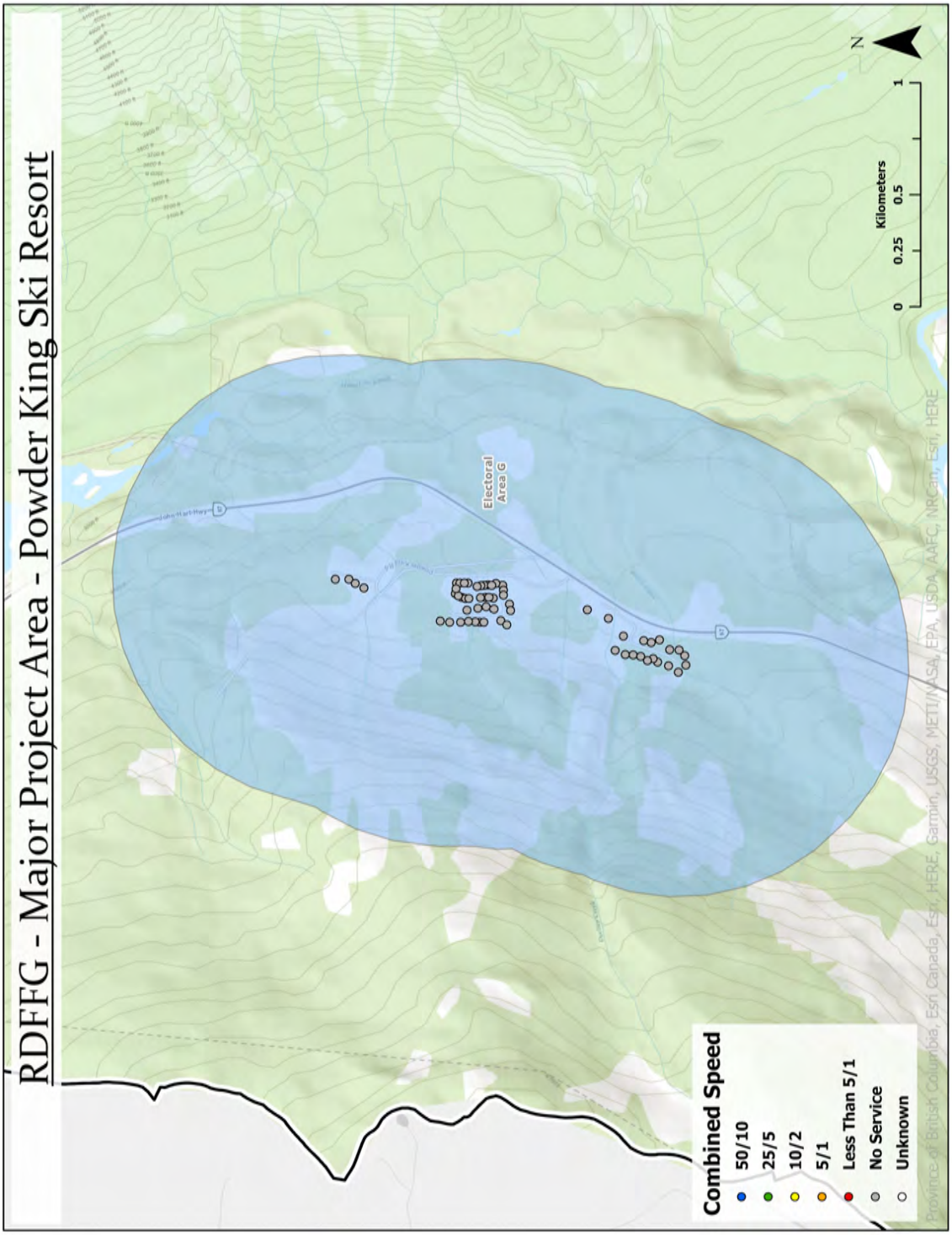

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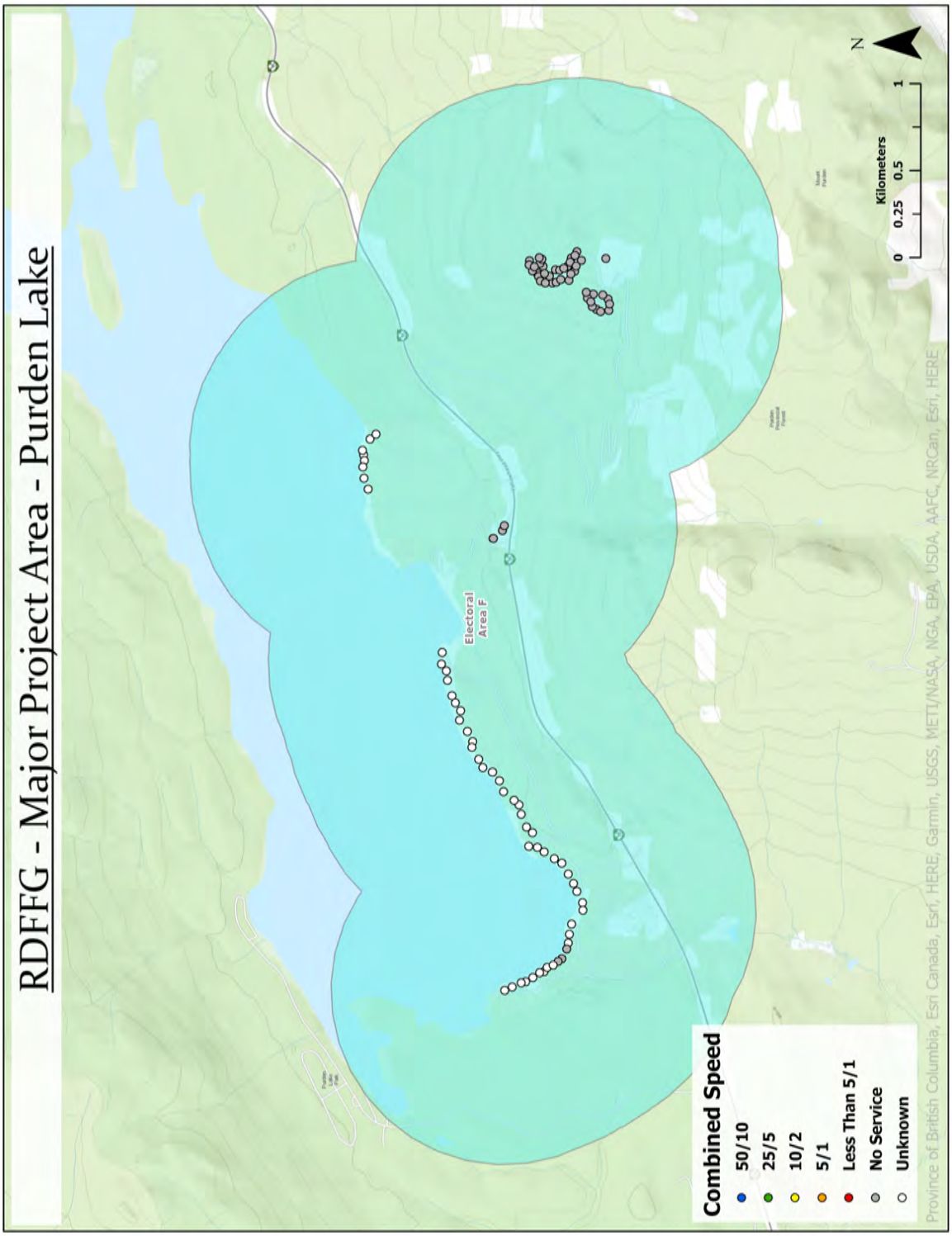

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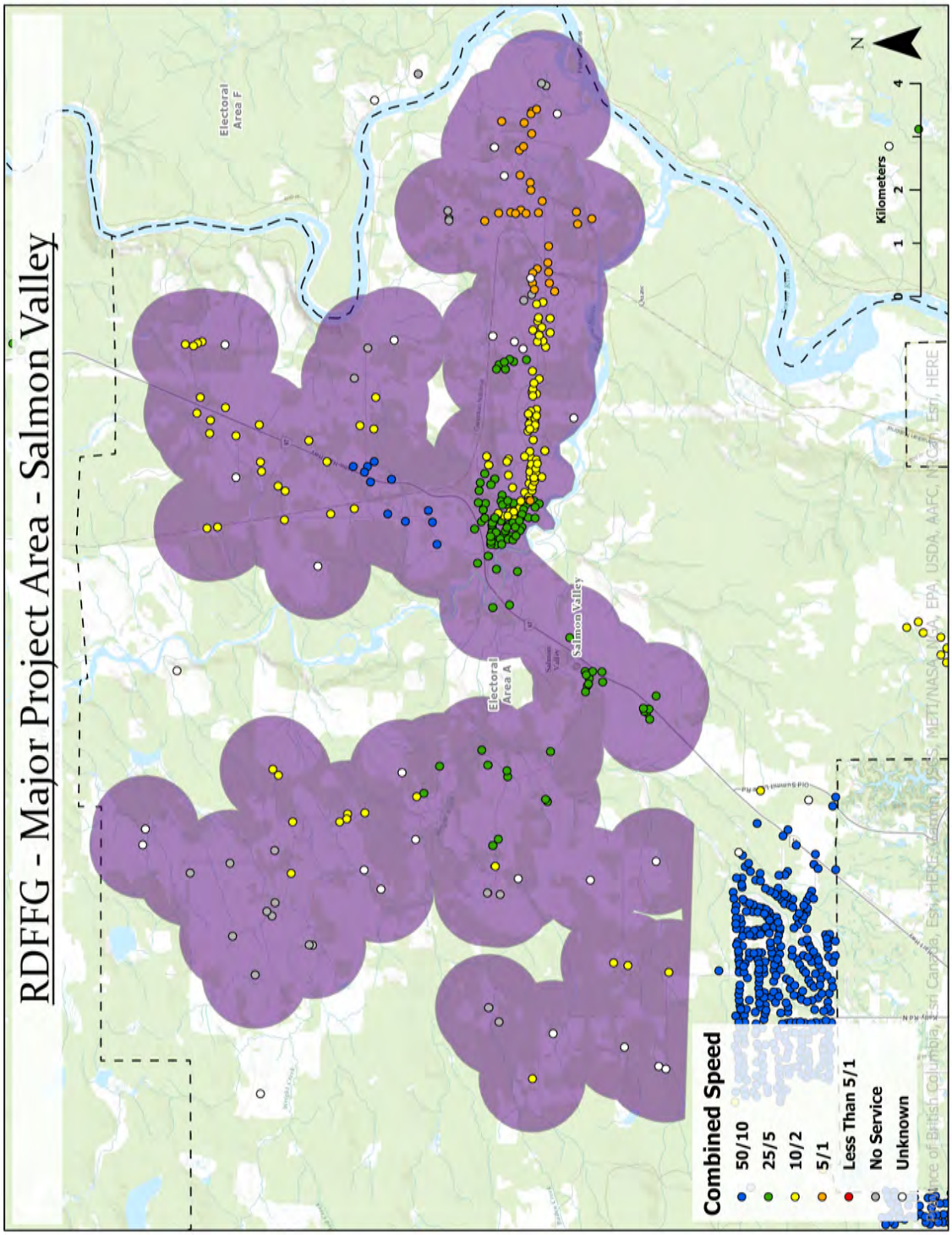

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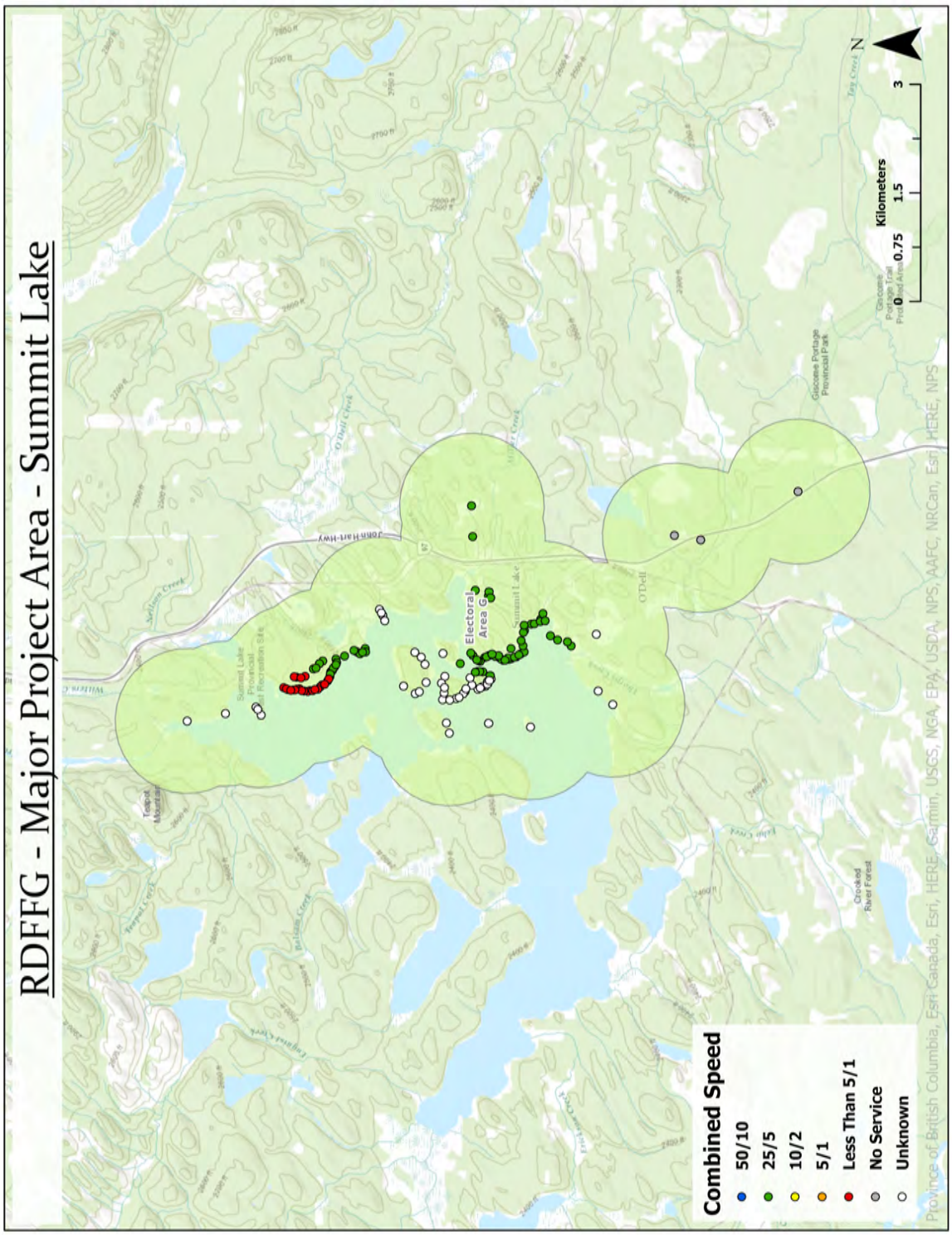

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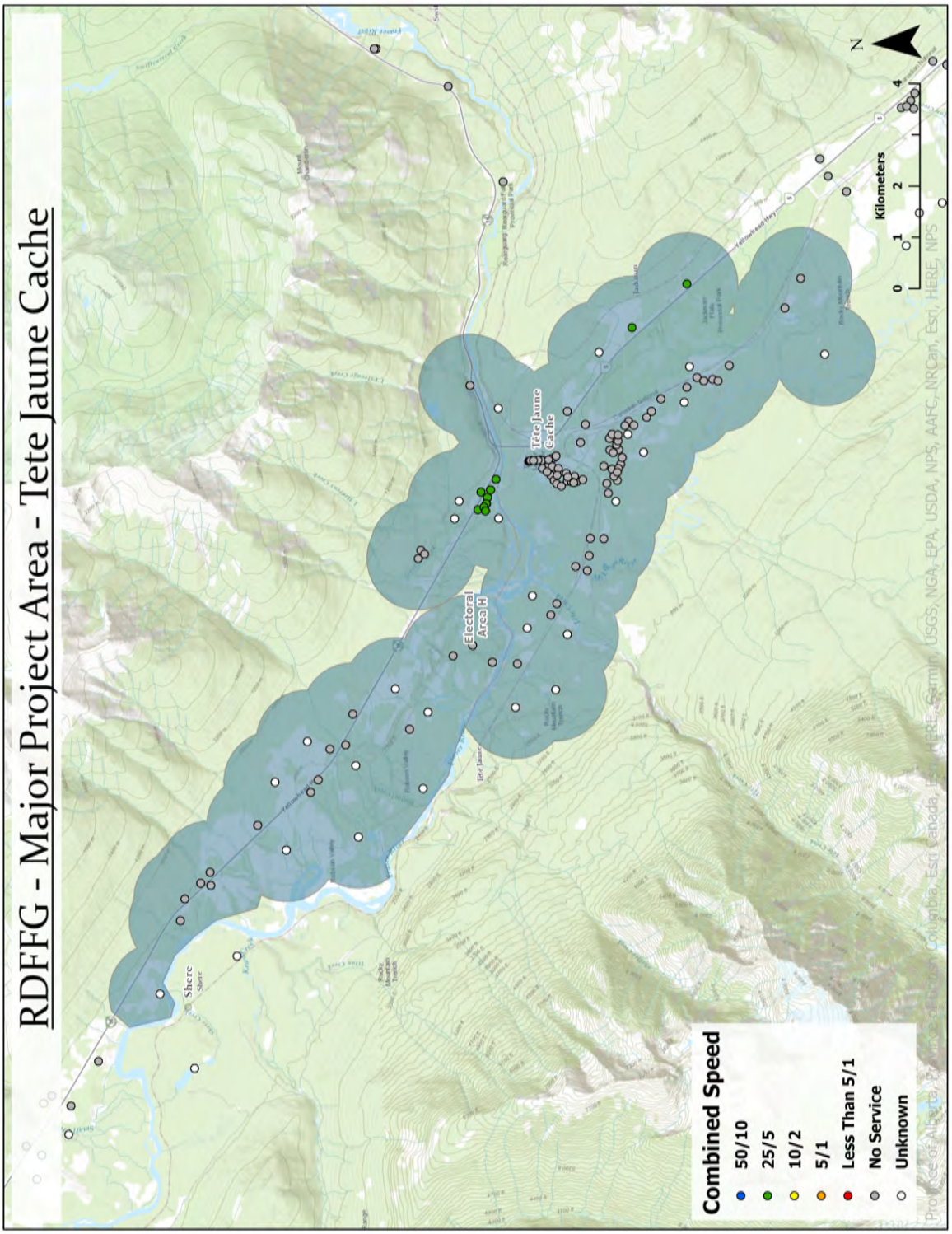

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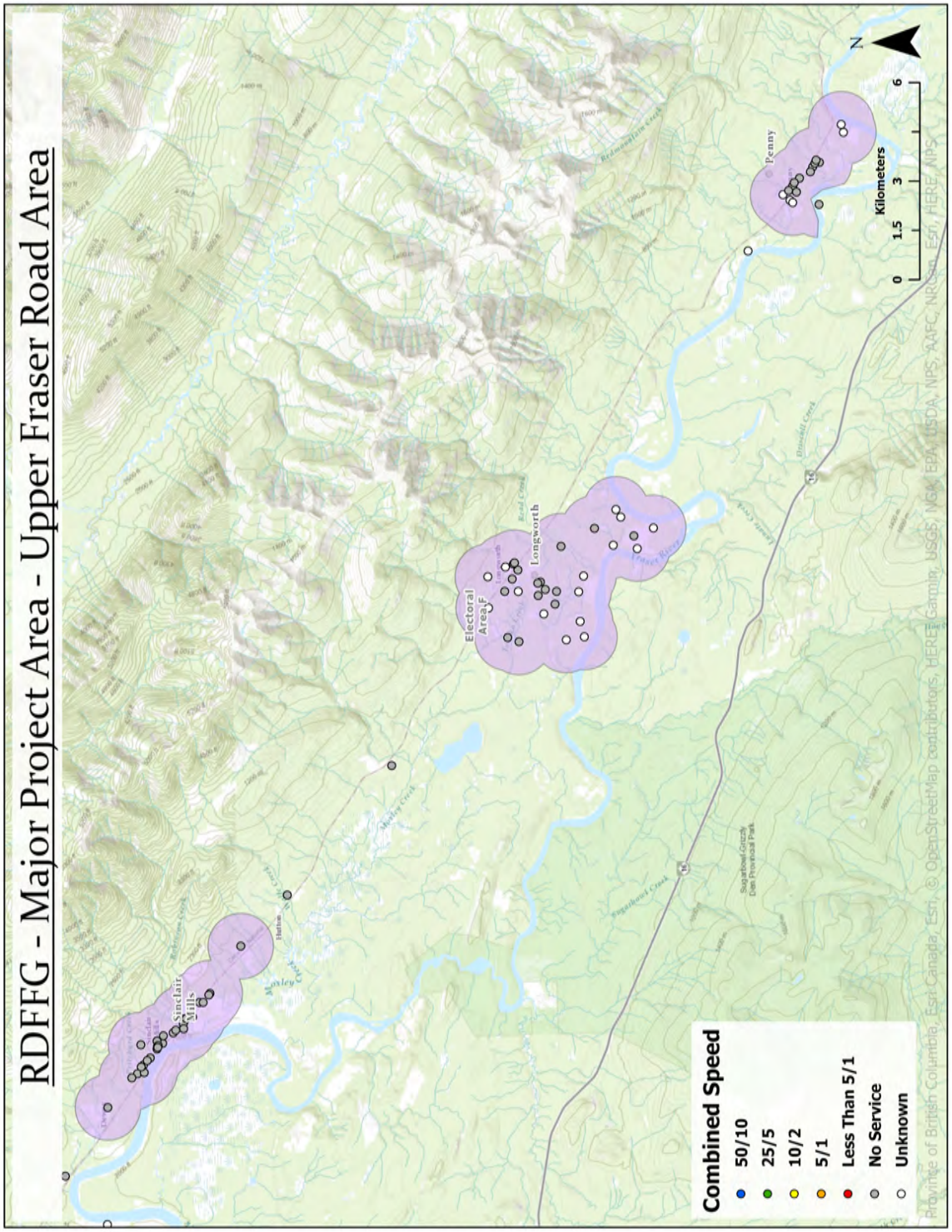

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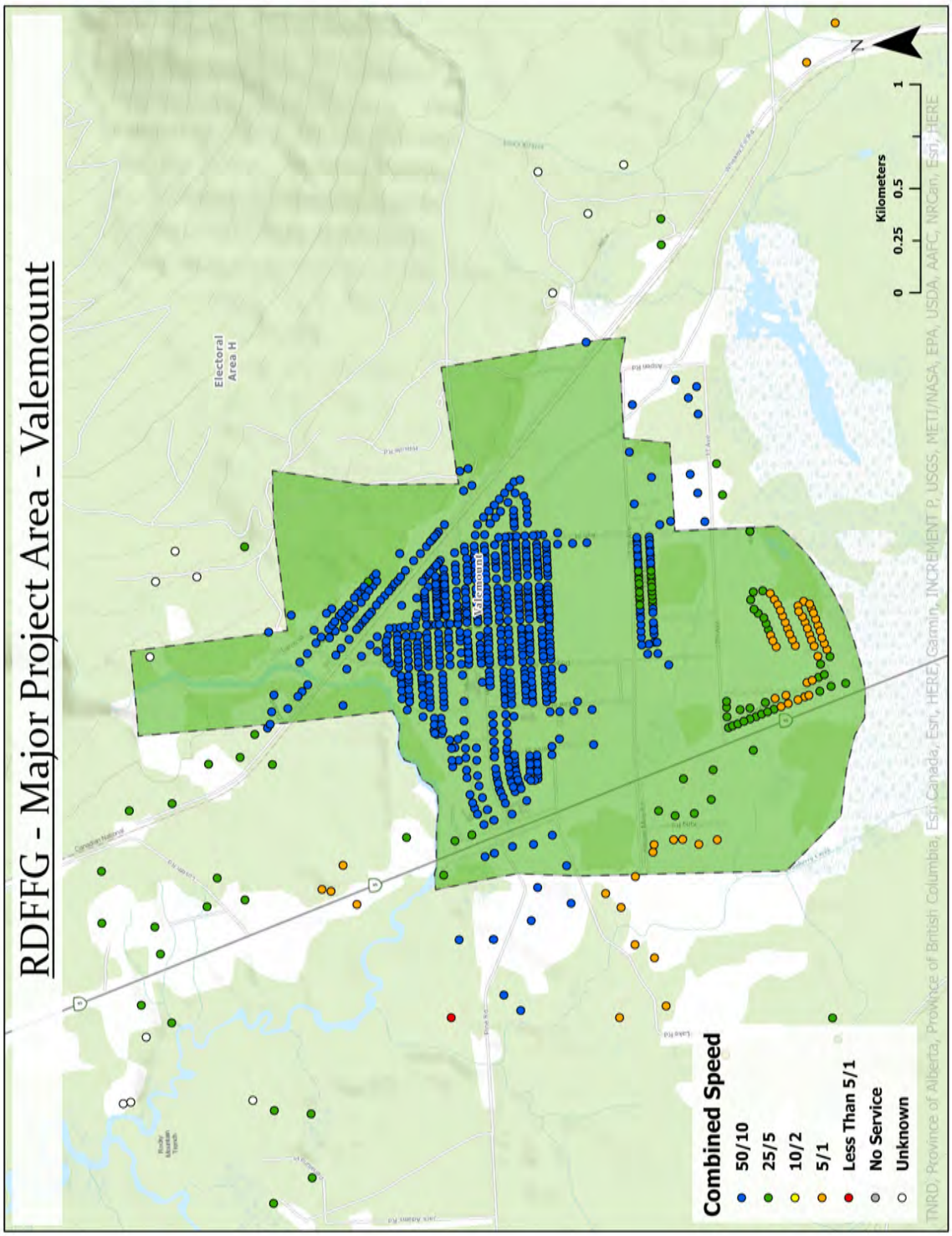

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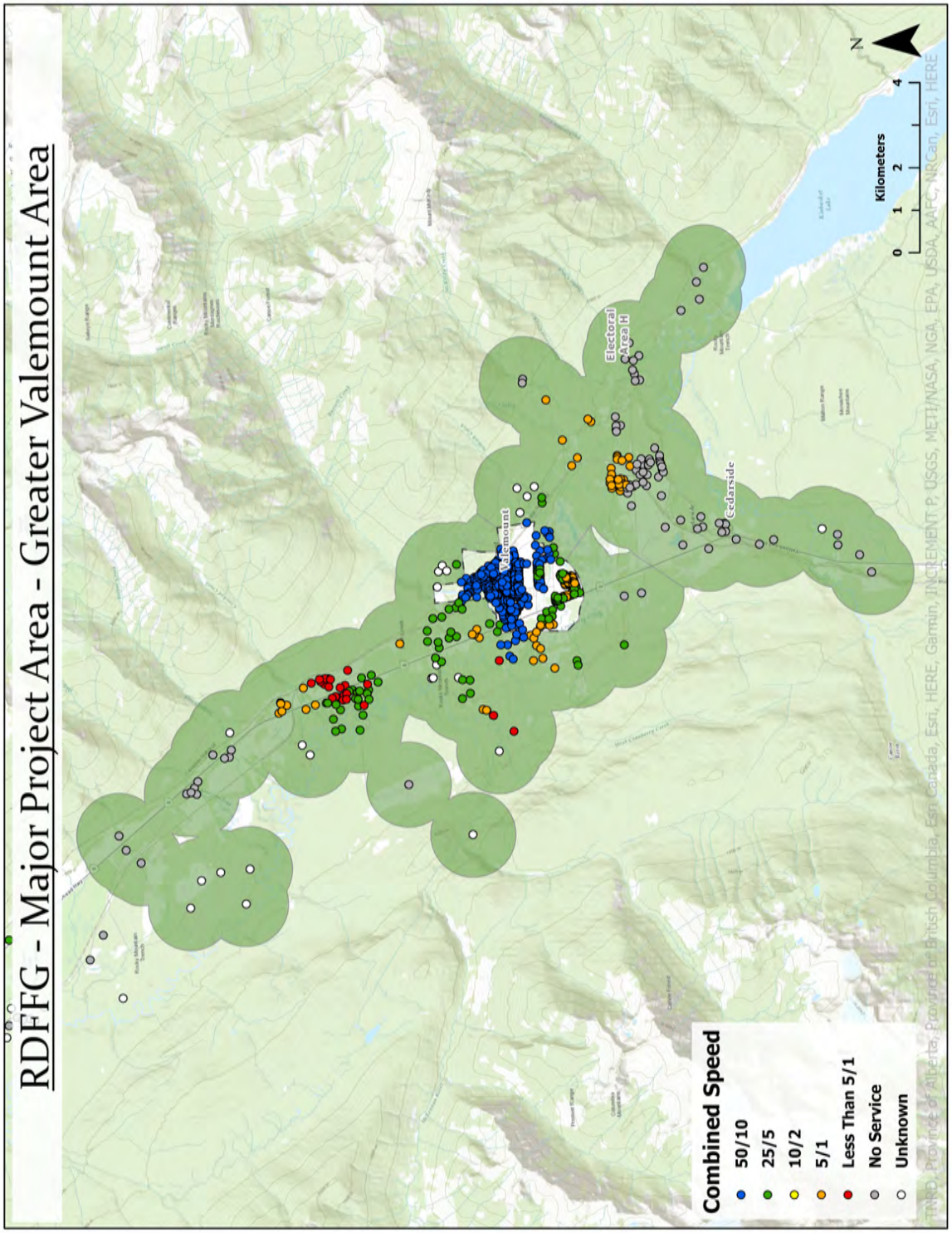

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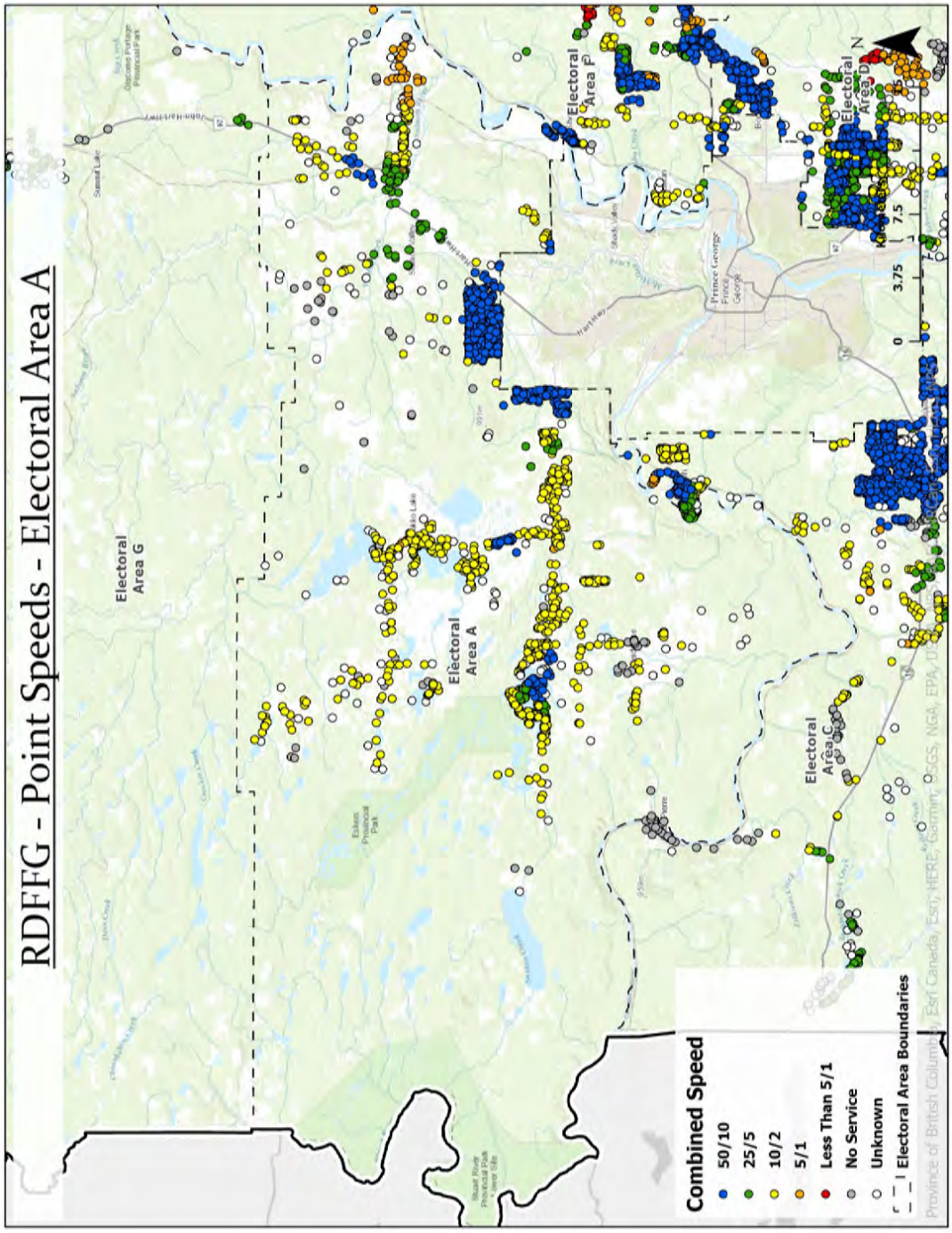
Appendix B - Electoral Area Points by Speed



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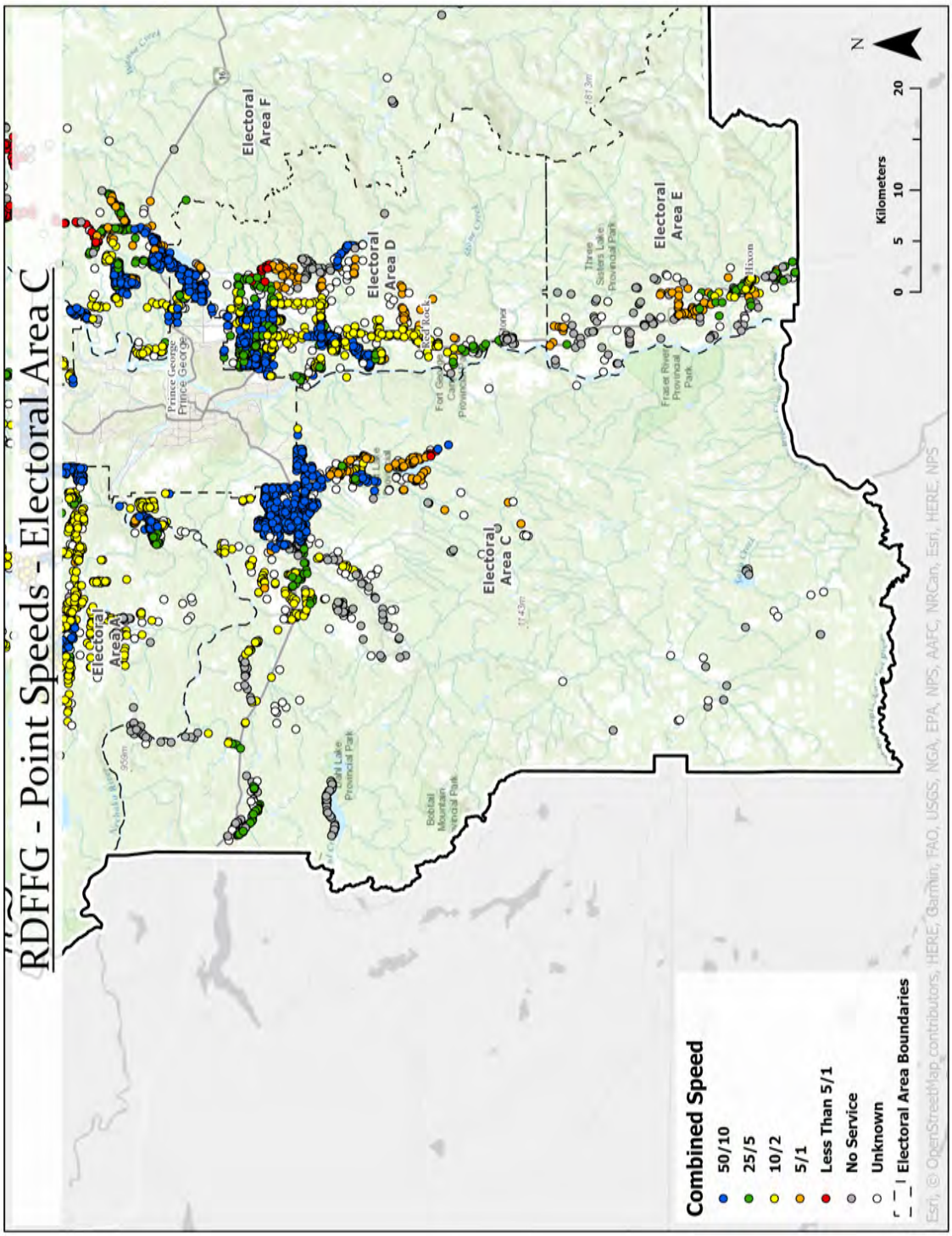

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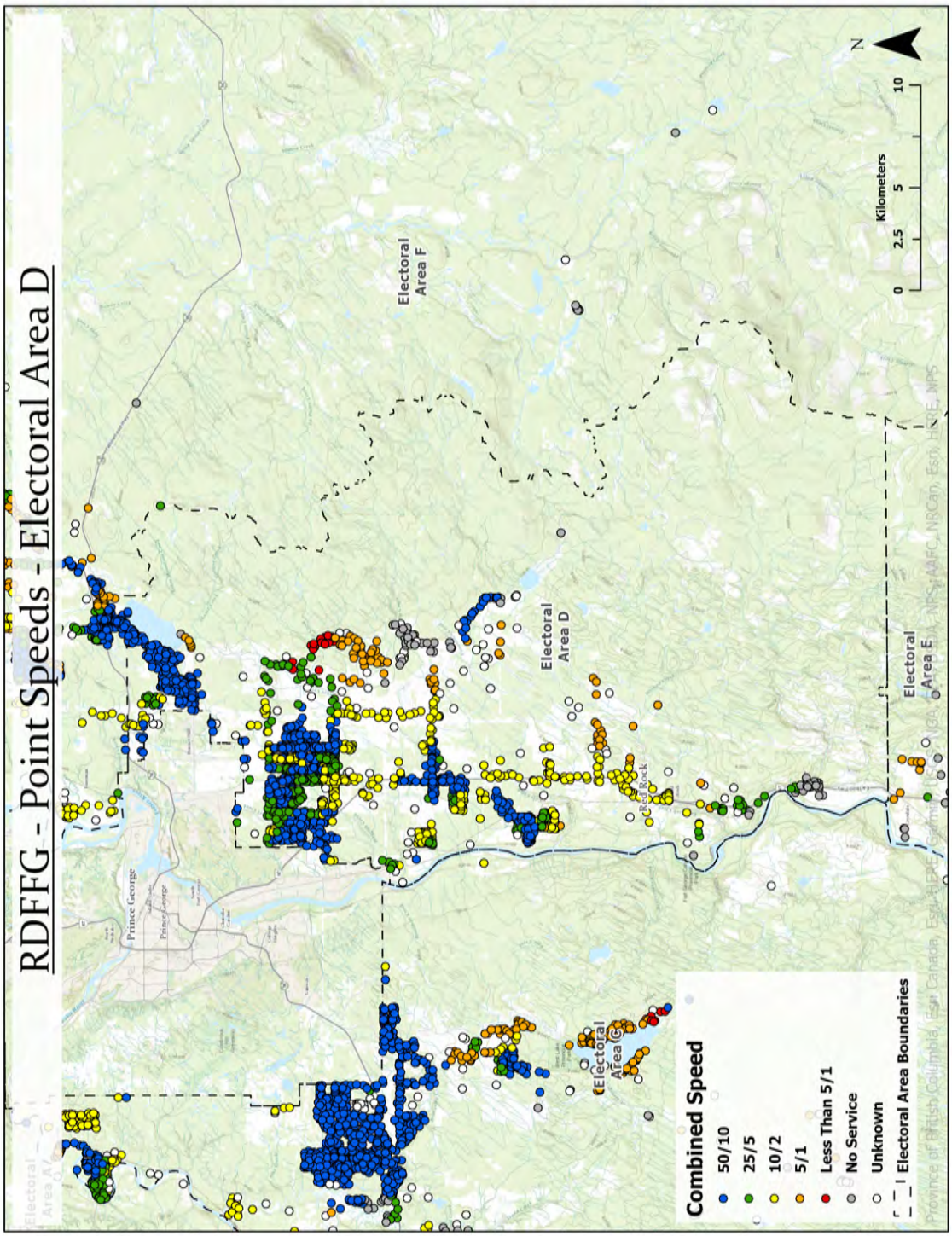

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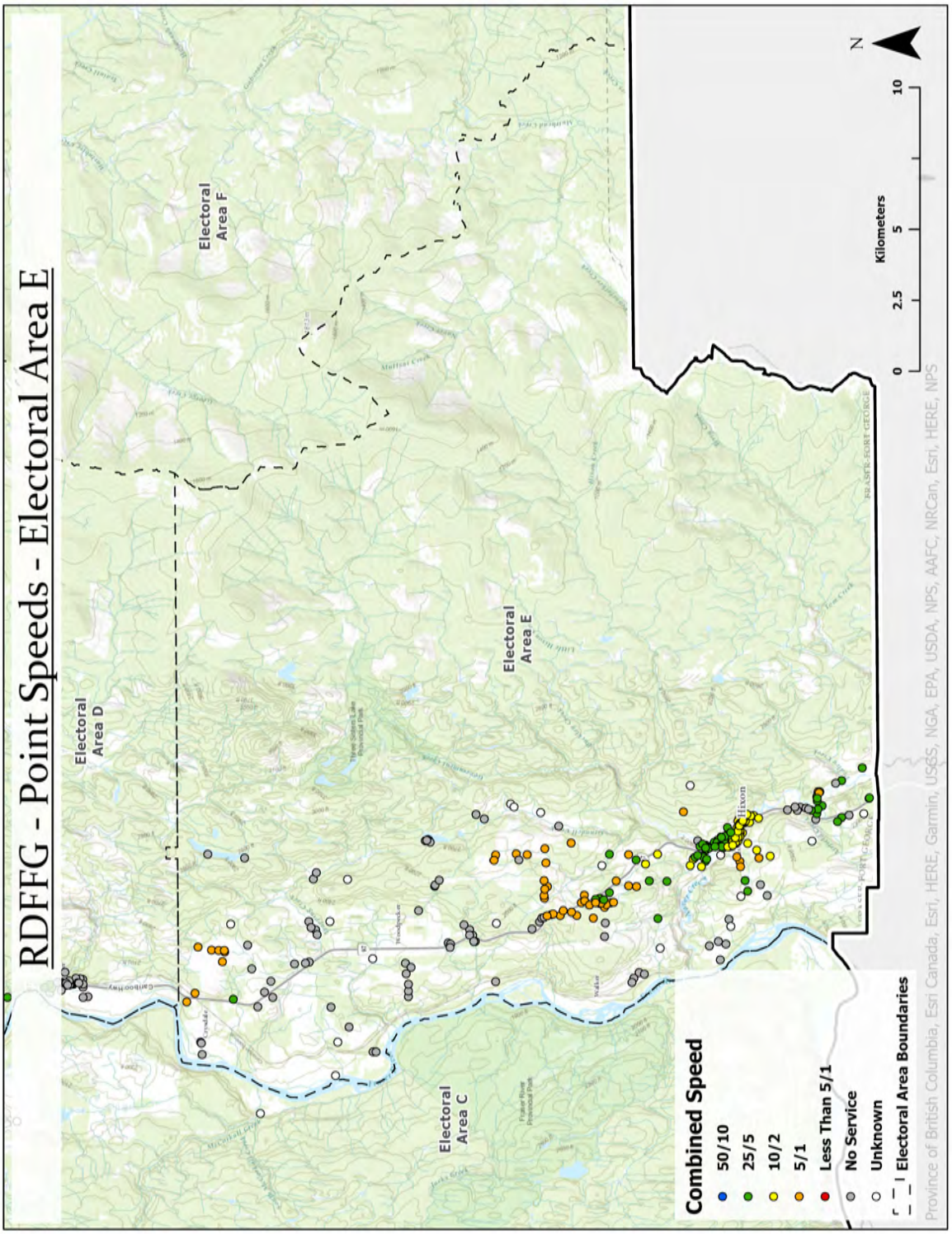

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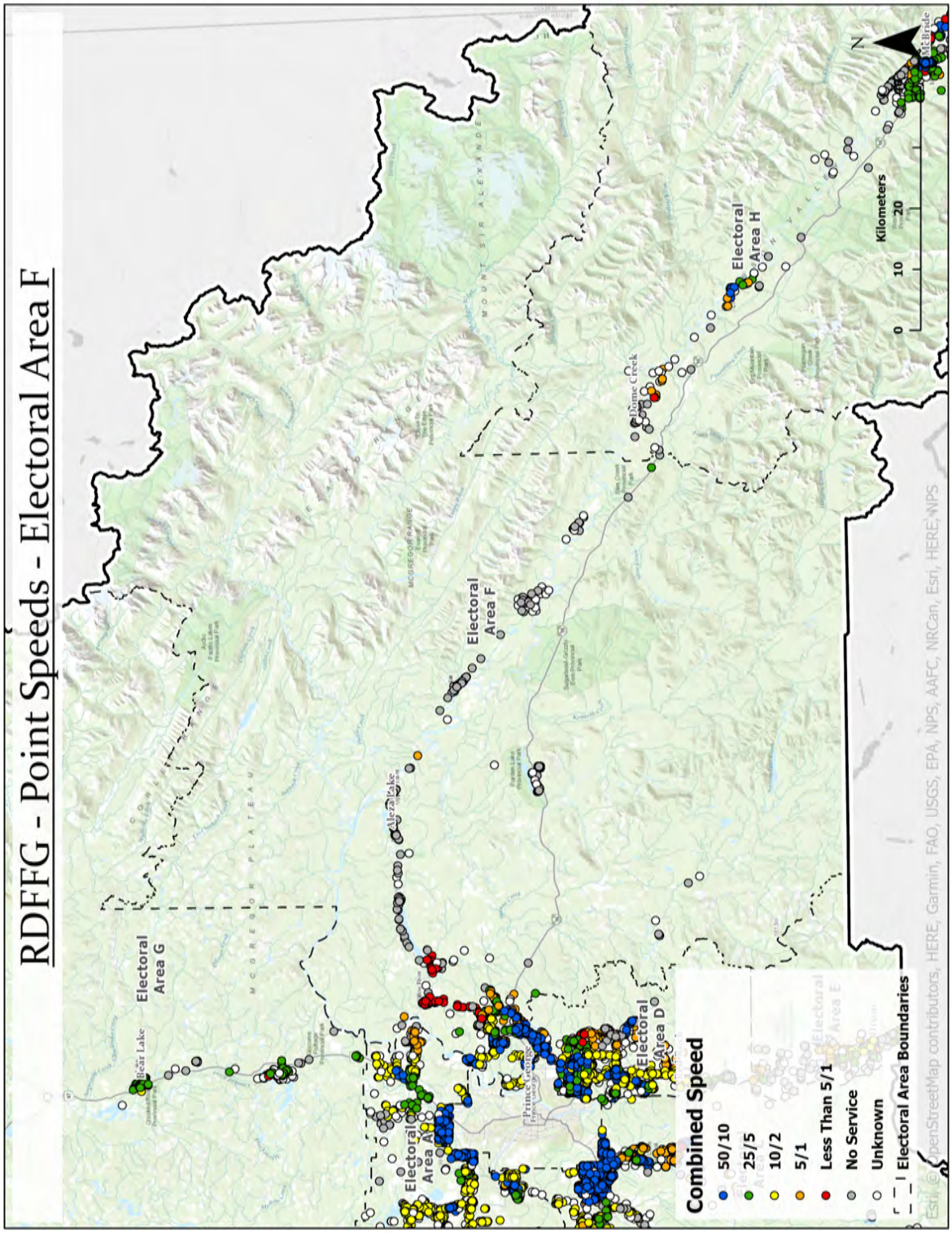

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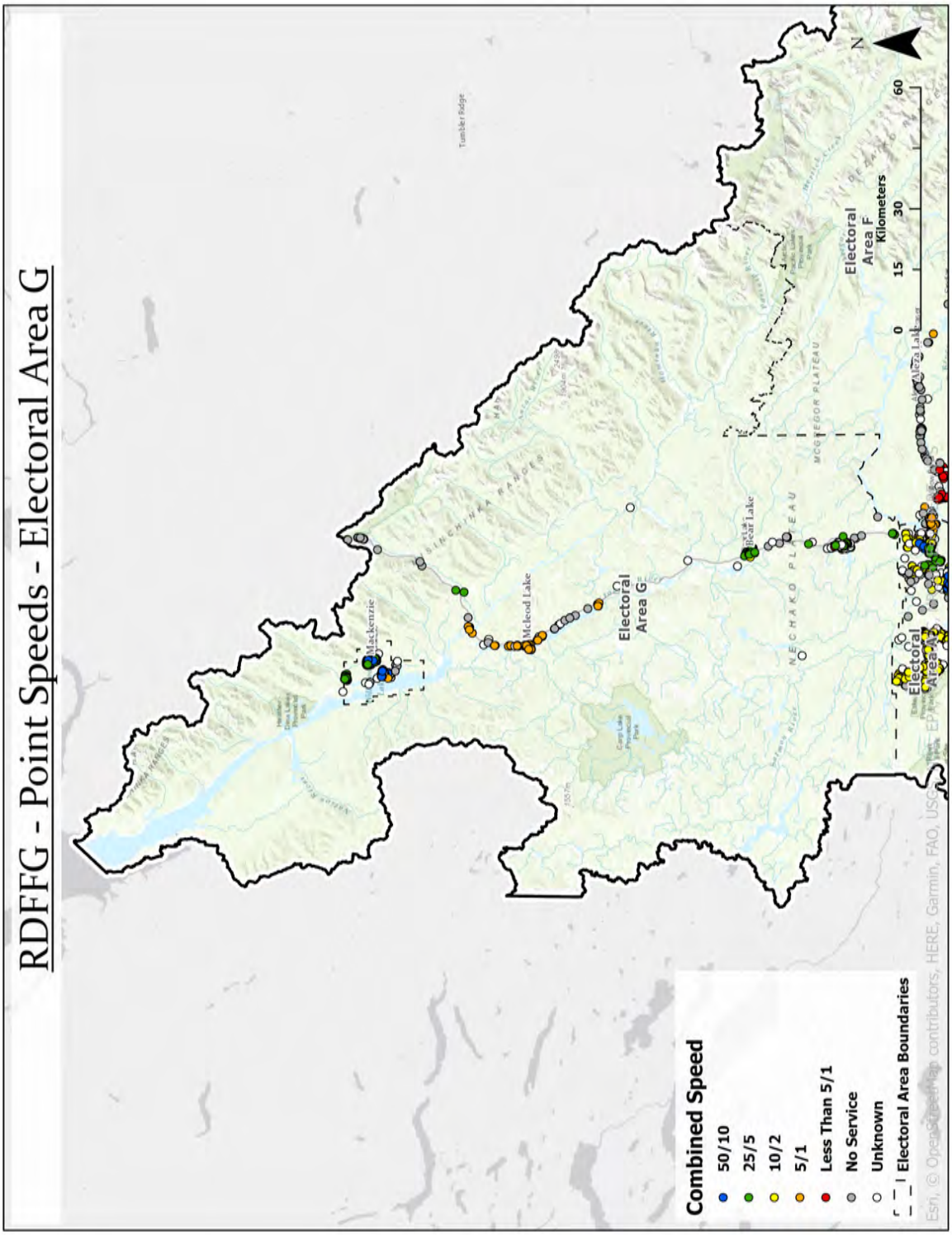

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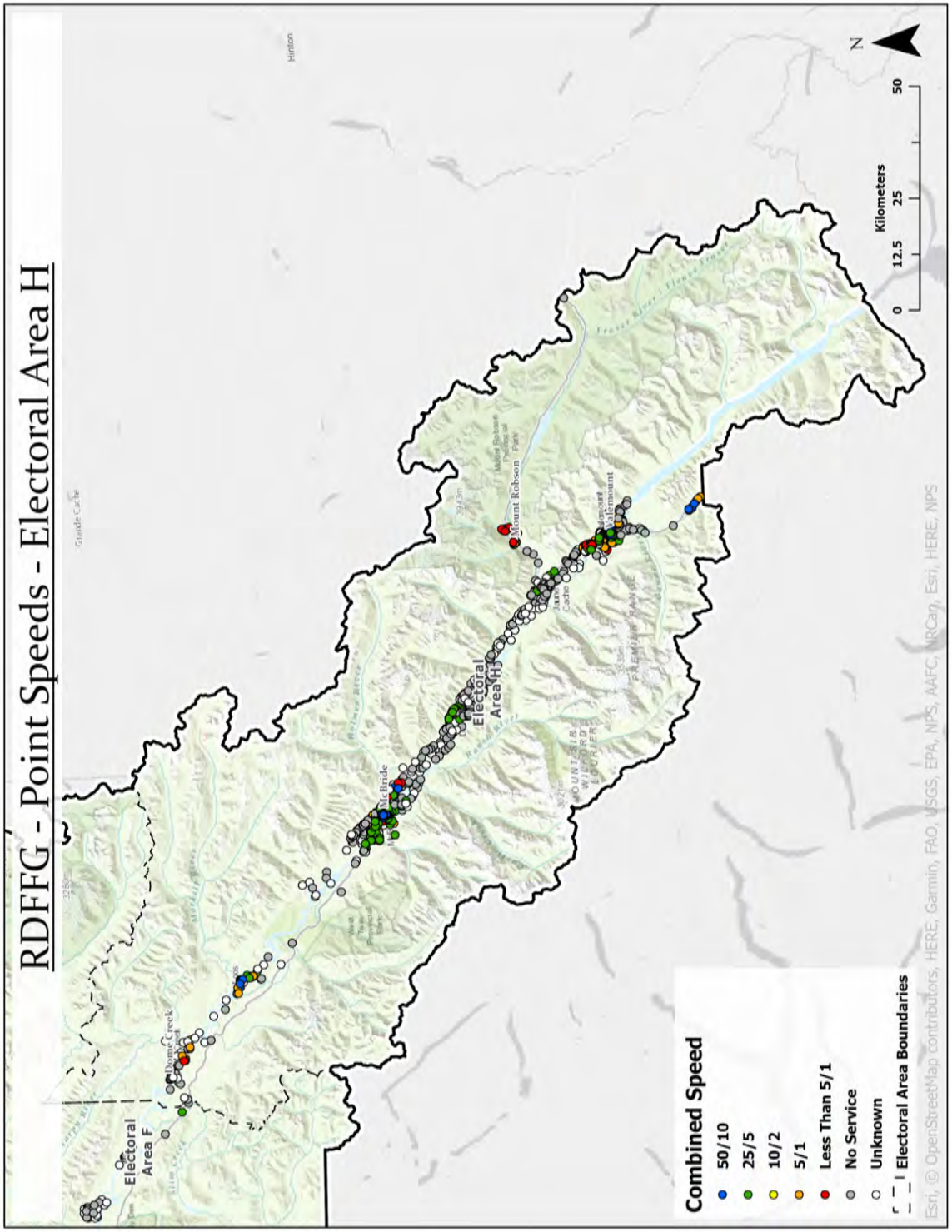

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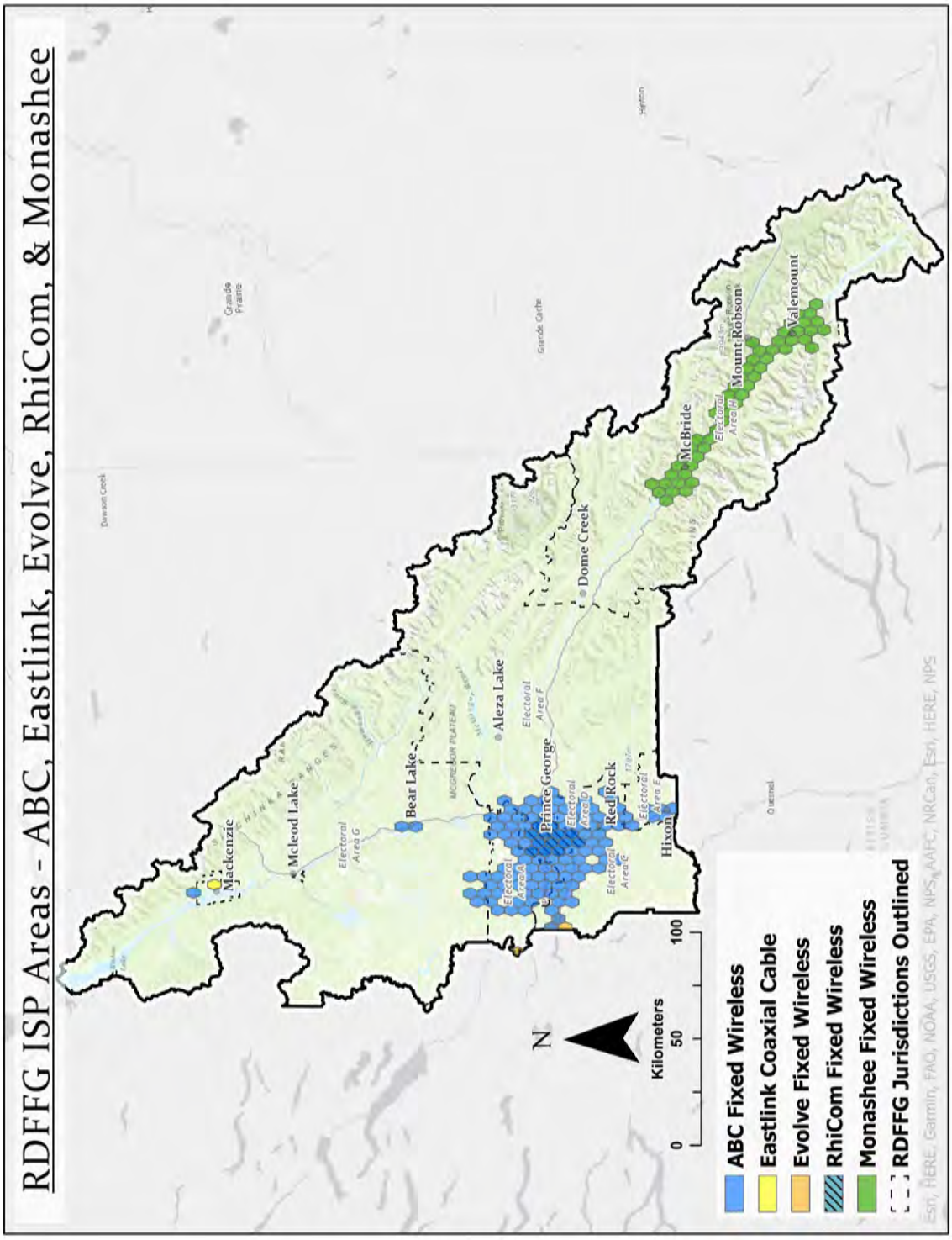
Appendix C – Service Provider Service Areas



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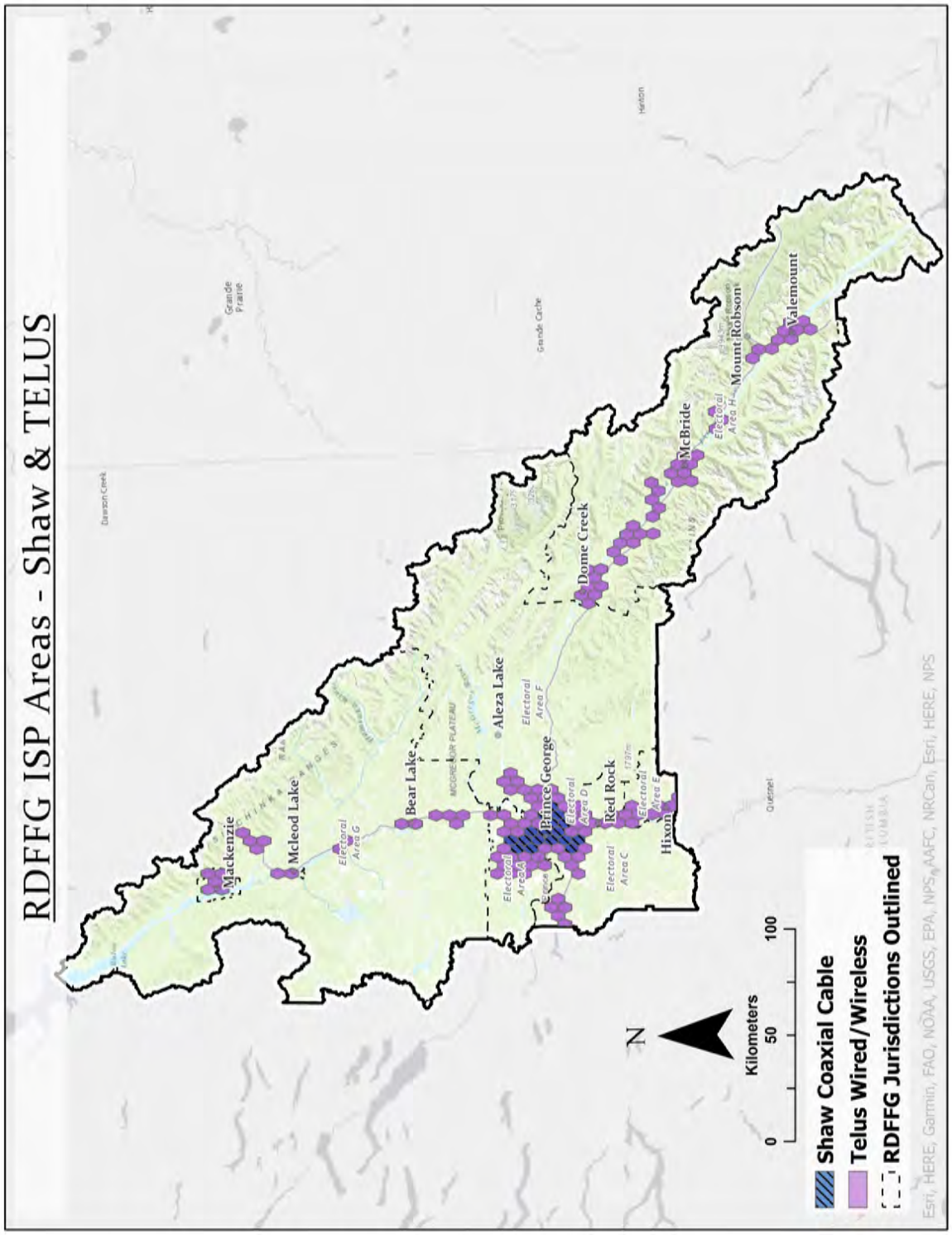

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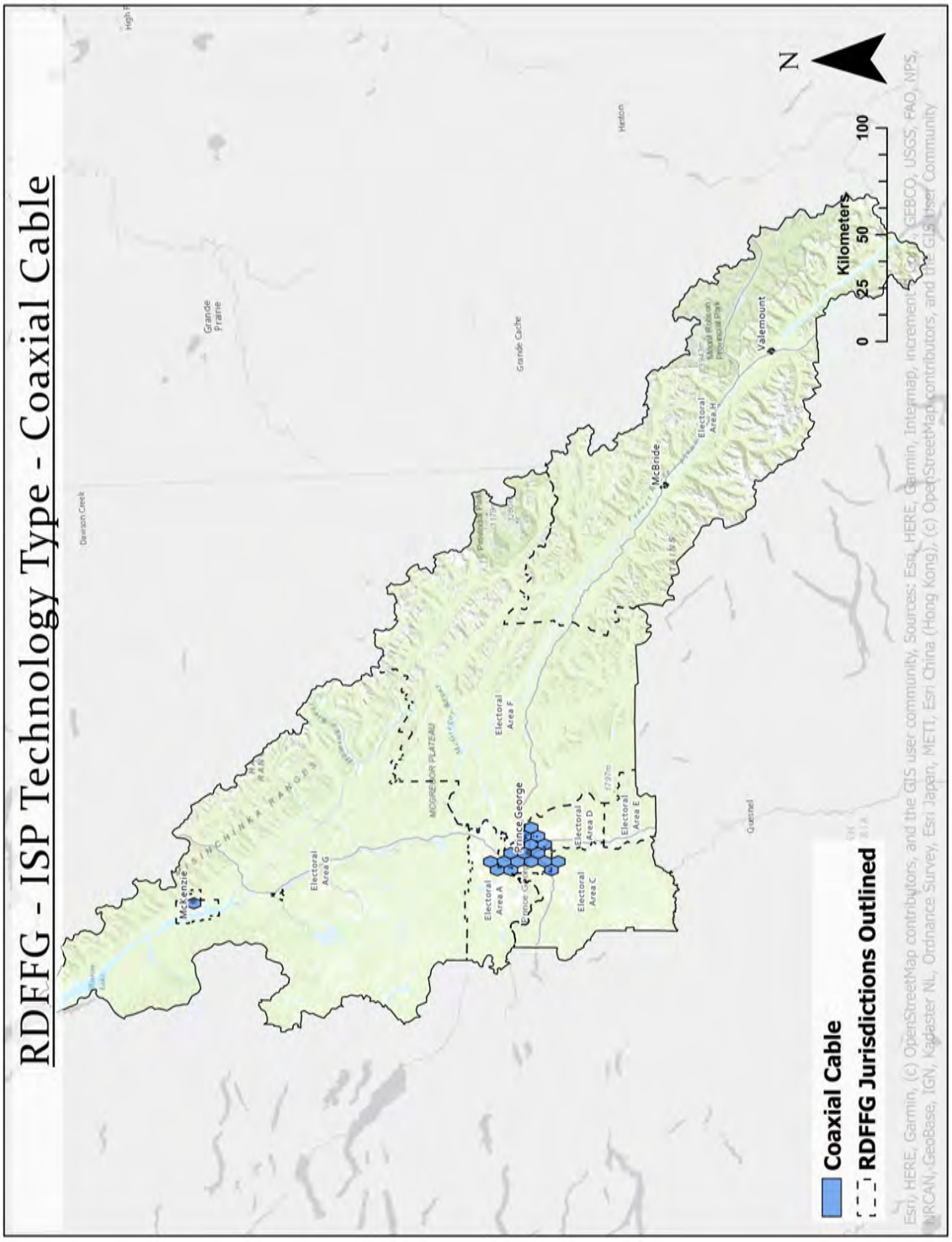
Existing Technology Service Type Maps



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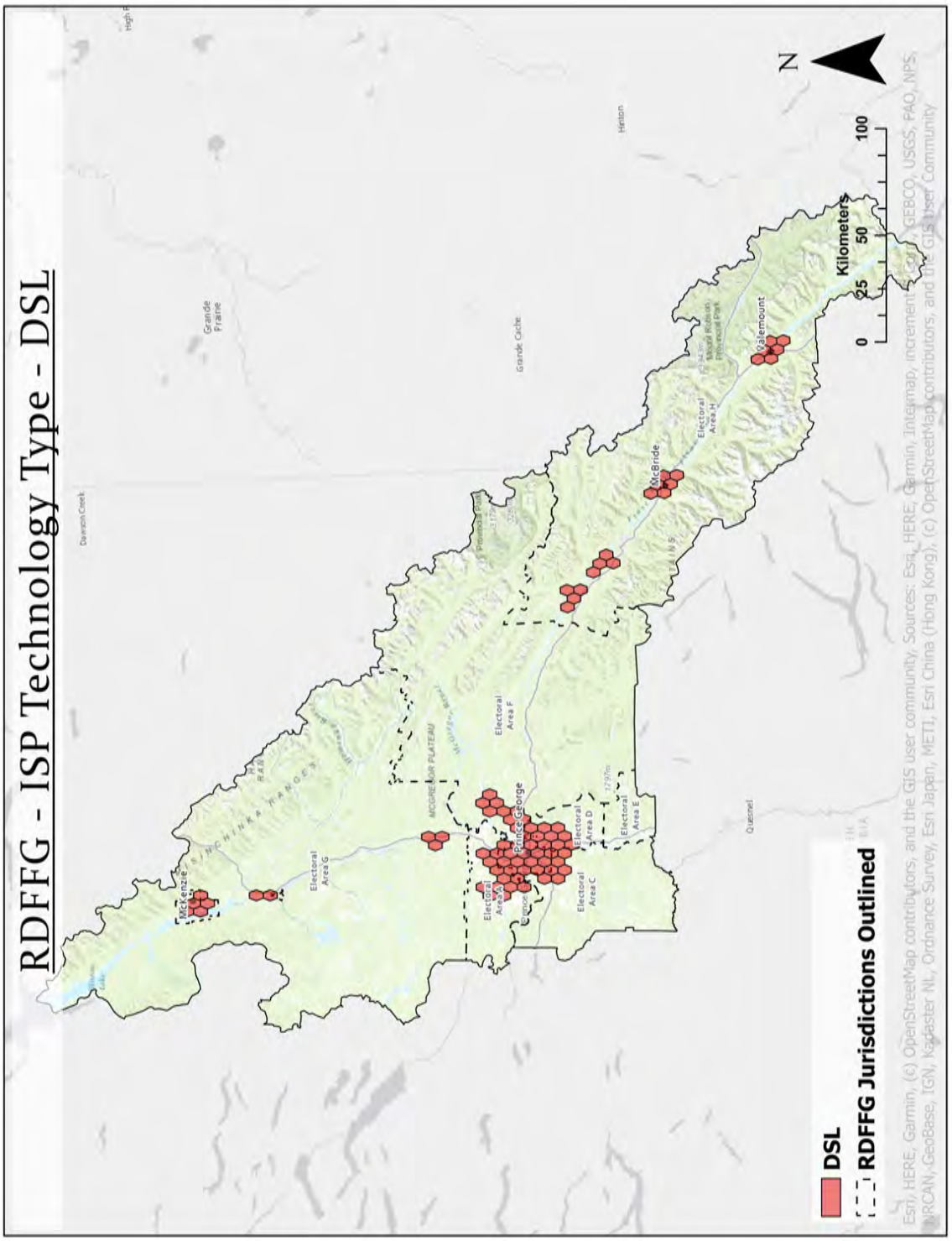

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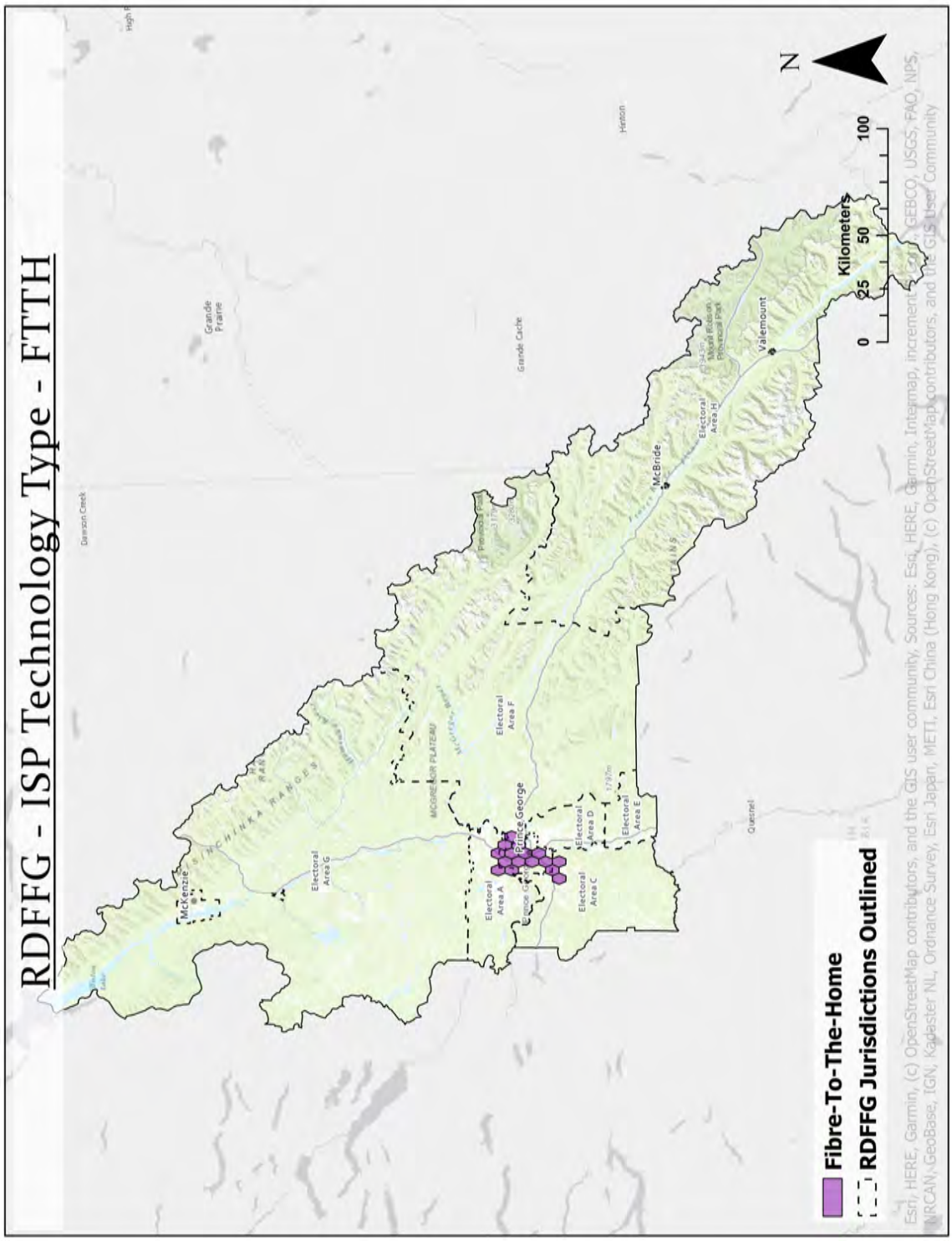

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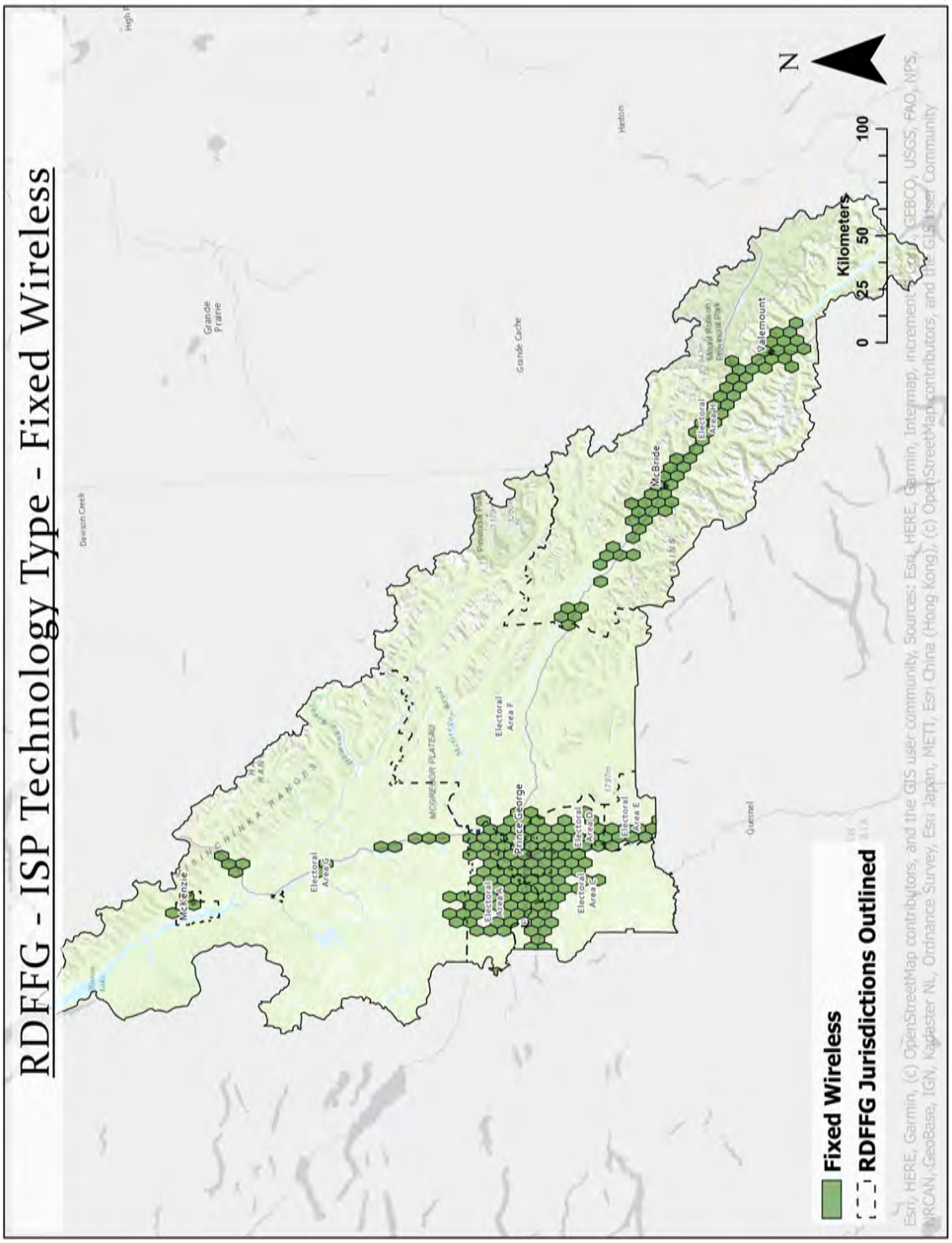

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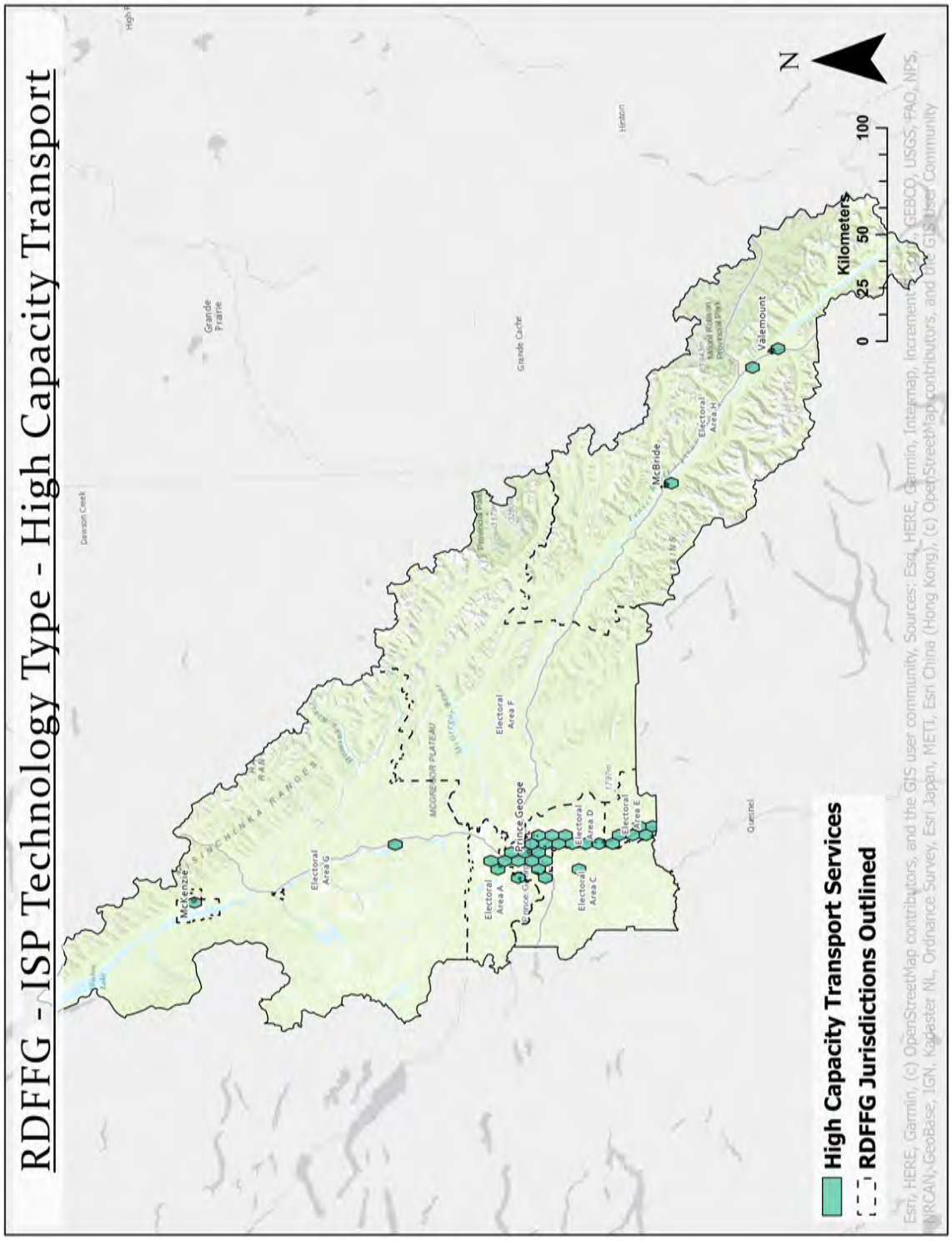

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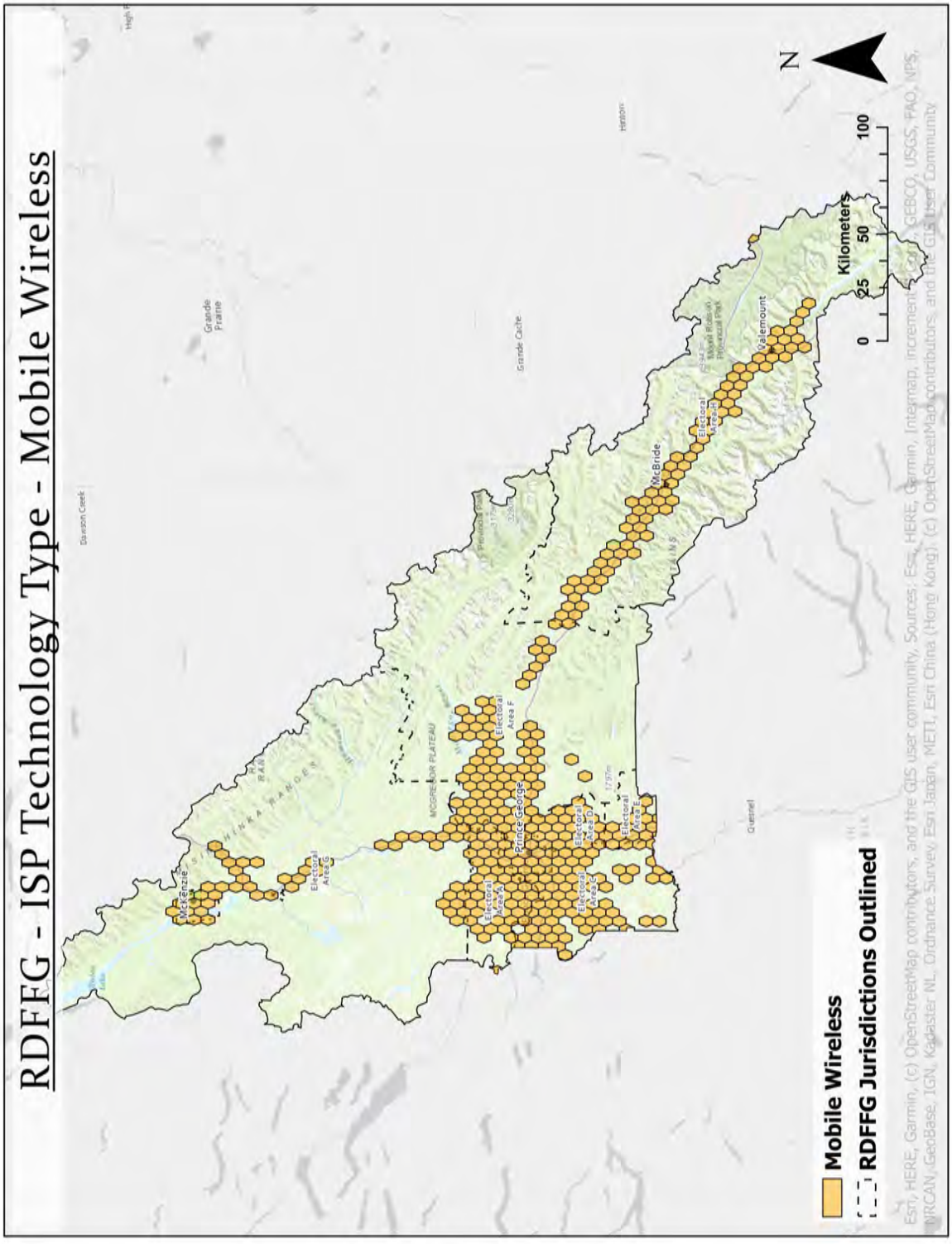

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Appendix D – Technology Overview

Technology Alternatives

In terms of technology, the primary obstacle for rural broadband is cost. Depending on the most suitable technology, the primary cost consideration may be associated with either the backbone or local access networks. A wide range of options are available and broadband services can be provided through a variety of technologies each with advantage and disadvantages. These technologies trade off high capital and operating costs with capacity, scalability and the ability to support the desired applications. The choice of technology needs to be assessed against the requirements for the particular situation and the cost of providing the services. While some technologies represent higher capital costs, the life expectancy may be factored over a long period of time (ie. 20 – 30 years) so capital costs need to be amortized over the lifetime of the asset when comparing technologies. This section of the document is a high-level introduction to these technologies.

Alternative technologies used to connect locations together are outlined below. Technology choice is dictated by the needs and circumstances of the service area. The challenge is to select technologies and configure them into systems that meet those requirements while minimizing life cycle cost.

As summarized above, **backbone or transport infrastructure** is the technology used to transmit and receive data over long distance to connect towns, cities, provinces and countries. Fibre optic cable (optical fibre), microwave radio, and satellite are the three principal transmission medias but fibre is, by far, the most desirable with very high scalable capacity, long life cycle and low operating cost. The challenge with fibre is the high initial cost and as such high capacity terrestrial microwave radio solutions, or even satellite, may be considered depending on the requirements.

Local access networks connect users to the backbone network in order to reach distant locations and applications. In broadband, the term applications, refers the services that people (subscribers) use including things such as the internet, video streaming or broadcast, voice communications, email, access to business services such as Microsoft Office 365, security services, business to business communications. These applications require high capacity, reliable connectivity.

Fibre to the Premise (FTTP, FTTH, FTTx) is the gold standard for broadband service to fixed locations such as homes, businesses and institutions, providing very high capacity, reliability and support for almost any application. As with backbone fibre, FTTP can be expensive to deploy as it requires a physical cable (or optical strand) to be connected from a local POP to every subscriber location.

Like fibre, **coaxial cable** service (typically used for Cable TV broadcast) and **Digital Subscriber Line (DSL)** service (over phone lines), share the requirement of installation of a physical cable from a local POP to the subscriber's premises. These technologies would typically be deployed in locations where this cable infrastructure already exists, thus avoiding the cost of construction. It would now be considered uncommon for a provider to construct new DSL or coaxial cable infrastructure rather than a fibre deployment. While coaxial cable can deliver capacity meeting, and exceeding, the CRTC Service Objective, DSL technology is limited in its ability to scale to these capacities. That said, neither technology can approach the capacity of fibre and as such, will likely not scale to meet the capacity requirements in the long term. Coaxial cable is also a shared technology as described below in Fixed Wireless.

The alternative to wired technology like optical fibre, coaxial cable or DSL is a radio-based "wireless" technology. **Fixed wireless** technology and unlicensed radio spectrum has been used as a low cost means of kick-starting internet service in low density rural markets. Fixed wireless is considered to be infrastructure that is fixed to a specific location, unlike technology used for mobile wireless described later. While no physical connection is required between the local POP and the subscriber's premises, high capacity wireless services typically requires "line of sight" to deliver reliable, high speed services. Any obstructions, including buildings, trees, or hills impair the signal resulting in no or poor service. Wireless technology, like coaxial cable, is a shared technology meaning that all subscribers using the wireless network are "sharing" the available capacity. The more subscribers using the service at one time, the less capacity each gets. The requirements to scale wireless service to high numbers of subscribers and capacities must be considered during the deployment of the network.

Cellular mobile technology, a variation of wireless, has become the de facto standard for voice and internet service direct to individual mobile devices. The data communication capability of current 4G (4th generation or LTE for Long-Term Evolution) cellular systems make this a viable broadband technology in appropriate circumstances. The emergence of 5G (5th generation) cellular over the next 5 to 10 years is expected to reinforce this trend (see emerging technologies below). While 5G technology is promising, it will require heavy investment in fibre to connect the local, high density of antennas to the backbone and ultimately globally provided services.

Finally, to reach isolated premises that are beyond terrestrial transport networks, fixed, or mobile wireless, direct to home **satellite** is the only viable choice. Xplornet's geostationary earth orbit satellite service is available across the region. Unfortunately, it suffers from high latency (the time it takes to send or receive information) resulting in some applications not functioning optimally and speeds can slow during periods of high usage. **Low earth orbit (LEO)** technology is emerging. The first to market with a direct to consumer play is Starlink. Starlink is currently (2021-02-19) in paid beta testing in northern US and southern Canada. As the satellite constellation fills in with more launches over the next few months to maintain continuous service, the service will become commercial. Beta test results support Starlink claims of 50 to 150 Mbps downlink speeds and 10 to 30 Mbps uplink speeds with round trip delay in the 20 to 40 ms range. Other broadband LEO systems are planned, but service is at least one or two years out and these may not be consumer service plays.

The following summarizes the key characteristics, advantages and disadvantages of the technologies used for broadband service delivery.

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Backbone and Local Access Technologies

Fibre optic cable - Backbone & Local Access

Extremely high capacity that is scalable for backbone / transport and local access. 10 Gbps already very common and 100 Gbps emerging.
[+] Long life cycle: 20 - 30+ years. Cost can be amortized over a long period of time.
[+] Low operating cost.
[+] High capacity, low latency, high subscriber counts.
[+] Very reliable.
[+] Very scalable. Upgrades to high capacity for relatively low cost.
[+] Supports a wide variety of applications.
[-] High initial (capital) cost.
[-] Acquiring right of way permits can be challenging
[-] Accessing existing underground and aerial infrastructure can be time consuming and expensive.
[-] Repair time can be long when cables break impacting network if redundant routes are not available.
[-] Not cost effective where low long-term capacity needs and long distances.
[-] Fixed to a specific location.

High capacity microwave - Backbone

High capacity microwave provides capacity up to approximately 1Gbps.
[+] Long hop distance is possible under optimal conditions (30 - 50 km). Higher distances may require multiple hops.
[+] Can be engineered for high reliability.
[+] Can be cost effective for one or two hops.
[+] Supports a wide variety of applications.
[-] Issues accessing or permitting to construct towers in some locations.
[-] High initial cost if tall tower required.
[-] High initial and recurring cost if remote tower sites are required.
[-] Can be support and power challenges for remote areas such as accessing mountain tops.
[-] Relatively low capacity: scales from under 100 Mbps to over 1 Gbps.
[-] Appropriate spectrum scarcity an increasing issue.
[-] Fixed to a specific location.

High-throughput satellite (Geostationary) - Backbone & Local Access

Well established technology with a competitive marketplace.
[+] Can be used direct to home (DTH).
[+] Cost does not vary with distance within the coverage footprint.
[+] Good capacity.
[+] Relatively low initial capital costs.
[-] High cost for usage (bytes per month).
[-] Can be susceptible to service impacts with severe weather.
[-] Larger antenna sizes needed at high latitude sites.
[-] Fixed to a specific location.
[-] May not be well suited to some applications.

Cellular mobile – Local Access

Open standards allowing mobility and connectivity anywhere, anytime.
[+] Huge global market and competitive ecosystem with ongoing evolution.
[+] Low cost for user equipment (competitive market).
[+] Versatile user equipment.
[+] Mobile services.
[-] Relatively high usage costs compared to fixed services (bytes per month).
[-] High initial costs for network build (poor return in low density markets).
[-] Relatively high operating cost (management and evolution).
[-] Limited competition in lower density markets.
[-] Shared technology. Additional subscribers degrade overall performance.
[-] Performance can be inconsistent. Latency can be high.
[-] Higher capacity usually requires significant investment in network upgrades to new technology.
[-] May not be well suited to some applications.

Fixed wireless– Local Access

Different technology with different coverage and capacity characteristics. A range of proprietary and semi-proprietary products are available.
[+] Can be fast to deploy (if antenna tower permitting is not an issue).
[+] Can have high capacity if high frequency (trade-off with coverage).
[-] Limited spectrum and licensed spectrum can be expensive.
[-] Unlicensed spectrum: performance may degrade from interference.
[-] Susceptible to weather and local weather can cause service issues.
[-] Usually needs fibre for sufficiently high capacity backhaul.
[-] Requires line of sight for high capacity and reliability.
[-] Shared technology. Additional subscribers degrade overall performance.
[-] Fixed to a specific location.
[-] May not be well suited to some applications.

Emerging Technologies

Low earth orbit satellite (LEO)

Only Starlink service is available for beta testing in Canada as of 2021-02-21.
[+] User speeds 50-150 Mbps downlink and 10-30 Mbps uplink.
[+] Delay in the 20 to 40 msec range.
[+] Potential to lower the cost of usage to isolated customer locations (beta service in Canada is $130 per month for unlimited usage).
[-] A competitive market may not emerge if other initiatives fail (OneWeb, Telesat LEO, etc).
[-] High inclined and polar orbits required for high latitude coverage.
[-] Long-term costs and performance are still uncertain.
[-] Current costs are not competitive for communities that are large enough to economically support fiber transport and fiber access networks (FTTH).

Cellular 5G – Local Access

Next generation 5G cellular
[+] Potential for low usage costs with 5G and mmWave frequencies.
[+] Mobile and fixed services.

[-] Requires a heavy investment in fibre to connect numerous 5G antennas..
[-] Emerging now in Canada but mmWave frequencies have yet to be auctioned.

Summary of Technology Alternatives

In summary, rural and remote areas are low density, meaning network links are required over long distance and all else being equal, rural telecom service costs per subscriber will always be higher than urban.

- Fibre optic infrastructure for both transport and access is the long-term end game for fixed broadband. No other currently available technology can match the speed and reliability of fibre connectivity or scalability for the future.
- Cellular mobile to open global standards is, and will remain, the delivery mechanism of choice for mobile voice and data communications direct to individuals.
- Proprietary radio access systems in license-exempt and licensed bands can have a role to play if they are sufficiently inexpensive that payback is within their expected service life.
- Satellite remains the service of last resort for isolated customer locations. Current services that are based on long-delay geostationary arc satellites can be expected to yield market share to low earth orbit broadband satellite service as or if cost-performance proves-in.

Business and Operational Considerations

Infrastructure enables services to subscribers, but it does not provide the resources required to effectively manage, monitor and obtain revenue from the network. When referring to the SDP introduced earlier in this report, the OSS/BSS layer provides all the infrastructure required to perform the operational and business functions required for the network to operate successfully.

The OSS/BSS layer of the SDP includes many components that enable and support service to the customer. In summary:

- Personnel with appropriate knowledge and experience with operating a network.
- Customer support to effectively support subscribers of the network such as technical support and customer service support.
- The infrastructure and software applications required to effectively monitor, manage and operate the network.
- Business operations for the business such as customer service and billing.
- Equipment, tools and assets required to complete onsite activities.

The OSS/BSS layer must include, but is not necessarily limited to:

Resources:

- The personnel required to:
  - support and provision network services.
  - provide maintenance activities on the network electronics and other infrastructure.
  - manage subscriber requests for adding, removing and changing existing services.
  - Provide the expertise required to enhance services on the network.
- The support system, which includes the personnel, required to effectively support subscribers of the network such as technical support and customer service support.
- The processes and procedures related to the operation of the business.
- The equipment and tools required to complete onsite activities such as vehicles, tools, fibre splicing and testing equipment, network testing equipment, etc.

The personnel required to operate the network need the following skill sets:

- Overall management resources that are familiar with the operation of a network and can provide the overall guidance for the network operations.
- Technical resources that can effectively design, commission and support the electronic components of the network.
- Technical resources that can effectively design, commission and support the infrastructure components of the network such as POPs, power systems, environmental systems, outside plant, fibre, etc.
- Installation and maintenance skills that can provide the onsite support for the infrastructure, electronic components and subscribers.
- Customer service resources that can provide effective assistance to subscribers of the network.
- Sales resources that can manage new opportunities.

Business Systems:

- Customer database containing customer information.
- Billing systems to issue invoices and accept payments.
- Documentation storage.
- Reporting systems to gather, consolidate and report on customer usage that may be used for customer billing.
- Scheduling systems to book and schedule customer site visits and technician tracking that may be required.
- Remote access systems used to provide key support and business technicians access to the systems 7x24x365.

Operational Systems:

- Monitoring systems to monitor the network, locate problems, send alerts to support technicians, gather statistics, report on trends, etc.
- Trouble reporting systems to gather and maintain information on problems reported by customers for timely resolution.
- Provisioning systems to add, change and remove services to customers.
- Logging systems to log network and customer events.
- Documentation storage.
- Manufacturer specific software required to operate and maintain network equipment.
- Backup and restore systems to maintain configuration backups and restore when required.
- Network maintenance software.

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- Network operation systems that are required to make Internet services function. Eg. Domain Name Service (DNS)
- Network authentication and registration systems such as RADIUS and DHCP that are required to activate subscribers on the network.

The hardware and software systems are typically located in one or more datacenters (or POPs) on the network. The intent is to have a location suitable for the equipment required to run the software applications required to effectively operate the network. As these systems will contain sensitive operational and subscriber information, they would typically be implemented in a manner that provides security from external sources such as the internet. These systems contain the infrastructure that provide the daily operational functions for the network.

Along with appropriate resources and software applications the OSS/BSS systems include all the processes and procedures and physical equipment required to perform these functions. An example of a process would include the step-by-step procedure to install and activate a new subscriber on the network as a number of components need to be considered including the physical installation of the fibre drop, the equipment at the subscriber premises, connection of the subscriber in the POP, the activation of the service on the network, etc. Each of these functions needs to be completed in order for the service to be ready for the subscriber.

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Technology	FTTP/FTTH	Fixed Wireless	LTE 4/5G	DSL	Coaxial Cable	GEO Satellite	LEO Satellite
[+]	Unlimited capacity Easily scaled Very reliable Multiple services Low OPEX	Low capital cost Fast to deploy Big bang for your buck Common for regional ISPs	Good capacity Mobile services No wires Low cost for user Versatility in services	Cost effective if cable exists Supports multiple services Leverages existing phone lines	Cost effective if cable exists High capacity Supports multiple services	Available anywhere Can be moved easily	Available in remote locations Can be moved easily Good performance
[-]	High capital cost Requires permitting & approvals Fixed a specific location	Limited scalability Technology lifecycle Requires line of site Unreliable if designed wrong Interference concerns for unlicensed	Limited scalability Technology lifecycle Poorly suited to some services High usage costs to subscriber Limited ability for competition	Cable has high capital cost Scalability is limited Subject to reliability issues Subject to quality & distance Limited ability for competition	Cable has high capital cost Scalability is limited Unreliable if designed wrong Limited ability for competition	Lower capacity High latency Costly bandwidth Problems in extreme weather	New technology Not available eveywhere Will take time to build out Long term is unknown Only one provider at this time
Characteristics	Dedicated	Shared	Shared	Dedicated	Shared	Shared	Shared
	A/Symmetrical	Asymmetrical	A/Symmetrical	Asymmetrical	Asymmetrical	Asymmetrical	Asymmetrical
	Very Low Latency	Low latency	Medium Latency	Low latency	Low latency	High Latency	Low latency

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Appendix E – Open Access Overview

British Columbia and Canada face a problem with connectivity in remote and rural communities of Canada. Many of these communities are faced with absolutely no connectivity or connectivity that is poor or unreliable. The primary challenge is that rural connectivity lacks a business case to invest capital and operational funds. Private enterprises do not provide services in these areas because it simply does not make business sense to do so. As a result, providers position requests for funding to build transport where it creates opportunities for them and local access in areas that may already be served leaving rural areas untouched as a lower priority.

Government funding programs often require that infrastructure constructed using funds from these programs be available for other providers to use at pre-determined rates ("quasi open-access"). The challenge with this approach is that the lack of a business case makes it nearly impossible for one provider to provide services in these areas, let alone more than one. While it may be physically possible for more than one provider to service these areas, the business case dictates that it will likely be a single provider thus excluding any form of competitive services or pricing.

Government support to address the connectivity problem is appropriate but the distribution of funds is typically in the form of grants of funds to an existing (often for-profit incumbents) provider on the basis that it will provide new or enhanced services. Funds are granted to the provider on the basis that they use them to solve connectivity issues in these un/underserved regions. While quasi open-access is a step in the right direction, it doesn't go far enough.

The connectivity problem in rural BC is not going to fix itself and using public funds to benefit private enterprise that are not motivated to solve the rural challenge is not the right approach. We need to think bigger. We need to think differently. Rural funding programs should support government priorities not the priorities of the service providers. Rural funding should be done as part of much larger vision with affordable choice for consumers.

In the traditional model, for a service provider to service a customer, they must construct all levels of the Service Delivery Pyramid ("SDP"). While this model may be acceptable in larger centers where there are enough subscribers to make a suitable business case for providers to essentially overbuild each other with different types of technology, in remote and rural communities, there is not enough subscribers to justify one provider building this infrastructure let alone more than one. Once a provider has built the infrastructure, there is virtually no chance that a second provider will provide any competitive services. In the short term, the funding can be considered a success and area residents do get improved services. In the long term though, as service requirements change due to progression in technology and connectivity requirements, these areas will lag behind once again and the problem of second-class connectivity will again be reality. Then government must, again, incent the provider to upgrade the service.

True Open Access ("TOA") networks alleviate the above problem by architecting the solution in a way that addresses the problem at a broader regional level and encourages competition, provides support for government initiatives, choice of services and providers for the consumer. A TOA network leverages technology and a business model to allow multiple providers to share the network and deliver a variety of services to the consumer. In the end, the consumer is the winner with a choice of providers and services in a competitive market forcing providers to deliver innovative services at improved price points and high levels of customer service. In the case of rural connectivity, using this model over a larger number of communities, aggregating the costs under a single entity provides the opportunity to make more attractive business case with the benefit of choice to the consumer.

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