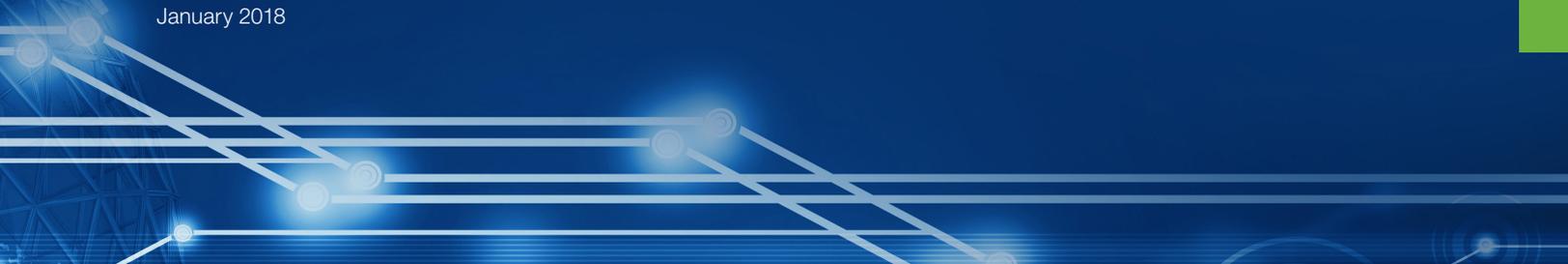


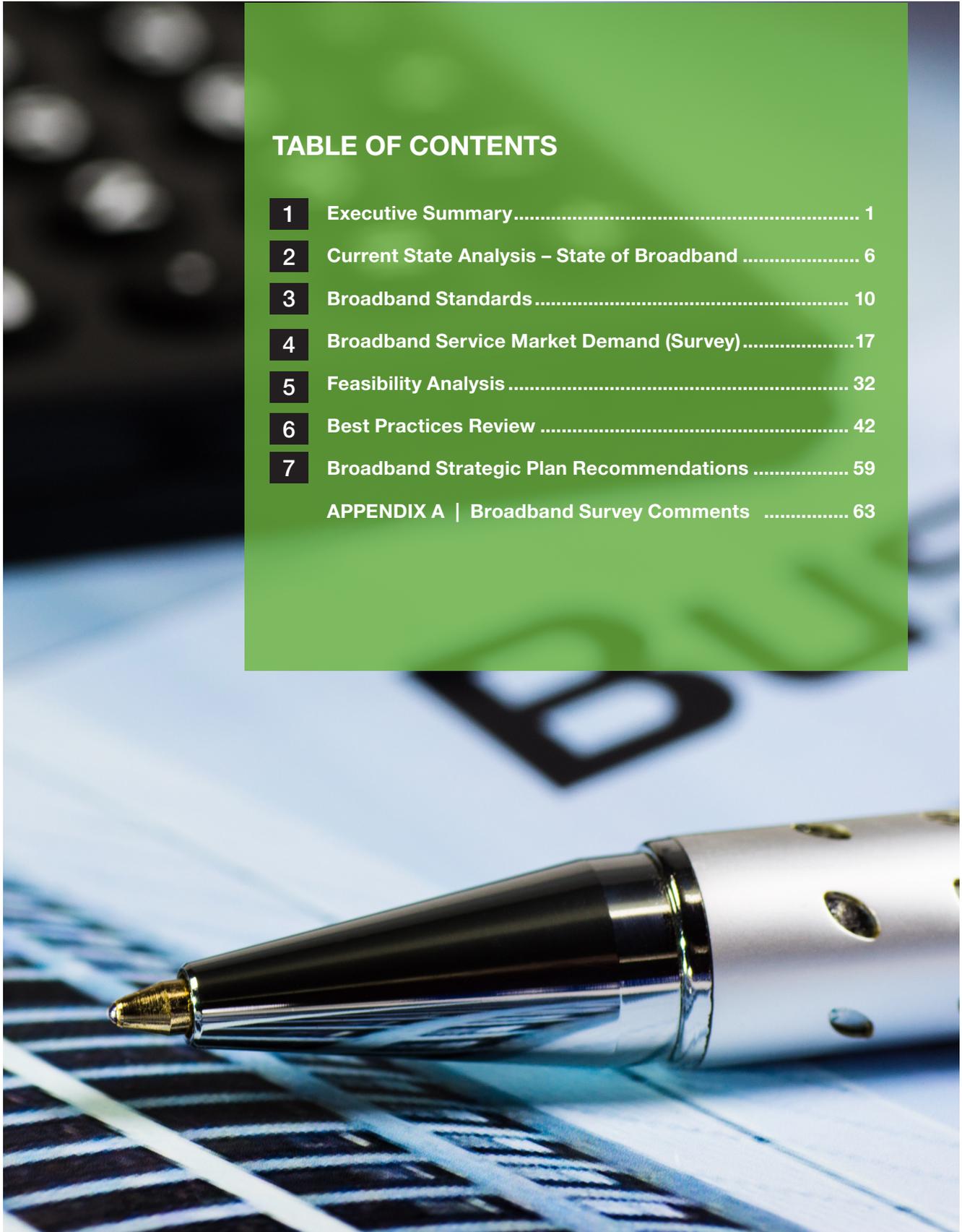
REPORT  
Broadband Strategic Plan

Prepared for the Town of Canmore  
by IBI Group  
January 2018

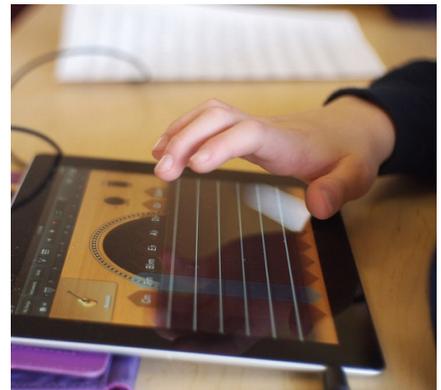


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TERM OR ABBREVIATION	MEANING
<b>BW</b>	Bandwidth Test
<b>CADD</b>	Computer Aided Drafting and Design
<b>CBD</b>	Central Business District
<b>CIRA</b>	Canadian Internet Registration Authority
<b>CMTS</b>	Cable Modem Termination Systems
<b>CRTC</b>	Canadian Radio-television and Telecommunications Commission
<b>Dark Fibre</b>	Unused Fibre Optic Cable
<b>DSL</b>	Digital Subscriber Line (Internet)
<b>EPON</b>	Ethernet over Passive Optical Network
<b>FSB</b>	Fibre Splice Box
<b>FTTP</b>	Fibre to the Premise
<b>IP</b>	Internet Protocol
<b>ISP</b>	Internet Service Provider
<b>OLT</b>	Optical Line Termination
<b>ONT</b>	Optical Network Terminal
<b>PON</b>	Passive Optical Network
<b>POP</b>	Point of Presence
<b>PPP</b>	Public Private Partnership
<b>TSP</b>	Telecommunications Service Providers
<b>VPN</b>	Virtual Private Network



# 1 | Executive Summary

The Town of Canmore recognizes the importance of cost effective, high speed connectivity to a community's economy. With its proximity to Calgary and a rapidly diversifying economy, high speed connectivity can link the Town's many businesses and facilities together, providing new and existing businesses and residents' access to global opportunities. IBI Group was engaged to provide a Broadband Strategic Plan for the Town, including advisory services and recommendations to provide for the improvement of broadband in Canmore.

The Town understands the importance of formulating a plan for how best to improve the current state of their broadband services. This likely involves building a telecommunications infrastructure on its own or in partnership with experienced service providers.

The key drivers supporting the need for a municipal broadband strategy are to serve the internal needs of the Town and support economic development and innovation within it. This strategy can include providing broadband connectivity to the Town's public sector partners.

This report provides analysis and recommendations on Broadband Strategy. Additionally, it provides an analysis of the existing market for broadband services, the results of a broadband survey and bandwidth testing performed over the months of August and early September 2017, a conceptual high level network design, case studies and analysis of various business models. The Broadband Strategy will allow the Town to make decisions on the long term deployment and support of a future broadband network.

## Current State Analysis

Canmore is located along a major communications corridor that contains the TransCanada Highway and the Canadian Pacific national railway, allowing for high speed internet and dedicated network connectivity across North America as well as globally. Last mile connectivity is generally limited to the incumbent providers (Telus and Shaw Communications) and is based on legacy copper and coax networks. Fibre to the premise is done on a case by case basis for commercial customers but can be expensive and cost prohibitive for the end user.

Other service providers are available but they are mostly reliant on utilizing the incumbent's last mile connections, or they need to build their own fibre or wireless last mile access.

Opportunities to build fibre in the community are available through Axia and Telus, however, this does not provide an open and competitive environment and the Town would not be able to utilize dedicated fibres for their requirements in these situations.

## Broadband Standards

Residents and businesses continue to have an increased reliance on reliable high speed connectivity. Recently, the Canadian Radio and Telecommunications Commission (CRTC) established that broadband internet was a basic service and set target service objectives of 50 Mb/s download and 10 Mb/s upload, with unlimited usage capacity to be available in 90% of Canadian premises by 2021.

Reliance on internet based services for both residential and commercial customers continues to grow as internet based communications, entertainment and computing applications and services expand.

The Town will need to work towards ensuring that broadband services in the Town keep pace to continue to attract residents, visitors, and businesses which will allow for growth and diversification of Town-based businesses.

Creating *Dig Once* policies for new construction, allowing for fibre deployment, partnerships with incumbent or new service providers and/or deploying Town fibre infrastructure will need to be evaluated and acted upon in order to ensure the Town's future broadband requirements are met.

## Broadband Service Market Demand (Survey)

IBI Group conducted an online Survey and Speed Test from August 8, 2017 to September 10, 2017. The survey polled both residential and commercial broadband users.

Participants were queried on the importance of broadband, service provider satisfaction, and typical applications utilized. Participants were also polled on the role of the Town with respect to ensuring that reliable, and affordable, broadband needs were being met in the future.

The outcome of the survey indicated that both residents and business were concerned with the ability of current providers to keep pace with their needs. There was a bias towards the Town taking an active role to improve broadband services; although responses from the business community were small, the responses and speed test results indicated a high level of dissatisfaction.

The speed test results showed that for the most part, broadband services across the Town were below average with respect to Canadian averages and well below the CRTC's 2016 established service standard.

## Feasibility Analysis

IBI Group developed fibre and electronics conceptual network designs to provide fibre to the premise for residential and commercial locations. The concept network provided connectivity to the various Town facilities and public sector locations.

Operational requirements were identified and models were analyzed in order to assist the Town in assessing not only the infrastructure costs, but also the ongoing requirements of owning and operating a broadband service network.

The network costs identified are based on common industry best practices, but are conceptual at this point. Detailed design and costing validation is required prior to moving forward with construction and implementation.

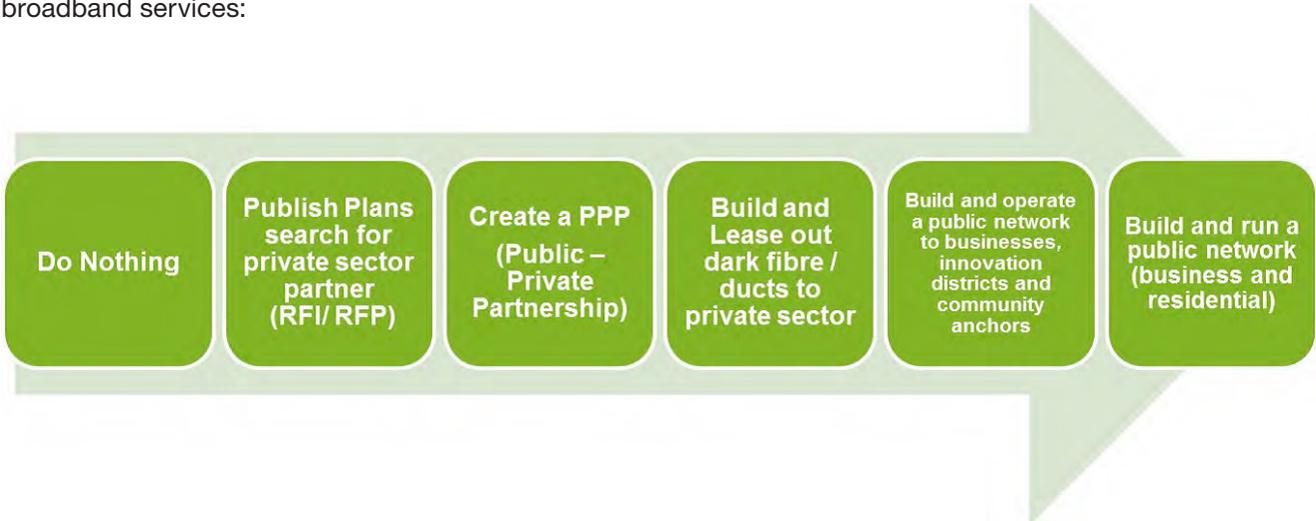
Costs to implement a fibre optic backbone for the Town are estimated at \$2.2M with a recommended phase 1 backbone implementation of \$334,000 to connect key Town facilities and carrier locations.

Total project capital costs are summarized as follows:

Backbone:	\$2.2M
Businesses:	\$1M
Residential:	\$11M
<b>Total:</b>	<b>\$14.2M</b>

## Best Practices

The Town of Canmore has various options for playing a role in the future of the Town’s broadband services:



Each of the above options are explained with benefits, risks and case studies of current deployments for each scenario.

Our recommendations for moving forward are focused on the sale of dark fibre services as well as the offering of broadband services to businesses and residents on selective basis with a view to providing services of a ubiquitous nature in the long term. This business approach would be best executed using an Arm’s Length Utility structure.

### Broadband Strategic Plan Recommendations

This report identifies a number of strategic plan recommendations that are based on industry best practices and case studies. The state of broadband within the Town is below Canadian averages, and well below the internet basic service standard identified by the CRTC in 2016. There is also a strong indication from the community that they want the Town to take an active role in improving broadband services to businesses and residents.

1. That the Town adopt broadband standards identified in this report to move it from its current state of average 16.0/7.5 Mbps (download/upload) towards increased speeds of 100/20 Mbps and future symmetrical speeds of 1000/1000 Mbps. These standards would apply to existing Town facilities and provide guidance on any future investment or partnership with other providers that are focused on delivering services in the Town. These new standards would be phased in over several years, as the Town will required a fibre optic backbone network to support these speeds.
2. The construction of a fibre optic backbone network to connect Town facilities.
3. The creation of a pilot project to provide broadband services to businesses and residents within close proximity to the fibre optic backbone. The creation of a detailed business plan to support this pilot is recommended.

4. It is recommended the Town adopt the following business approaches to achieve improved services, including the sale of dark fibre services as well as the offering of broadband services to businesses and residents on selective basis with a view to providing services of a ubiquitous nature in the long term. This business approach would be best executed using an Arm's Length Utility structure.
5. Investments in municipal broadband networks have been identified as eligible under many federal government infrastructure programs such as the Building Canada Fund and the Connect to Innovate Programs. These programs do require provincial matching dollars, so planning and coordination with provincial representatives is required. Further investigation and follow up is recommended.
6. Internet as a Basic Service (Telecom regulatory policy CRTC 2016-496): in December 2016 the CRTC announced this policy which provides for broadband internet as a basic service, defined as 50Mb/s download and 10Mb/s upload. The announcement created a fund of \$750M over the next 5 years to support investment in broadband networks to achieve these service goals. Announcements are expected in late 2017 to define the details of the funding mechanisms that will be available and eligibility of broadband projects to receive consideration for funding. Further investigation and follow up is recommended.
7. On November 23, 2017 Infrastructure Canada announced the details of the Smart Cities Challenge program. Preliminary information on this program indicates that the intent of the Smart Cities Challenge program is to fund investments in technology that would require the use of broadband services, however, the Smart Cities Challenge program would expect that municipalities use existing programs, such as the Connect to Innovate and Internet as a Basic Service (referenced in items #5 and 6 above) to fund investments in broadband networks.
8. It is recommended that a Dig Once Policy be reviewed by the Town's engineering department to support the inclusion of underground conduit, handwells (splice/access boxes) in any Town road works, bridge or utility projects that involve the excavation of roadways, trenching on public rights of way, etc. Specific recommendations on conduit sizing and handwell placement are provided in section 3 of this report.

## 2 | Current State Analysis – State of Broadband

### Introduction

The Town of Canmore is currently serviced by Axia, Shaw and TELUS as the primary carriers. Shaw and TELUS provide both residential and business services, while Axia provides SuperNet, and business services.

Additional ISP's such as Xplornet, TekSavvy and Lightspeed are also available. In the case of TekSavvy and Lightspeed, their local connections are usually provided over Shaw and TELUS facilities. These ISP's are referred to as Third Party Internet Service Providers, and are able to take advantage of fixed local loop rates from the incumbent service providers (Shaw and TELUS) to offer their Internet services.

The railway right of way through Canmore is a major corridor for multiple Canadian carriers which are able to offer business services. Similar to the third party ISP's, they are reliant on the three primary carriers to provide the last mile connectivity. That being said, from an intercity perspective, the Town is in a position to access high speed backbone connectivity to major Canadian centres.

Business services for the Town, as with other communities struggle to achieve the reliable high speed connectivity required to support their growing data requirements. Generally local fibre facilities are required to meet their bandwidth needs. Due to the Carrier's ROI (Return on Investment) requirements, initial and expensive installation costs are not palatable to the end customer and businesses must then rely on existing copper and coaxial based services to provide their basic internet requirements. In most instances, these services are generally residential grade.

### Axia

Axia is currently providing SuperNet connectivity for various Canmore institutions as well as for Town Hall requirements.

Axia provides community wide fibre build programs that will provide fibre to the premise for residential and business customers conditional on a guarantee of at least 30% of the market subscribing to their services. Axia will plan, build, activate and operate an active Ethernet network for the community and will provide layer 2 and layer 3 connectivity to individuals, business as well as the municipal government at competitive rates. Axia does not lease out their fibre and the Town would be required to lease active Ethernet services for their needs.

The Axia model allows for the customers to select their voice and video products, however the internet service is Axia's. Axia is not required to provide Third Party Internet Services as TELUS and Shaw are mandated to do by the CRTC.

The Town was approached by Axia in January 2017 to gauge interest from the community. They require a 30% interest/commitment level prior to engaging in budgeting and service design. Typically once approved, Axia will look to connect approximately 90% a community. This will be done on a concentrated effort in short order to reduce construction and installation costs.

## Shaw

Shaw provides voice, video and internet services for the residential and business community in the Town. The majority of Shaw's services are provided utilizing their Hybrid Fibre Coaxial (HFC) network with some business locations being fed by fibre directly to the premise.

Shaw currently has a national program to upgrade their HFC network technologies to accommodate the next generation of internet speeds which will eventually provide gigabit user speeds. The planning and timing of these programs are not generally communicated to the public.

With respect to business services that require higher speeds, and/or dedicated bandwidth or fibre, Shaw either builds local fibre loops or leases last mile fibre in order to accommodate these customers. As most commercial buildings in Canmore require fibre to be built in these instances, upfront installation costs for the customer can be a hurdle to ordering these services. This is due to construction costs associated with deploying the fibre.

In discussions with Shaw, they have indicated that they are open to deploying fibre networks if the community is willing to construct the duct/conduit infrastructure. The preference is for a dedicated conduit for Shaw use. In this case, Shaw would more than likely utilize this infrastructure to push fibre deeper into residential areas to increase their cable plant capacity, and look at Fibre to the Premise deployments in commercial areas.

As mentioned, Shaw does lease last mile fibre, but this is done on a case by case basis as they are approached by business customers with a request for service. The leasing of this fibre still needs to meet their return on investment terms.

Freedom Mobile is a Shaw company and at this time relies on partner roaming in the Town of Canmore. If Shaw was to expand Freedom's footprint to Canmore, there is a possibility it could lead to additional fibre deployment depending on required cell tower deployment.

## TELUS

TELUS provides voice, video, internet and cellular services for the residential and business community for the Town of Canmore. TELUS utilizes a combination of DSL and fibre optics to deliver these services to the Town. DSL is generally used as the internet service delivery mechanism in town with the exception of fibre implemented on an individual business customer basis.

DSL service speeds are limited by the distance of the customers copper pairs to the Digital Subscriber Loop Access Multiplexor (DSLAM) that is either located in the TELUS Central Office or in the field. DSL has the ability to deliver these higher speeds, but it does require TELUS to deploy fibre deeper into the neighbourhood and deploy the DSLAM electronics.

At present, TELUS has the PureFibre program which is a direct fibre to the premise program which they have initiated/deployed to approximately 71 communities in Alberta and British Columbia. The general goal of the PureFibre program is to deploy to approximately 90% of a community in fairly short order. This minimizes construction and deployment costs.

TELUS has indicated that there is no cost for this program for a community. Terms of the program were not discussed in detail. Timing on triggering a PureFibre program were dependent on discussions directly with the community and business case scenarios on TELUS' part. Depending on discussions and existing work in the queue, this could take up to a year.

### Other Internet Service Providers

The Town of Canmore does have access to alternate Internet Service Providers such as TekSavvy, Lightwave, and Xplornet to name a few.

With the exception of Xplornet, most of these providers are reliant on Axia, Shaw or TELUS to provide any local facilities. As shown in the Table below, Third Party ISP's are able to utilize Shaw and TELUS business and residential services to resell to their customers while paying the incumbents a wholesale rate that is set by the CRTC.

In the case of fixed Wireless, these providers generally require fibre fed tower locations to support their services.

At this point, there is no mandate for Shaw nor TELUS to wholesale their local fibre services in the Third Party ISP regulatory model. Any indication of a fibre to the premise service would be based on a case by case model in this situation.

The Third Party ISP's are responsible for their own Internet backbone networks, but speeds and availability locally are the same as the incumbent providers. A complete list is provided below in Table 1.

**Table 1: Canmore Third Party Internet Service Provider List**

ISP	Cable	DSL	Fixed Wireless	Fibre
TekSavvy	✓	✓	✓	
Vmedia	✓	✓		
Yak	✓	✓		
XinFlix	✓	✓		✓
Slamhang	✓	✓		
Nucleus	✓	✓		
tnw		✓		✓
The Internet Centre		✓		
Uniserve	✓	✓		
Unmetered	✓	✓		

High end Internet connectivity for business services would still require either building or leasing local fibre.

### Internet Service Packages

Residential and business internet packages are provided in Table 2 and Table 3. For the purposes of this exercise, not all the above listed ISP's were examined. The pricing is based on standard monthly pricing as shown on each ISP's website. With the exception of Axia, and Xplornet, all business internet plans are based on DSL or cable technologies. Axia does not provide residential internet services in Canmore. The pricing shown is their standard rates if they provide fibre services to a community.

**Table 2: Residential Internet Service Providers and Packages**

Residential ISP	Speed Mbps											
	5	15	20	25	30	50	60	75	100	150	500	1000
Axia*				\$59.00							\$79.00	\$99.00
Lightspeed - DSL	\$29.95	\$39.95		\$44.95		\$64.95			\$74.95			
Lightspeed - Cable	\$23.95	\$32.95			\$39.95			\$49.95		\$69.95		
Shaw	\$60.00	\$70.00						\$80.00		\$84.90		
TekSavvy - DSL	\$29.99			\$44.99		\$53.95						
TekSavvy - Cable		\$39.99										
Telus		\$68.00		\$73.00		\$77.00				\$82.00		
Xplornet*	\$99.99											

\* Axia pricing is for reference only as Canmore is not an Axia fibre community \*\* Xplornet is a satellite based service

**Table 3: Business Internet Service Providers and Packages**

Commercial ISP	Speed Mbps											
	5	15	20	25	30	50	60	75	100	150	500	1000
Axia*				\$99.00		\$199.00			\$299.00			\$599.00
Lightspeed - DSL	\$29.95	\$39.95		\$44.95		\$64.95			\$74.95			
Lightspeed - Cable	\$23.95	\$32.95			\$39.95			\$49.95		\$69.95		
Shaw			\$74.95		\$96.95		\$124.95			\$145.95		
TekSavvy - DSL	\$49.95			\$44.99		\$59.95						
TekSavvy - Cable		\$54.95					\$99.95					
Telus		\$60.00		\$85.00								
Xplornet*	\$84.99											

\* Axia pricing is for reference only as Canmore is not an Axia fibre community \*\* Xplornet is a satellite based service

As shown above, there are a wide range of packages available in the Town. Availability for various ISP's services are based on location and the ability for the existing infrastructure to support the various speeds. For the purpose of pricing existing ISP's, a downtown Canmore location was used as a common address. Axia's prices are fixed for each community they serve.

In addition to these packages, there are further differentiators with respect to upload speeds, Data caps, email/web space, and open Wi-Fi hot spot availability. There is a fairly broad range of speeds and price options available to the Town.

### Dedicated Business Internet

Dedicated business internet packages are provided, but these costs are generally only available when direct quotes are requested. These quotes usually require a facilities check to be completed by the provider prior to a firm quotation being provided.

These dedicated lines can be obtained through service providers such as Bell, and Zayo, however the local facilities are generally subleased through the current local providers, being Axia, Shaw or TELUS.

## 3 | Broadband Standards

### Introduction

Responding to a global transition to knowledge based economies, governments at all levels have identified access to information communication technologies (ICT) as a cornerstone to support future sustainable economic development, enable wealth creation and serve as a cornerstone to maintain a high standard of living and quality of life.

The very definition of broadband has evolved rapidly over the past 5 years as governments and regulatory bodies have closely examined the service characteristics of internet services that allow consumers and businesses to take advantage of the benefits these services.

### Canadian Regulatory Context

In 2011, the Canadian Radio Telecommunications Commission (CRTC) established universal target speeds of 5 Mb/s download and 1 Mb/s upload, stating that these speeds should be available to all Canadians by the year 2015.

In revisiting the 2011 universal target speeds, in 2016 the CRTC issued *Telecom Regulatory Policy CRTC 2016-496 - Modern Telecommunications Services*. This provided the path forward for Canada's digital economy with the following statements to provide additional context for the policy:

*This decision sets out the actions the Commission is taking to help meet the needs of Canadians so that they can participate in the digital economy and society.*

*Modern telecommunications services are fundamental to Canada's future economic prosperity, global competitiveness, social development, and democratic discourse. In particular, fixed and mobile wireless broadband Internet access services are catalysts for innovation and underpin a vibrant, creative, interactive world that connects Canadians across vast distances and with the rest of the world.*

*Canadians are using these services to find jobs, manage their investments, conduct business, further their education, keep informed on matters of public concern, consult with health care professionals, and interact with all levels of government. In general, fixed and mobile wireless broadband Internet access services improve the quality of life for Canadians and empower them as citizens, creators, and consumers.*

*A country the size of Canada, with its varying geography and climate, faces unique challenges in providing similar broadband Internet access services for all Canadians. Private sector investments, as well as funding programs from various levels of government, support the expansion of these services outside densely populated urban centres. Despite these efforts, many Canadians, particularly in rural and remote areas, do not have access to broadband Internet access services that are comparable to those offered to the vast majority of Canadians in terms of speed, capacity, quality, and price.*

As part of this policy, the CRTC established that broadband internet was a basic service with target service objectives of 50 Mb/s download and 10 Mb/s upload, with unlimited usage capacity to be available in 90% of Canadian premises by the end of 2021 and in the remaining 10% of Canadian premises within 10 to 15 years.

Communities and regions within Canada have adopted strategies and targets for high speed broadband within their community that go well beyond the CRTC’s recently announced basic service objectives.

For example, in York Region (Ontario), the following vision statement has been adopted by the Region: *“To establish York Region as a Gigabit Region, recognized for its leadership in fostering an eco-system of collaboration and business innovation within a connected lifestyle community.”* Supporting that vision, the Region established the following 5 and 10 year broadband targets in 2014:

Land Use Type	5 Year Target		10 Year Target	
	Upload	Download	Upload	Download
Regional Centres and Corridors	10 Gbps	10 Gbps	1 Tbps	1 Tbps
Employment and Institutional Lands	10 Gbps	10 Gbps	1 Tbps	1 Tbps
Urban Residential	500 Mbps	500 Mbps	1 Gbps	1 Gbps
Urban Commercial	1 Gbps	1 Gbps	10 Gbps	10 Gbps
Towns and Villages	50 Mbps	250 Mbps	100 Mbps	500 Mbps
Rural Areas	50 Mbps	100 Mbps	50 Mbps	250 Mbps

Source: York Region Broadband Strategy 2014<sup>1</sup>

### Global Context

In 2015 the American Federal Communications Commission established advanced broadband speed thresholds of 25 Mb/s (download) and 3 Mb/s (upload)

Globally, many nations have identified high speed broadband as a key element of their national development strategies to enable the next phase of economic growth, attract global businesses to operate in their location and provide opportunities for their citizens to participate in the knowledge economy. Countries such as Australia and Singapore have invested in national broadband strategies and funded the development of extensive fibre optic networks to ensure that affordable high speed broadband is available to almost all citizens.

The Akamai State of the Internet Q1 2017 Report provides us a global context in terms of not only download speed, but also the distribution of speeds in the range of 4Mb/s up to 25 Mb/s.

<sup>1</sup> <http://www.york.ca/wps/wcm/connect/yorkpublic/3995a98f-d1f8-4fe1-b553-ce2651c89f2d/may+1+broadband+ex.pdf?MOD=AJPERES>

**Global Ranking (Q1 2017) Download Speed**

Country/Region		Q1 2017 Avg. Mbps	QoQ Change	YoY Change
-	Global	7.2	2.3%	15%
1	South Korea	28.6	9.3%	-1.7%
2	Norway	23.5	-0.4%	10%
3	Sweden	22.5	-1.3%	9.2%
4	Hong Kong	21.9	-0.2%	10%
5	Switzerland	21.7	2.1%	16%
6	Finland	20.5	-0.7%	15%
7	Singapore	20.3	0.8%	23%
8	Japan	20.2	3.1%	11%
9	Denmark	20.1	-2.9%	17%
10	United States	18.7	8.8%	22%

Source: Akamai State of the Internet Q1 2017<sup>2</sup>

In terms of global ranking, we see top average download speeds of 28.6 Mb/s. Download speeds globally are increasing on average at 15% per year. Canada's Q1 2017 average download speed ranks 20th globally at 16.2 Mb/s, while recent survey data from the town of Canmore provides us with an average of 16.0 Mbps which would place it 21st in the Global ranking, slightly below the Canadian average.

Another key metric to observe are the number of broadband connections above 15 Mb/s, expressed as a percentage.

<sup>2</sup> <https://www.akamai.com/us/en/about/our-thinking/state-of-the-internet-report/global-state-of-the-internet-connectivity-reports.jsp>

**Americas Ranking % above 15Mb/s:**

Global Rank	Country/Region	% Above 15 Mbps	QoQ Change	YoY Change
8	United States	48%	14%	36%
16	Canada	40%	16%	25%
50	Chile	15%	18%	243%
54	Uruguay	13%	55%	206%
65	Mexico	6.1%	15%	52%
66	Brazil	5.8%	16%	451%
68	Argentina	5.1%	-5.6%	206%
72	Peru	4.4%	60%	211%
73	Ecuador	4.3%	-9.4%	263%
75	Columbia	2.1%	-6.0%	259%
-	Panama	4.4%	15%	465%
-	Costa Rica	1.0%	13%	66%
-	Bolivia	0.4%	11%	117%
-	Venezuela	0.1%	4.8%	-42%
-	Paraguay	0.1%	20%	-55%

Source: Akami State of the Internet Q1 2017<sup>2</sup>

From this data, we see the Canadian % above 15 Mbps at 40% with a global rank of 16. Recent survey data from the Town of Canmore places the Town at at 32%, ranking it 27th globally. Notably, the year over year change for these rankings are important to note in that many of the lower ranked countries are making large progress towards improving their ranking in this category.

Globally, broadband speeds continue to increase year over year. Fixed broadband services have generally increased 25% year over year. According to a 2014 study completed by Ookla ©, the Town's average download speed has increased 28% from 2010 to 2014. These increases are generally due to a combination of technology advancements and competition.

### Applications Drive Bandwidth

Historically, bandwidth consumption patterns have been driven by a download consumption model. Consumers and business users would download content (e.g. email, video, music) from major content creators on the internet and thus the disparity between download and upload speeds available did not significantly impact the users experience as long as download speeds could be maintained.

## Video

Emerging applications that support real time video communication (e.g. FaceTime, Skype, etc.) and the penetration of mobile devices has allowed a far greater number of consumers and businesses to upload video content created on their smart phones. Many online businesses rely on creating and publishing bandwidth intensive content to the internet or to corporate servers (e.g. graphic designers and videographers, professional photographers, engineers, etc.), creating pressure on limited upload speeds that currently exist. Overall the penetration and use of real time video in HD, 4K and emerging 8K formats continues to drive the need for high speed symmetrical bandwidth. The use of video and imaging applications within the healthcare and educational sectors continues to increase, driving the need for increasing bandwidth that is reliable and supports real time video applications.

## Cloud

Over the past 5 years, most applications have moved to cloud based hosting and service models. Software as a Service (SaaS) has become the predominant business model for major application and software providers such as Microsoft, Google and many other firms. In order for clients to take advantage of the benefits of the cloud based services, they must have access to the internet in order for these applications to perform efficiently. While a single instance of a cloud application does not need a large volume of bandwidth, the widespread adoption of these applications mean that every device (computer, tablet, and smart phone) connected to the cloud is constantly consuming bandwidth, creating higher levels of bandwidth demand in the aggregate.

## Broadband Standards – Town of Canmore

Standards for the Town need to be set within the context of the vision of the Town for its future development, the type of businesses and residents and future developments it wants to attract and its overall strategy to support growth and development.

Canmore has transformed from a small mining town with a once uncertain future into an international tourist destination with a reputation for excellence and innovation. The Town's youthful, energetic and well-educated population values a vigorous, outdoor adventure lifestyle that supports and encourages an entrepreneurial spirit. This compelling combination has made Canmore one of the fastest-growing and most desirable communities in Canada. Keenly aware of the fine balance between economic growth and environmental stewardship, Canmore seeks to support businesses that take advantage of its incredible location while producing minimal environmental impact. The Town's future lies in the intellectual and creative wealth coming to the community from all over the world. There are strong growth opportunities in recreational tourism and the health and wellness sector.

With the desire to support knowledge based growth as well as providing a world class tourism and hospitality experience, it is important that broadband standards reflect the need to provide a world class experience that encourages businesses to locate in the Town and residents, along with encouraging knowledge based residential businesses and professionals that work from home on a permanent or occasional basis.

**Download / Upload Speeds**

Focusing on the average download and upload speeds is an important standard however careful attention must be paid to not only the average metric, but as well the distribution of the results (median) values. It is important to note that while the CRTC has established a basic service standard of 50 / 10 Mbps, this standard reflects the current state of the incumbents’ technology and will promote continued investment in legacy technology. Establishing standards beyond the minimum will allow the Town to take a leadership position with respect to superior broadband services that will allow the Town to attract businesses and residents that will take full advantage of broadband services and provide knowledge economy based growth and investment in the Town.

Should the Town proceed with investments in broadband technology, either as a wholesale or retail provider, or as a partner/ enabler of private sector investment, it is recommended that a minimum broadband standard be maintained in order to ensure that strategic objectives for the Town are met.

Looking forward 5 years and 10 years, it will be important that broadband investments be able to support anticipated future growth and therefore aspirational targets for 5 years and 10 years ahead are also recommended.

**Town of Canmore Recommended Broadband Standards**

Metric	Current State	Proposed Standard (2017)	5 Year Target	10 Year Target
<b>Average Download / Upload Speed</b>	16.0 / 7.5 Mbps	100 / 20 Mbps	1 / 1 Gbps	10 / 10 Gbps
<b>% Above 15 Mbps Download</b>	32%		40%	80%
<b>Latency (North America destinations)</b>		Less than 150ms		
<b>Reliability</b>		99.99% service uptime with a mean time to repair (MTTR) objective of 4 hours		
<b>Open Access to Carriers</b>		Yes		
<b>% of Properties Connected</b>			90%	100%

Other Recommended Broadband Standards and Policies:

**Affordability and Usage Limits:**

Flat rate pricing without incremental charges for usage

**Access to 3rd parties:**

The broadband network shall be managed as an open network, allowing connections to other carriers on reasonable terms and prices and on a non-discriminatory basis.

### **New Development Connections**

All new property developments must include dedicated telecommunications conduit systems for the Town's use and operational control, providing a connection to the fibre optic backbone system at the closest practical connection point (planned or existing) and as well as a dedicated conduit connection from the backbone to the main telecom room or distribution facility located within the new development, or provide a connection directly to the dwelling unit.

### **Dig Once Standard**

All new construction or rehabilitation of roadways, bridges or other transportation infrastructure under the control and direction of the Town shall install new underground telecommunications conduit and associated hand wells/ pull boxes as part of the project scope.

All new construction of potable water or sanitary sewer trunk lines shall be reviewed for the feasibility to install new underground telecommunications conduit and associated handwells/ pull boxes as part of the project scope.

IBI Group recommends that following guidelines with respect to Fibre Optic Duct Engineering. These guidelines are subject to review and approval by the Town of Canmore's Engineering Department.

### **Fibre Optic Duct Engineering Guidelines:**

1. Throughout the route, there shall be at least 2 x 50 mm HDPE conduits deployed for backbone network. The exact quantity will be determined during detailed design phase.
2. There shall be cable vaults located at approximately every 2 km along the route. Size and type to be specified during detailed design phase.
3. There shall be hand wells located at approximately every 500 m along the route. Additional hand wells may be required due to on-site conditions or wherever the cumulative bends of conduits exceeds 180 degrees. Hand wells are also to be located near each traffic controller and placed in order to aggregate drop conduit for individual building connections. Size and type to be specified during detailed design phase.
4. Additional 1 x 50 mm HDPE conduit, with sub-duct shall be installed for drop connections to provide connectivity to commercial buildings or residences. The installation of this conduit will be coordinated with specific construction details of the individual property, to be determined during the detailed design phase.

## 4 | Broadband Service Market Demand (Survey)

### Introduction

The Town of Canmore, located in the Bow Valley, is one hour from Calgary and minutes to Banff National Park. The Town is one of Alberta's top tourist destinations but still retains a diverse economic base with construction, health and wellness providing major contributions to the local economy. There are approximately 14,000 residents with an estimated 3,900 non-permanent residents that own property in the Town.

Canmore has 1,300 registered businesses in their Town registry. IBI Group reviewed this data from the Town's business registry, and of these businesses, 611 were registered as Commercial and 717 as Home-Occupation.

The general breakdown of market segments using the Town provided business data is as follows:

Market Segment	Market %	Broadband Dependence
Tourism/Hospitality	30%	High/Medium
Construction	25%	Low
Health/Education	21%	High
Retail	15	High/Medium
Professional/Business	9	High

With respect to the market segments and their broadband dependence, reliance is continually increasing as individuals have more devices that are required to be online, as well as a growing reliance on cloud-based services, such as Ring Central, GoToMeeting, Microsoft Office 365 and Amazon Web Services, to name just a few. Speed and reliability are critical factors in operating a business, regardless of location.

In the hospitality sector, customers now expect high speed services for business use as well as personal. Over the Top (OTT) services such as Netflix are expected to be accessible and reliable for a location's guests.

The same criteria carries into the residential market, where video streaming is a common application. The Service Providers themselves are either already providing or moving towards IP based video services such as Crave and Shaw Free Range. Customers expect fast and reliable connectivity service.

### Survey and Bandwidth Testing

Surveying and bandwidth testing was performed with the IBI Group Survey Tool. The tool was used to gather information by directing residents and businesses to an online, internet-based survey available through a link.

The survey was configured to identify residential and commercial use and pose specific questions relevant to each service. In the case of business internet, it was important to identify specific bandwidth applications that were key to each companies' needs and

requirements for their success. As an example, a café requiring internet service for Point of Sale transactions is a low bandwidth user, whereas a corporate office with multiple employees utilizing cloud-based applications, and moving large files, requires high bandwidth.

Bandwidth testing was performed as part of the survey process, with survey respondents asked to activate a test through their web browser, located at their residence as well as at their place of business, in order to measure and record the speed and capacity of their internet services.

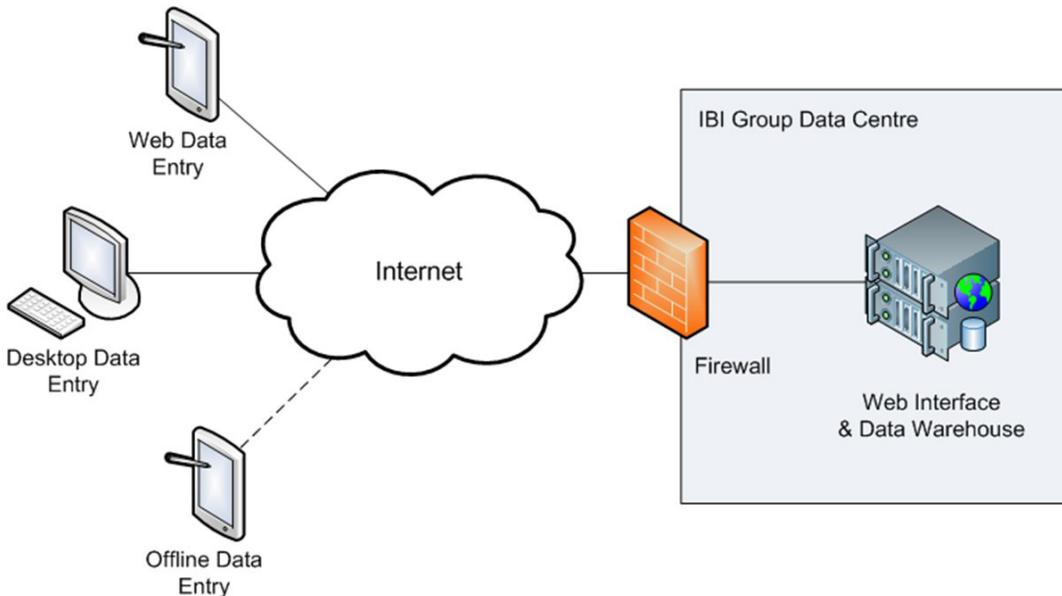
The Town has been provided with all raw data collected from the survey. This section of the report provides a summary of survey questions and responses as well as summary of bandwidth test results, classified by various categories of interest.

The survey objective was to capture a valid, representative sample (within agreed upon confidence interval) from the Town residents and businesses. This information would provide feedback on various broadband questions, and create a baseline bandwidth measurement that would be used to measure the level of commercially available residential and business internet services and the changes to such services over time.

### Technical Configuration

Access to the survey was provided through a link that was sent via email to businesses; various promotion initiatives were put in place by the Town to encourage survey participation.

The following diagram depicts the survey network architecture that was implemented.



Note that in this scope of work, offline data and Web data entry options were not used as the objective was to capture speed test results from desktop connected computers.

The data collected from the survey was exported in a standard electronic format (e.g. Microsoft Excel).

### Integration of Bandwidth Testing

The IBI Group Speed testing tool was utilized as part of this survey. Geocoded data was captured from survey respondents using publically available mapping tools.

Survey respondents were asked to provide their address, so bandwidth coverage can be mapped and coverage results reported by location and aggregated to community level information. Bandwidth performance (upload, download speeds and latency) was also measured and recorded. This information helped to illustrate specific broadband performance characteristics by location and/or by service provider.

### Survey Schedule

The Survey was designed based on survey questions previously reviewed by the Town with suggested feedback and collaboration from IBI Group as to visual display, format, etc.

The survey was launched on August 3, 2017 and ended September 10, 2017.

The Town advertised the survey through their website, Facebook and local media. IBI Group participated in an interview with a local paper to provide additional information with respect to the survey and its intended outcome.

### Number of Responses

The format of the survey requested respondents to answer a number of questions. Once all questions were completed, they were asked to click on a “Submit” button to confirm their results and complete the survey. If the survey respondent did not answer all questions, or did not click the submit button at the end of the survey, the questions that were answered were still recorded and classified.

There was a total of 274 non-blank, non-test distinct survey results captured as of September 10th, 2017. Based on approximately 13,000 residents in Canmore, this volume of response to the survey questions provides a **confidence interval of +/- 5.86%** based on a **confidence level of 95%**.

The **confidence interval** (also called margin of error) is the plus-or-minus figure usually reported in newspaper or television opinion.

**The confidence level** tells you how sure you can be. It is expressed as a percentage and represents how often the true percentage of the population who would pick an answer lies within the confidence interval. The 95% confidence level means you can be 95% certain; the 99% confidence level means you can be 99% certain. Most researchers use the 95% confidence level.

The confidence was calculated based on all the survey results as opposed residential and Business. The Business/Commercial survey participants were low, however when reviewing the residential respondents, it was noted that 60% of these participants utilized their service for Telecommuting and other business based applications.

### **Bandwidth Test Results by Location**

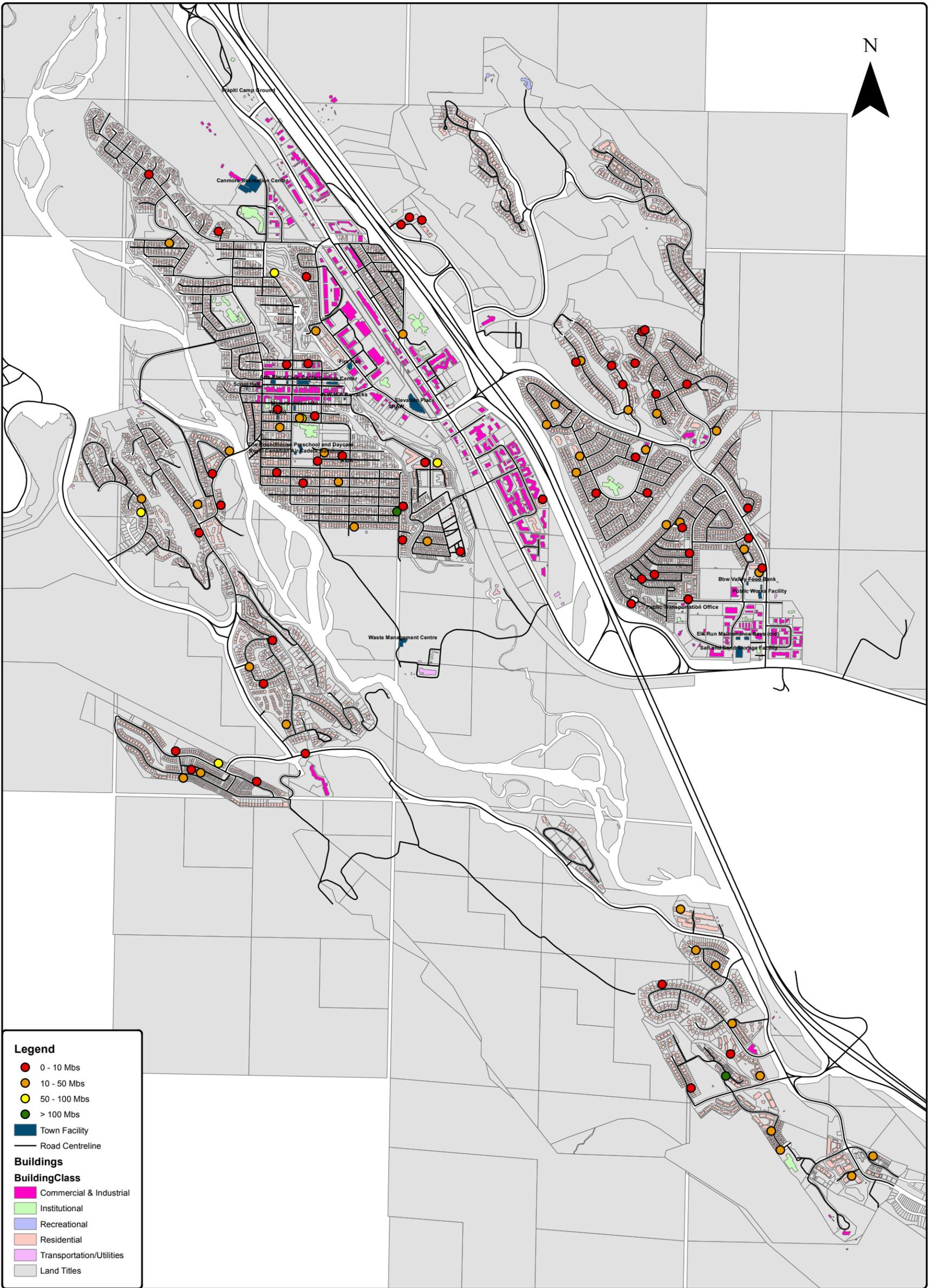
The results of the survey speed testing performed are mapped according to the address information gathered. IBI Group has provided three maps with broadband test results for the Town of Canmore. The broadband results are broken into residential, and commercial. The third map is results from test data made available from the Canadian Internet Registration Authority (CIRA) website; this map does not specifically indicate whether the test is residential or commercial.

**Exhibit 1 - Residential Broadband Test Results by Location**

**Exhibit 2 - Commercial Broadband Test Results by Location**

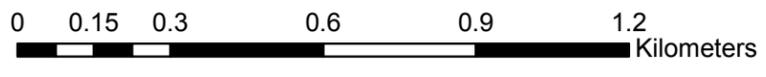
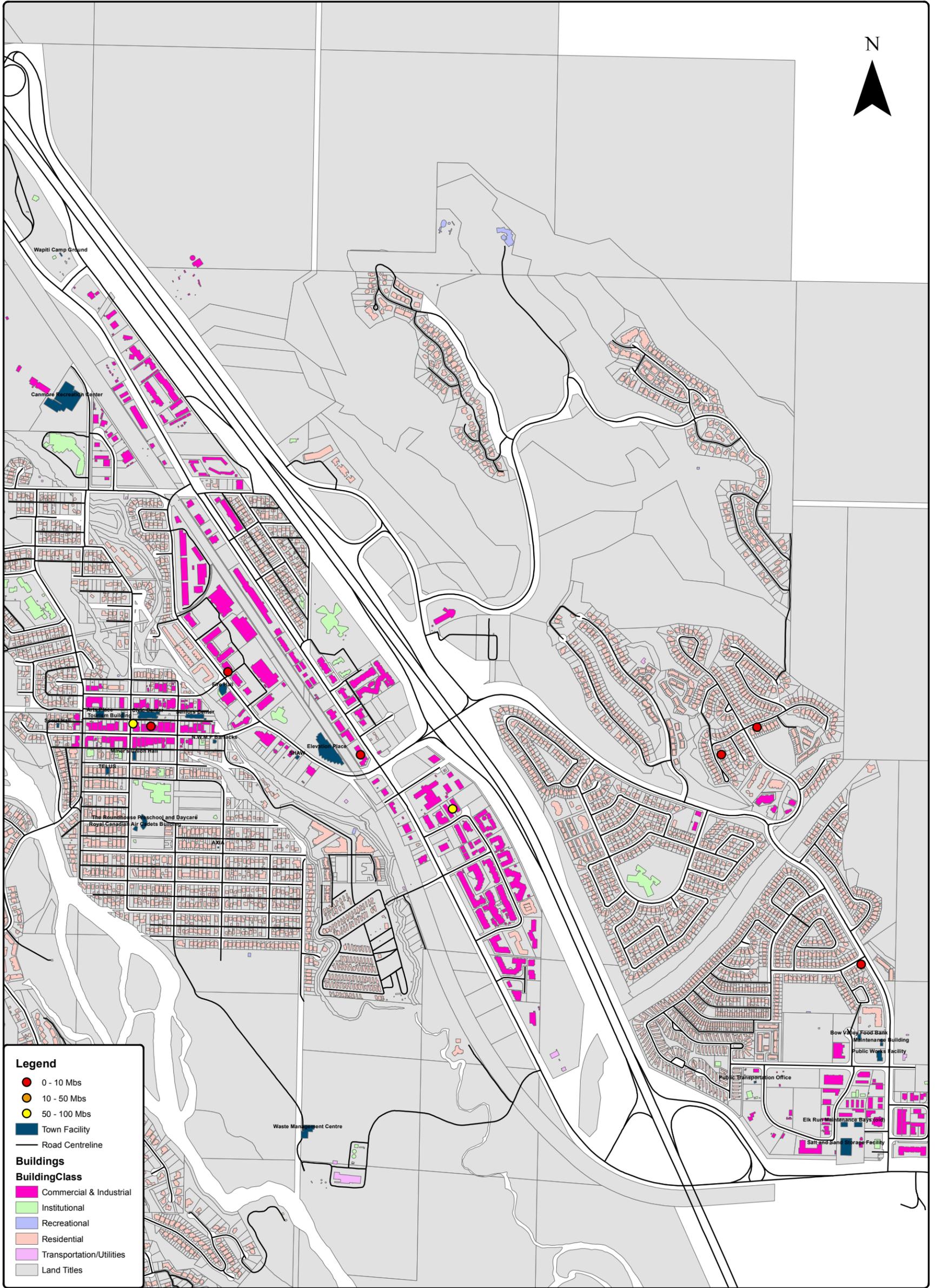
**Exhibit 3 - CIRA Broadband Test Results by Location**

# Town of Canmore Residential Broadband Test Result

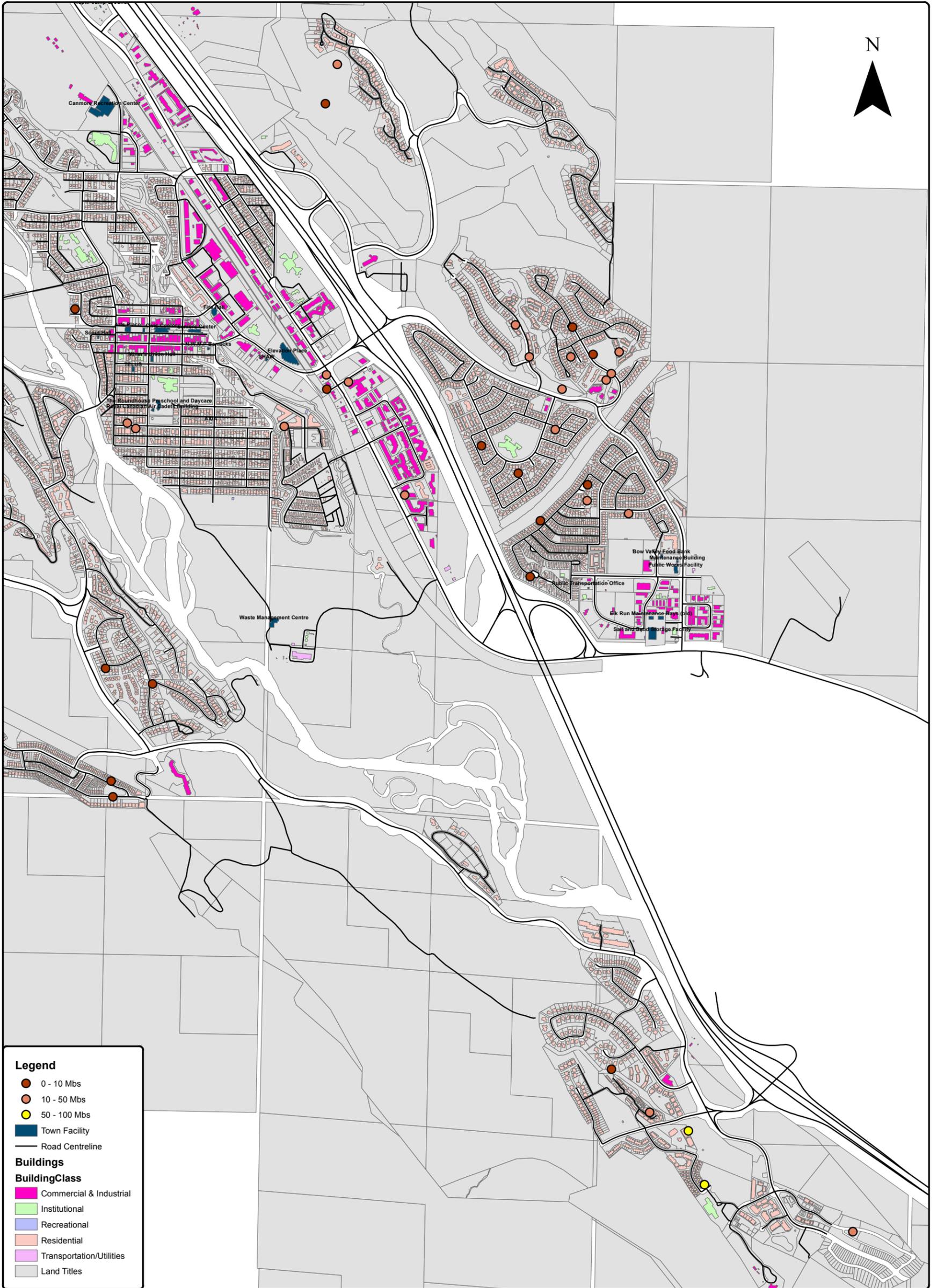


0 0.25 0.5 1 1.5 2 Kilometers

# Town of Canmore Commercial Broadband Test Result



# Town of Canmore CIRA Broadband Stat Result



0 0.225 0.45 0.9 1.35 1.8 Kilometers



## Survey Questions and Responses

As of September 11th, 2017, surveys initiated totalled 348. This data was reviewed and surveys with a combination of missing data, out of town addresses and duplicate entries removed.

The overall survey counts are as follows:

Totals	Count
Surveys Initiated	348
Surveys in Canmore	220
Addresses with Lat/Long	173
Residential	193
Business	27
Speed Tests Completed	138

As the residential and business surveys had different questions, the results are provided separately.

## Residential Survey Questions and Responses

### 1. How important is access to you?

Rating	Count	Percentage
Not important	2	1%
Somewhat important	0	0%
Very important	36	19%
Can't live without it	150	80%
Total Responses	188	100%

### 2. What is your satisfaction with your current home internet service?

Participants were asked to rate their service on a scale of 1 to 5 for the attributes of reliability, speed, value and customer service.

*(1 – Very Dissatisfied, 3 – Satisfied, 5 – Very Satisfied)*

Satisfaction Level	Reliability	Speed	Value	Customer Service
1 to 5	3.66	3.21	2.58	3.21

**3. What is your overall satisfaction with your current internet service?**

(1 – Very Dissatisfied, 2- Dissatisfied, 3 – It’s Okay, 4 – Satisfied, 5 – Very Satisfied)

Satisfaction Level	Responses	Percentage
Very Dissatisfied	8	5%
Dissatisfied	28	19%
It’s Okay	59	40%
Satisfied	38	26%
Very Satisfied	15	10%
Total	148	100%

**4. What do you use your home internet for?**

Usage Type	Counts	Percentage
Basic Internet	143	96%
Video Streaming (YouTube, Netflix, Crave, etc.)	129	87%
Gaming	45	30%
Telecommuting (VPN, Web Conference, etc.)	89	60%
Voice and Video (Skype, Facetime, WhatsApp, etc.)	113	76%
Cloud Services and Storage (iCloud, One Drive, Google Drive, etc.)	110	74%

*\*Based on 149 responses to the question*

**5. What is the maximum monthly amount you would be willing to pay for a high speed internet connection at home?**

Monthly Maximum	Count	Percentage
\$30	9	6%
\$50	36	22%
\$75	67	41%
\$100	44	27%
\$150+	7	4%

**6. If available, would you upgrade your service?**

Upgrade	Yes	No
Counts	149	16
Percentage	90%	10%

**7. What Internet package do you currently subscribe to?**

Internet Package Mbps	Light Speed	Rogers*	Shaw	TekSavvy	Telus	No ISP Provided
5			1			
15	1		17	1	8	
25					11	
30				1		
50					20	
75			26			
150			48		7	
Unknown		1	1		3	
<b>Total ISP</b>	<b>1</b>	<b>1</b>	<b>93</b>	<b>2</b>	<b>49</b>	<b>49</b>

\*Rogers is a wireless data stick service

These results are based on the participant providing their ISP information.

**8. Has your Internet Service Provider kept up with your current needs?**

Kept Up	Count	Percentage
Yes	105	59%
No	73	41%
Total	178	100%

**9. What role, if any, should the Town of Canmore take in ensuring that Canmore's future internet speed requirements can be met?**

Town's Role	Not Sure	Passive	Moderate	Active
Responses (Total 167)	18	11	39	109
Percentages	10%	6%	22%	62%

## Business Questions and Responses

### 1. What does your business currently use the internet for?

Business Usage Type	Counts	Percentage
Credit Card Processing	13	50%
Corporate VPN	14	54%
Large File Transfer	23	88%
Voice and Video communication (e.g. Skype, Ring Central, video conferencing, other VOIP services)	22	85%
Download/viewing of videos (training/education for staff)	22	85%
Manage online business/website	26	100%
Security system / video camera monitoring of business and/or remote locations	10	38%
Provide internet access (Wi-Fi) to customers/staff	18	69%
My business uses and/or provides Cloud Services	13	50%

### 2. What do you currently pay, on a monthly basis for your existing internet connection?

\$100 and Less	\$100-\$200	\$500	\$1,000 and Up
8	5	1	5

### 3. How important is access to the internet for you?

Rating	Count	Percentage
Not important	0	0%
Somewhat important	0	0%
Very important	2	7%
Can't live without it	25	93%
Total Responses	27	100%

### 4. What is your satisfaction with your current internet service?

Participants were asked to rate their service on a scale of 1 to 5 for the attributes of reliability, speed, value and customer service.

(1 – Very Dissatisfied, 3 – Satisfied, 5 – Very Satisfied)

Satisfaction Level	Reliability	Speed	Value	Customer Service	Overall
1 to 5	3.15	2.7	2.52	3.08	2.86

**5. What is your current download speed in Mbps (Megabits per second)?**

*Combined Table with results from Question 6.*

**6. What is your current upload speed in Mbps (Megabits per second)?**

Count	Download (Mbps)	Upload (Mbps)	Percentage
1	15	15	4%
1	25	5	4%
1	30	5	4%
1	60	10	4%
1	60	15	4%
1	100	20	4%
1	100	100	4%
1	150	15	4%
19	Unknown	Unknown	68%

Unknown results can be due to employees not knowing their business internet contracts.

**7. If you had access to a higher speed (e.g. 100 Mb/s or greater) reliable Internet connection, would it allow you to: (select all that apply)**

Yes	No
a. Operate more efficiently (i.e. lower costs)?	
89%	11%
b. Grow your business (i.e. increase revenue)?	
72%	28%
c. Provide improved customer service?	
81%	19%

**8. If available, would you upgrade your internet service?**

Yes	No
88%	12%

**9. What service speed do you feel would meet all of your current requirements?**

Speed (Mbps)	Count	Percentage
10	1	4%
50	2	7%
150	10	37%
1,000	8	30%
>1,000	5	19%
No Response	1	4%

**10. What is the maximum monthly amount you would be willing to pay for a high speed Internet connection for your business?**

Rate/Month	Count	Percentage
\$50	3	11%
\$100	5	19%
\$150	8	30%
\$250	0	0%
\$500	2	7%
>\$1,000	8	30%
No Response	1	4%

**11. Has your Internet Service Provider kept up with your current needs?**

Yes	No
36%	64%

**12. What role, if any, should the Town of Canmore take in ensuring that Canmore’s future internet speed requirements can be met?**

Role	Count	Percentage
Not Sure	1	4%
Passive	2	7%
Moderate	4	15%
Active	20	74%

- Passive – The Town has no involvement in Canmore’s internet needs
- Moderate – The Town encourages and/or supports the private sector in Canmore’s internet needs
- Active – The Town partners with the private sector and/or invests as required

The survey also provided commercial respondents to provide comments with respect to their current level of service. The majority of comments expressed frustration on the quality of service and an inability to fully utilize hosted services, and reliability on file transfers and the use of Voice over Internet type services.

## Bandwidth Testing

The IBI Group Bandwidth testing tool measures the actual transfer speed of a file over the Internet to a centralized server on the internet’s backbone, located at a data center in Calgary, Alberta, Canada.

Many bandwidth tests, including some speed tests done by an Internet provider, measure only the local connection between the residence or business and the nearest server that is hosted by the Internet provider. This is a measurement of the maximum speed that can be expected over the local connection, however it is not an accurate measurement of the actual performance of the connection when accessing typical files on the Internet and content that are not stored (cached) locally.

The location of the IBI Group server is a net neutral location via the Calgary Internet Exchange.

The Town wishes to establish a baseline for the community of the Internet speeds that are truly usable for high speed applications, such as voice and video streaming, to other locations in the province and around the world. The Town anticipates that future Smart City applications for residents and businesses will require much higher levels of Internet bandwidth in the future, and not all applications may be hosted locally. Measuring from one common location will provide a baseline to compare service levels in different geographical areas of the town.

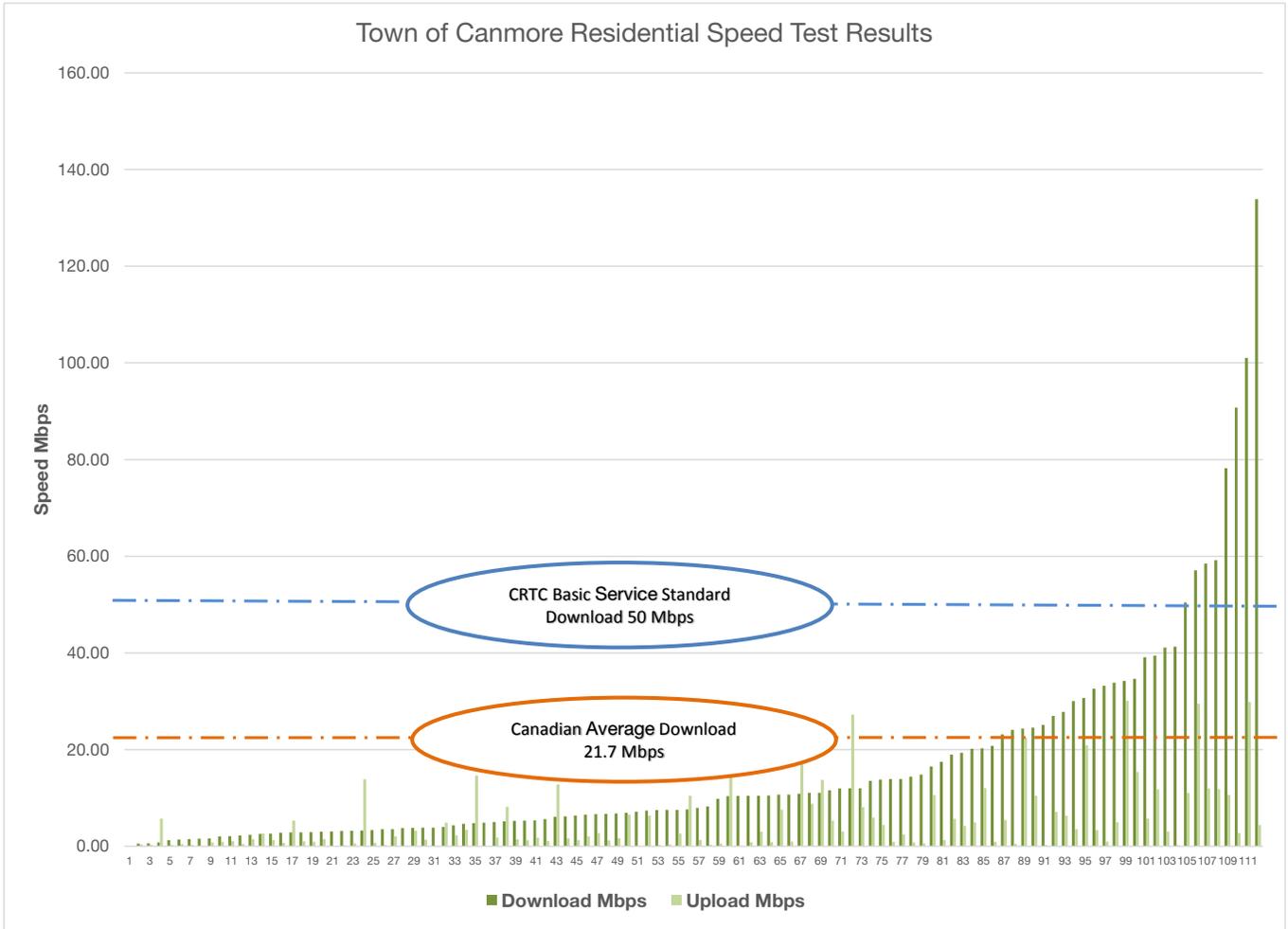
Survey respondents could return to the bandwidth testing portion of the survey multiple times and record test results. Test results for each survey respondent were averaged to a single result for each survey/unique location. IP address of the Internet Service Provider (ISP) was also recorded to allow a correlation of results to service provider.

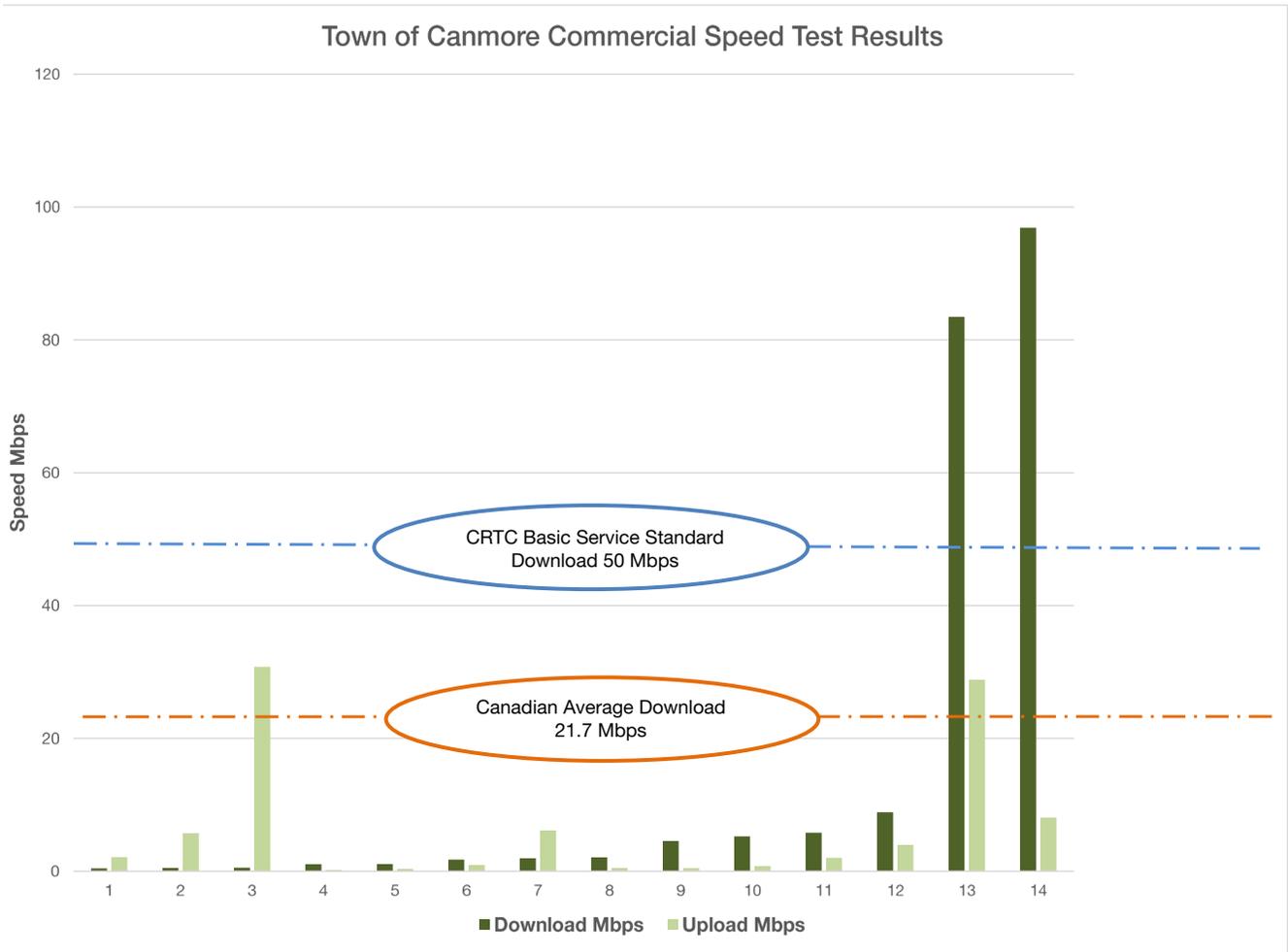
Test Parameters that were recorded include:

- Average Download Speed (Mb/s)
- Average Upload Speed (Mb/s)
- Latency (milliseconds)

## Bandwidth Test Results

The two charts following summarize the individual residential and commercial test results and context in terms of the Canadian average and the CRTC Basic Service level. For each chart, the majority of test results fall below the Canadian average of 21.7 Megabits per second.





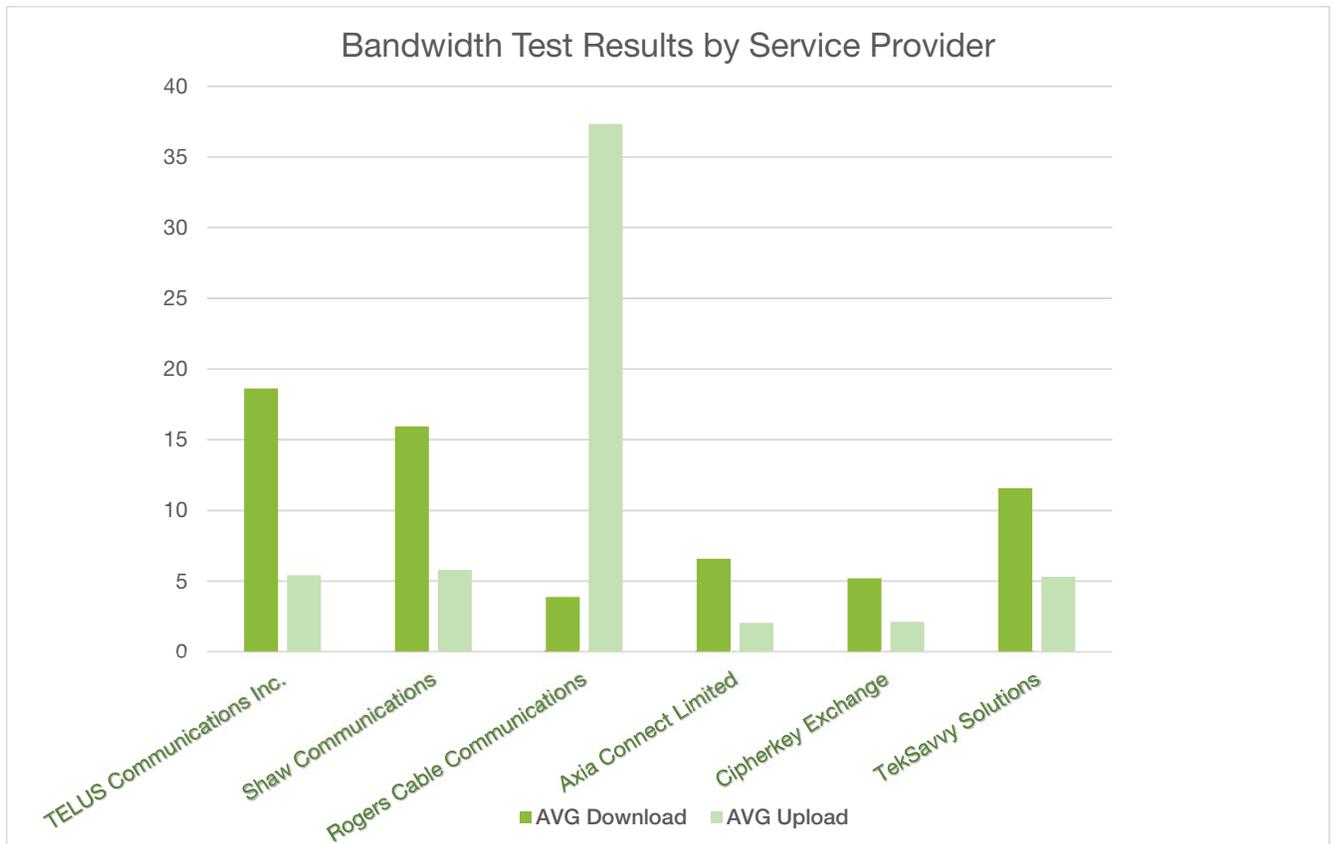
### Bandwidth Test Results

Test Parameter	Residential Speed Test Result	Commercial Speed Test Result	Overall Town Average
Average Download (Mbps)	16.1	15.3	16.0
Average upload (Mbps)	7.6	6.5	7.5
Average Latency (milliseconds)	80.66	155.2	88.7

### Bandwidth Test Results by Service Provider

Service Provider	Number of Test Results	Average Download Speed (Mbps)	Average Upload Speed (Mbps)	Average Latency (milliseconds)
TELUS	37	18.6	5.4	42.92
Shaw	67	16.0	5.8	85.51
Axia	1	6.6	2.1	36.1
Cipherkey	2	5.2	2.1	79.9
TekSavvy	1	11.6	5.3	99.1
Rogers	4	3.9	37.3	190.2

\* The Service Provider determination was based on the internet address where the survey originated from. This did not always align with the ISP information as provided by the participant.



## Summary of Key Findings

In analyzing the results of the survey and bandwidth testing, the following key findings are noted:

1. There is an even geographical distribution of speed test results, indicating that service provider broadband infrastructure and service offerings across the Town are similar in terms of capacity and speed.
2. Bandwidth test results reveal that, for the most part, broadband services across the Town are below average with respect to Canadian averages and well below the basic service standard established by the CRTC in 2016
3. While the volume of service responses from businesses were lower than expected, the results obtained point to a particular issue with low broadband speeds for businesses.
4. Both businesses and residents use broadband extensively to support both commercial and leisure activities. There are concerns identified by survey respondents that their future needs will not be met by the current service providers and existing subscribers would upgrade services if available.
5. There is a positive bias for the Town to take an active role to improve broadband services
6. There is significant demand for business services in excess of 100Mb/s up to 1 Gb/s and beyond and a willingness to pay additional monthly fees (\$1,000/ month and greater) in order to obtain such services.

## 5 | Feasibility Analysis

### Introduction

Currently the Town's Telecommunications infrastructure is based on leased services and wireless infrastructure to meet their current needs. A minor fibre installation is in place providing connectivity to a single location. The goal of this memorandum is to provide a concept architecture for fibre and network electronics that would support the Town's internal telecom requirements, as well as provide an opportunity to support both business and residential broadband services to the community.

The proposed network architecture is comprised of two components:

- Fibre/conduit infrastructure
- Network service (electronics) design

Each of the design components are based on providing the ability to service the Town's current and future network requirements, as well as provide the ability to provide connectivity to both residential and commercial customers.

The fibre design architecture supports interconnections to existing Service Providers in the Town and, by extension, support wholesale and retail broadband models.

The proposed network service design provides a reliable infrastructure to support a 24/7 broadband service. The system would be capable of scaling to best meet additional areas of the Town.

The proposed design is based on common practices and assumptions. A deployment for the fibre infrastructure and network service electronics would require a detailed review, including site surveys/walkouts, as well as service and capacity definitions.

### Fibre Network Design

The fibre network design is based on providing connectivity to the Town's facilities and generally follows existing utility right of ways and would be deployed in a manner that would maximize the ability to extend to residential and commercial customers. The fibre network would be comprised of the backbone system, providing the main transport systems, and the distribution system, providing the connection to the individual properties.

The fibre network will be deployed with conduit sizing and fibre counts that allow for growth of services and connections as required. Conduit is proposed with adequate breakout points and room to accommodate the deployment of additional fibre cable.

The fibre network would have adequate fibres to accommodate an aggregated fibre to the premise network, dedicated point to point connections and support carrier/service provider connections as required. The system will have capacity to enable the Town to take advantage of connectivity to support their internal services, both existing and planned.

The proposed infrastructure is to provide the Town with high level estimates. Detailed routing and costs would be an additional exercise and IBI Group would need to engage the Town's engineering team.

### Fibre Backbone Network

The fibre backbone was designed to accommodate connectivity to six zones of the Town. With the exception of the Waste Management Centre, the network will connect all of the Town facilities and extend into the various commercial and residential zones.

This would consist of a high count fibre optic cable. Breakout locations would be provided that would interconnect to local distribution and access fibres to the various premises.

**Exhibit 4 - Town of Canmore Zoning and Backbone** provides the proposed routing, and identifies Town facilities, as well as commercial, residential, and institutional locations.

IBI Group created the table below which provides the cost of constructing and deploying backbone fibre for each of the zones. An average cost of \$100 per metre was utilized in order to provide the budgetary estimates of the backbone fibre. The approximate distances of each of the fibre segments and their cost is as follows:

Backbone Fibre	Distance – Metres	Cost
Zone 1	2,830	\$283,000
Zone 2	6,730	\$673,000
Zone 3	4,160	\$416,000
Zone 4	2,560	\$256,000
Zone 5	2,470	\$247,000
Zone 6	3,430	\$343,000
<b>Total</b>	<b>22,180</b>	<b>\$2,218,000</b>

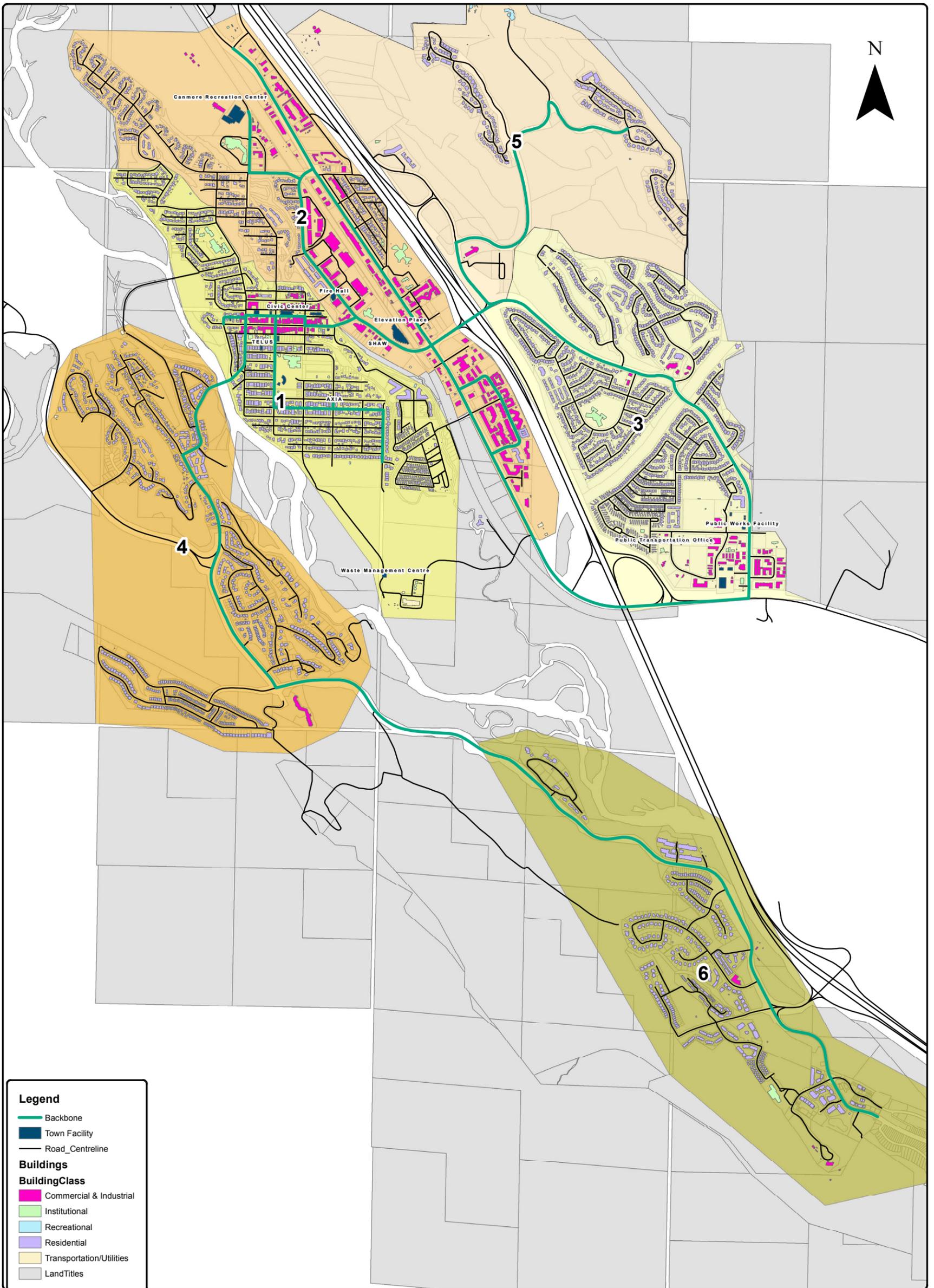
### Distribution Fibre Network

The Distribution fibre network will provide last mile connectivity from specific backbone locations to the various premises, whether they be residential or commercial.

IBI Group utilized an estimated cost per premise based on previous network designs. The cost is per building and does not take into account multi-dwelling or multi-tenant premises. Multi-unit premises will lower the overall cost per customer, as in-building distribution systems may already be in place, or more cost effective to provide. The cost of \$2,000 per premise was utilized to provide the distribution zone capital estimates.

Distribution Zone	Premise Counts	Drop Cost
Zone 1	1,470	\$2,940,000
Zone 2	1,000	\$2,000,000
Zone 3	1,836	\$3,672,000
Zone 4	1,085	\$2,170,000
Zone 5	210	\$420,000
Zone 6	361	\$722,000
<b>Total All Zones</b>	<b>5,962</b>	<b>\$11,924,000</b>

# Town of Canmore Zoning & Backbone



**Legend**

- Backbone
- Town Facility
- Road\_Centreline
- Buildings**
- BuildingClass**
- Commercial & Industrial
- Institutional
- Recreational
- Residential
- Transportation/Utilities
- LandTitles

0 0.25 0.5 1 1.5 2 Kilometers

## Fibre Network Summary

As the zones consist of residential and commercial premises, the town has the option to prioritize fibre deployments and possibly address the business community in initial stages. The following are the approximate counts for residential and commercial buildings:

Zone	Residential	Commercial
Zone 1	1,385	85
Zone 2	727	273
Zone 3	1,750	86
Zone 4	1,084	1
Zone 5	192	18
Zone 6	345	16
<b>Totals</b>	<b>5,483</b>	<b>479</b>

Overall costs per zone with a breakout of residential and commercial are provided below.

Zone	Backbone	Commercial	Residential	Totals
Zone 1	\$283,000	\$170,000	\$2,770,000	\$3,223,000
Zone 2	\$673,000	\$546,000	\$1,454,000	\$2,673,000
Zone 3	\$416,000	\$172,000	\$3,500,000	\$4,088,000
Zone 4	\$256,000	\$2,000	\$2,168,000	\$2,426,000
Zone 5	\$247,000	\$36,000	\$384,000	\$667,000
Zone 6	\$343,000	\$32,000	\$690,000	\$1,065,000
<b>Totals</b>	<b>\$2,218,000</b>	<b>\$958,000</b>	<b>\$10,966,000</b>	<b>\$14,142,000</b>

As previously mentioned, the premise counts do not account for multi-tenant, or multi-dwelling buildings. To accurately reflect a cost per premise, a detailed review of the zones would be required to identify the number of units per building/premise. This would further assist in business case development of a fibre deployment.

## Service Network

The retail model of broadband service requires several levels of network electronics, servers, and software in order to operate. These various levels are responsible for access, routing, activation, monitoring, management, and security.

All components proposed are common off the shelf products supported in the North American market.

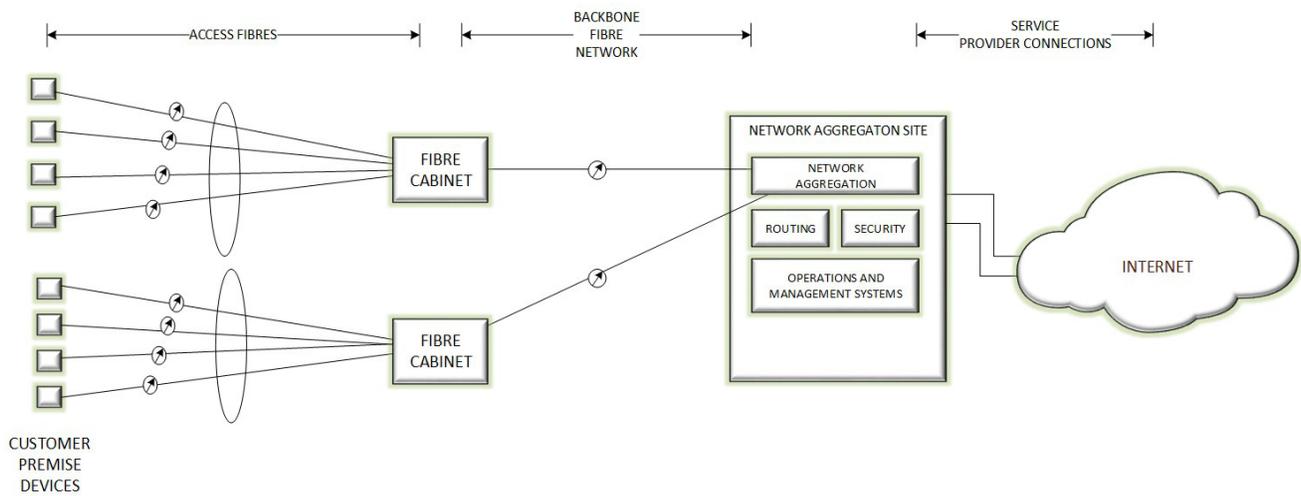
### The Service Network

The service network provides the customer premise electronics that connect back to the core network electronics located in the Town’s network aggregation site. This could be a single site, or dual to accommodate for redundancy.

Service network electronics are available for multiple uses and speeds, such as DSL for copper networks and CMTS (Cable Modem Termination Systems) for coax networks.

The following diagram provides a high level overview of the service network and how it would interconnect with the backbone and access fibres.

### Proposed Service Network



For the fibre network, there are two options as a deployment strategy, an Ethernet over Passive Optical Network (EPON), or an Active Ethernet System. The proposed architecture shown will support both EPON and Active Ethernet deployments.

The EPON system is capable of combining up to 64 customer fibres in the field, to utilize a single fibre to the aggregation site. The system can provide end users with Gigabit interfaces and the ability to provide varying levels of speeds and levels of service. The system is capable of 10 Gigabit capacity on the fibre. EPON systems are efficient at creating a large shared pool of bandwidth, and is an excellent technology for addressing residential and small business services.

The network aggregation device would be proposed with redundant modules and connections into the router network in order to minimize service outages.

The Active Ethernet system utilizes a dedicated fibre linking each premise to the aggregation site. The aggregation site has a fully redundant aggregation switch. This system can provide full symmetrical line rates in increments of 100 Megabits per second, 1 Gigabits per second, and 10 Gigabits per second. Generally, Active Ethernet systems are deployed for commercial customers who require higher bandwidth than residential users. The customer premise electronics are higher than EPON.

Each system is capable of addressing the Town's requirements and would be addressed in a detailed design. Depending on the service scenarios, a hybrid network consisting of EPON and Active Ethernet are possibilities. The Access Network can be deployed in a bandwidth only wholesale model, where ISP's lease bandwidth from the Town for their customers.

In addition to the network electronics, infrastructure to support routing, security, and operational management are required as outlined below.

### **Routing and Security Network**

The routing and security network provides the functionality to interconnect to the service providers and delivers the necessary security to protect the Broadband Network and, to a certain extent, the customers from outside threats/outages.

A high availability router and firewall is proposed to provide adequate capacity for expansion. These devices would have redundant modules and connections between the various devices to minimize service outages.

Routing and security requires specialized skill sets in order to continually optimize as well as secure the infrastructure.

### **Management, Activation and Billing Systems**

The management, activation and billing systems are the back office servers required to run the service. These systems provide monitoring, control, configuration and reporting.

Early phases of deployment would not require significant deployment of this hardware as this can be scaled as the system grows. A small server with Open Source Monitoring software will provide additional management and monitoring functionality.

### **Network Service Electronics Costs**

A proposed initial deployment of Broadband services by the Town, would be to address the downtown, and the commercial zones which are comprised of zones 1, 2 and 3. This would provide connectivity for municipal requirements, and allow for the town to deliver higher revenue business services. The system would allow for expansion and provide the Town with the ability stage the deployments of fibre and network.

The following network service electronics associated with an initial retail model are based on a deployment covering commercial users in zones 1, 2 and 3. Costs are based on the following assumptions:

- Initial systems scaled to support a minimum of 500 users
- 200 Customer premise devices included
- 32 premises connected per backbone fibre
- Majority of services based on +100M internet service
- The system can support additional bandwidth and Ethernet only service, if required
- Initial deployment will utilize on-board management systems for network management, configuration and reporting
- Core network electronics will have redundant modules and connections to avoid service disruptions

These costs are budgetary and would require further review with the various vendors once a detailed design has been completed. For the purposes of this exercise, the EPON system was used as the Access Network.

Network	Component	Cost	Comments
Access Network	OLT	\$50k	Core Aggregation Device
	ONT's	\$10k	Customer Premise Equipment
	Combiners	\$3k	Field PONs
Routing and Security	Router	\$30k	Core Aggregation Router
	Firewall	\$20k	Core Internet Firewall
Management	Server	\$2.5k	Management Server
Overall Network	Miscellaneous Items	\$5k	Miscellaneous cables, connectors, installation hardware, and cabinets
Overall Network	Aggregation Site Services	\$5k	Electrical and mechanical services system implementation
<b>Total Costs</b>		<b>\$125.5k</b>	

### Network Summary

The overall summary of fibre and network electronics costs associated with a deployment of commercial broadband services in zones 1, 2, and 3 are provided in the following table. The table provides the overall cost of activating the three zones with varying customer/premise counts. As shown, the backbone costs are constant, but the cost per premise reduces as customer counts increase. The costs provided are for the network only and do not include operating costs.

Premise Count Options	Fibre Backbone Cost	Fibre Drop Cost	Network Electronics	Total Cost	Cost/Premise
<b>200</b>	\$1,372,000	\$400,000	\$125,500	\$1,897,500	\$9,488
<b>300</b>	\$1,372,000	\$600,000	\$130,500	\$2,102,500	\$7,008
<b>400</b>	\$1,372,000	\$650,000	\$136,500	\$2,158,500	\$5,396

The 200 and 300 premise count scenarios assume a direct fibre at the \$2000 rate per drop assumption. The 400 customer count takes into account a \$500 rate per drop that could be assumed when providing internal cabling to a multi-tenant premise. The core network electronics and fibre backbone costs should remain relatively the same in these scenarios.

### Upstream Interconnections to Internet (Retail Model)

The Town's broadband network will require interconnections to one or more service providers for internet connectivity. Two separate providers protects against service disruptions in the event one of the providers networks has failures or their own service disruption.

For an initial launch, our firm would recommend a dual carrier diverse connection in order to provide the required capacity and redundancy. Further reliability can be achieved by having Calgary and Kamloops or Vancouver exchange connections.

Budgetary costs associated for a 1 and 10 Gigabit leased Internet connection costs to a Calgary Internet exchange are as follows:

Access	Installation Charges	Monthly Recurring Charges
1 GBPS	\$1200	\$1200
10 GBPS	\$2500	\$3500

The above connections are the access connection only, and there are additional service costs to provide a committed rate. Prices vary with carriers and interconnect partners at the Internet exchanges. Costs fluctuate with volume and can vary from \$2 per megabit up to \$8 per megabit per month on the committed bandwidth rate. As an example, a committed bandwidth rate of 400 Megabits on the 1 GBPS service is an additional \$1,600 per month at a rate of \$4 per megabit. This bandwidth is a shared pool that is utilized by all the customers on the system.

For budgeting purposes, an average cost per megabit of \$4 is used. Initial Internet usage would be approximately 500 Megabits, resulting in a cost of \$2,000 in usage charges per month. This shared pool of bandwidth could service the initial pool of subscribers utilizing basic internet services, but would require active monitoring. A high end commercial customer could require this to be augmented prior to activating their service.

A burstable service would allow for this to fluctuate as required to ensure service levels for business customers are met. Upgrading the service rates are generally performed quickly by the service providers and will increase as the customer base and their bandwidth requirements grow.

### Network Operational Modes

Network Operations are critical to any network deployment. Systems must be monitored and maintained in order to protect the investment and ensure its success.

The deployment of a municipal network will require an operations component that provides the following for the network and customers:

- Network and customer activations
- Adds, moves and changes to the infrastructure as well as to the customer services
- Capacity management
- Maintenance and repair activities
- Customer management including billing
- Wholesale and carrier management

The operational models are dependent on the business service plan that the Town pursues. A Retail service provider model requires a higher level of operations than a wholesale fibre provider model.

There will be a mix of options that the Town can consider with respect to how operations can be supported. The abovementioned activities can be done with a combination of Town resources, partnerships, and service contracts.

**Fibre Network**

The deployment and ongoing support of fibre networks, which includes the conduit and associated civil work requirements as well as recommendations, are detailed in the table below.

Resource	Support Options	Comments
<b>Engineering Design</b>	Contract	After deployment, ongoing engineering work would not require full time resource.
<b>CADD, Records Management</b>	In-House	The Town will require this in-house on existing systems.
<b>Construction Resources</b>	Contract/In-House	Recommend that the Town utilize their existing methodology for construction and placement of conduit, manhole and handholds.
<b>Fibre Installation/ Maintenance and Adds/ Moves/Changes</b>	Contract	After fibre deployment this will not require full time staff.

There are multiple companies that can provide contract services for the fibre network. Larger organizations such as Ledcor Technical Services and AFL Global have excellent representation in Alberta, as well as access to smaller sub-contractors that are regional.

The overall recommendation would be to contract the specific fibre engineering, installation, maintenance, and adds/moves and changes to a single outsourced company.

**Service Electronics Network**

The deployment and ongoing support of the Service Electronics will include access transmission gear, customer premise electronics, management and activation servers, and routers and firewalls.

Each of these components require differing technology skill sets, as well as varying levels of these skill sets. With a 24/7 operational environment, there is a higher level of personnel requirements to manage, and maintain this portion of the network.

The estimated staff requirements for the Town to support this are provided in the table below. These estimations err on the high side in order to ensure adequate staff levels during leaves, etc. Some of these functions could serve dual purposes in addition to relying on vendors to supply support. The initial 6 months of operation could be done on a smaller scale.

Resource	Staff	Comments
<b>24/7 Network Operations</b>	4 - 6	In order to staff a 24/7 centre, operators and supervisors are required and levels must accommodate staff leaves/absences
<b>Network Engineers/ Specialists</b>	1 - 2	Technology experts required for maintaining technology standards, developing services and overall network responsibility
<b>Installation and Repair Technicians</b>	1 - 2	Required to support installation and repair of customer and network services
<b>Server Engineers/Specialists</b>	1	Technology expert to support the server and associated software infrastructure
<b>Total</b>	<b>11</b>	<b>Based on maximum staff counts</b>

There are companies that provide outsourced Network Management and Operations services from a remote location. Most vendors have this offering.

IBI Group has had discussions with O-NET who offer a full service operational model, as well as the ability to white label Internet, Voice and Video services on behalf of the Town.

Benefits of an outsourced model is reduced staff requirements and the ability to use their back office infrastructure further reducing capital costs for management, activation and provisioning tools. The outsource provider would have advanced systems, trained staff, and could manage the capacity of these systems with no impact to the Town.

The Town would still require local technical resources for customer interfacing for sales and service.

### **Other Operational Requirements**

Outside of the technical personnel and systems, the Town will also need resources to run the overall program and have ownership of the Municipal Broadband Network and Services.

Financial oversight will be required.

Management of carrier, vendor and wholesale negotiations and agreements will be necessary.

An initial staged deployment of a broadband service network would require less start up resources, however the Town will need to evaluate additional internal resources, and/or a combination of outside resources.

## Summary Recommended Operating Models

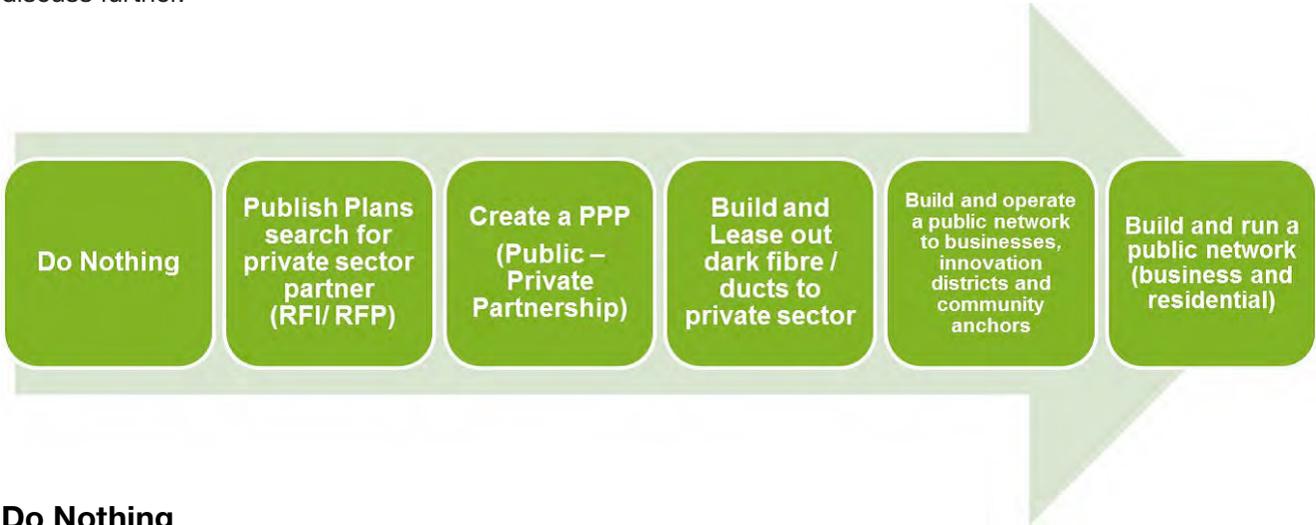
If the Town of Canmore decides to proceed with deploying a fibre infrastructure and provide Broadband services, there are several options/recommendations available:

1. Deploy fibre infrastructure to enable Town services and reduce any third party costs.
2. Identify key deployment locations to maximize commercial customers and anchor clients who require services with a higher recurring revenue. This would be institutions, high density hotels, and business locations.
3. Review the residential model and services that are possible, and evaluate the current incumbent competition.
4. Create interconnections with carriers to enable the Town to provide local loop services. This opens up the town to additional service providers and more competition for commercial customers.
5. Utilize manual provisioning and onboard systems provided with the network service electronics for any initial deployments to reduce costs. In the longer term, further evaluation of Network Operations Outsource companies, or partners would be required to build out a long term operational model.

# 6 | Best Practices Review

## Business Models

There are many options for the Town of Canmore to consider in terms of varying municipal involvement in the ownership and operations of a municipal fibre optic network. The figure below identifies the spectrum of ownership and involvement, which we will discuss further.



### Do Nothing

Under this scenario, the Town would continue to purchase the services it requires from commercial telecommunications providers at the broadband speeds and prices available in the current marketplace.

### Benefits and Risks

This option has the benefit of requiring no investment; however, there is a risk that places the Town at a comparative disadvantage in the long term if commercial telecommunications providers do not make investments in fibre optic infrastructure to support the needs of the Town, local businesses, and residents. Recent discussions with representatives of Telus and Shaw indicate the incumbents do not intend to change their current investment strategies in the Town, so status quo must be assumed.

### Existing Examples

There are numerous examples of municipalities in Canada who have taken a ‘Do Nothing’ approach to date.

### Private Sector Partner (Private – Public Partnership)

Under this scenario, the Town would engage potential partners in the investment and operations of the network by publishing long range plans and soliciting partner interest through a Request for Proposal (RFP) process. Potential partners could participate in the form of providing financing, construction, and/or operational expertise to build and operate the network. Depending on the nature of the partnership, the Town may contribute to the partnership in the form of capital contribution, long term commitments

to purchase telecommunications services or a combination of both. This model is more expensive than direct ownership of assets since private sector partners will want to receive a return (profit) from their investments.

### Benefits and Risks

This option has the benefit of leaving options open for the Town if it is unwilling to commit to a build program, or lacks the available capital to invest in broadband infrastructure. Partners may bring needed construction and/ or operational expertise that the Town requires for such a network. This model creates a shared risk reward scenario for the Town and the partner. Risks involved with this approach include the ability to attract a suitable partner for various reasons (size of the investment, market conditions, etc.), as well as the risk of losing some local control over the implementation of the network, uneven network coverage, etc. Since these arrangements are normally over a period of 10 to 30 years in order to allow for investment recovery and profit, it is important to ensure that long term vision of the partner is aligned with the Town to prevent partnership conflicts. Exit strategies for both the Town and the Partner must be carefully thought through as part of forming the partnership.

### Existing Examples

Examples of the search and implementation of partnership models include the RMWB (AB), the Alberta SuperNet, the SWIFT Network and the Google Fibre Network implementation in Kansas City, MO.

## Build and Lease Dark Fibre / Ducts

This scenario sees the Town making an investment in building fibre optic networks to support municipal connectivity, as well as making build investments to commercial buildings. This is typically driven by commercial demand or private sector interest in purchasing duct or dark fibre capacity to connect to the building. By using municipal connectivity requirements as a network anchor / backbone, and installing additional duct and fibre capacity at the time of construction, incremental extensions to the municipal network can be made, driven by private sector commercial demand. The Town would effectively enter the wholesale telecommunications business, by selling capacity to retail telecommunications providers.

### Benefits and Risks

This option provides the benefit of stimulating and increasing competition for broadband services as it would allow telecommunications resellers to develop and offer services based on a fibre optic network. Incumbents are likely to respond in the form of additional network investments and capacity to maintain their existing market share. The Town retains local control over its assets, and this scenario leaves options open for the Town to both expand the network as needed, or enter the retail telecommunications market in the future. Since ducts and dark fibre have low operational requirements, the Town does not require a large investment in operational staff to pursue this option. Risks with this model are primarily financial. The cost of construction presents a risk that can be managed through diligent procurement and construction management, however there is a longer term risk of demand for wholesale services not meeting initial forecasts, or competitive forces creating price pressure on wholesale services. This may result in underutilized or stranded network investment in the longer term.

### Existing Examples

Reference case studies for this model include QNet in Coquitlam, BC, EPCOR dark fibre services in Edmonton, AB, Rhyzome Networks in Stratford, ON, and municipal network services in Mesa, AZ. The Public Sector Network (PSN) in Peel Region (Ontario) and WREPNet in Waterloo (Ontario) are examples of this approach, however these networks only offer services to other public sector institutions within their municipalities.

### Build and Offer Limited Retail Services

This scenario sees the Town making an investment in building fibre optic networks to support municipal connectivity as well as making build investments to commercial buildings, typically driven by commercial demand. Using municipal connectivity requirements as a network anchor / backbone, and installing additional duct and fibre capacity at the time of construction, incremental extensions to the municipal network can be made, driven by private sector commercial demand. The Town would effectively enter the retail telecommunications business, by selling capacity to retail businesses. At its discretion, the Town could choose to offer services to other public sector partners, innovation districts (as a form of tax incentive) or support other community / social initiatives with broadband connectivity.

### Benefits and Risks

This option provides the benefit of stimulating and increasing competition for broadband services at a retail level. Incumbents are likely to respond in the form of additional network investments and capacity to maintain their existing market share. The Town retains local control over its assets and this scenario leaves options open for the Town to expanded the network if need be. This model may not stimulate the wholesale / reseller telecommunications market (even if wholesale services are offered at reasonable discounted rates) as some resellers may be wary of trying to compete with the Town for commercial clients. Risks with this model are both financial and operational. The cost of construction presents a risk that can be managed through diligent procurement and construction management, however, there is a longer term risk of demand for retail services not meeting initial forecasts or competitive forces creating price pressure on retail services. This may result in underutilized or stranded network investment in the longer term. The Town may not have the expertise to operate retail telecommunications services, so there is some risk in terms of creating operational expertise, attracting and retaining qualified staff and overall operational sustainability. Finally this model will likely result in a direct response from incumbent telecommunications providers in the forms of:

- (i) politically lobbying against the initiative;
- (ii) predatory pricing to retain existing clients; and
- (iii) focused win back programs to incent Town customers to switch back to the incumbent, with one time incentives that the Town may be unwilling to match.

### Existing Examples

Reference examples for this model include York Telecom Network (Ontario), RedNet (Red Deer, AB), networks constructed in Arlington, VA and Washington, DC. Rhyzome Networks in Stratford, ON offers services on a wholesale basis only (to other broadband service providers).

## Build and Offer Full Business and Residential Services

This scenario sees the Town making an investment in building fibre optic networks to support municipal connectivity as well as making build investments to provide universal connectivity to all business and residential customers. Using municipal connectivity requirements as a network anchor / backbone, and installing additional duct and fibre capacity at the time of construction, incremental extensions to the municipal network can be made. The Town would enter the retail telecommunications business by selling capacity to retail businesses and residents.

### Benefits and Risks

This option provides the benefit of stimulating and increasing competition for broadband services at a retail level. Incumbents are likely to respond in the form of additional network investments and capacity to maintain their existing market share. The Town retains local control over its assets. This model may not stimulate the wholesale / reseller telecommunications market (even if wholesale services are offered at reasonable discounted rates) as some resellers may be wary of trying to compete with the Town for commercial and residential clients. Risks with this model are both financial and operational. The cost of construction presents a risk that can be managed through diligent procurement and construction management, however there is a longer term risk of demand for retail services not meeting initial forecasts, or competitive forces creating price pressure on retail services. This may result in underutilized or stranded network investment in the longer term. The Town may not have the expertise to operate retail telecommunications services, so there is some risk in terms of creating operational expertise, attracting and retaining qualified staff and overall operational sustainability. Finally, this model will likely result in a direct response from incumbent telecommunications providers in the forms of:

- (i) politically lobbying against the initiative;
- (ii) predatory pricing to retain existing clients; and
- (iii) focused win back programs to incent Town customers to switch back to the incumbent, with one time incentives that the Town may be unwilling to match.

### Existing Examples

Reference examples for this mode include O-Net (Olds, AB), Bruce Telecom (Kincardine, ON), Electric Power Board (EPB) in Chattanooga, TN and Lafayette, LA.

## Business Model Recommendations

There are several factors that lead to the recommendation that the Town take positive action to improve the state of broadband services. Survey results and bandwidth testing reveal both below average broadband speeds for residents and businesses as well as a strong bias for the Town to take an active role in improving services.

### Do Nothing

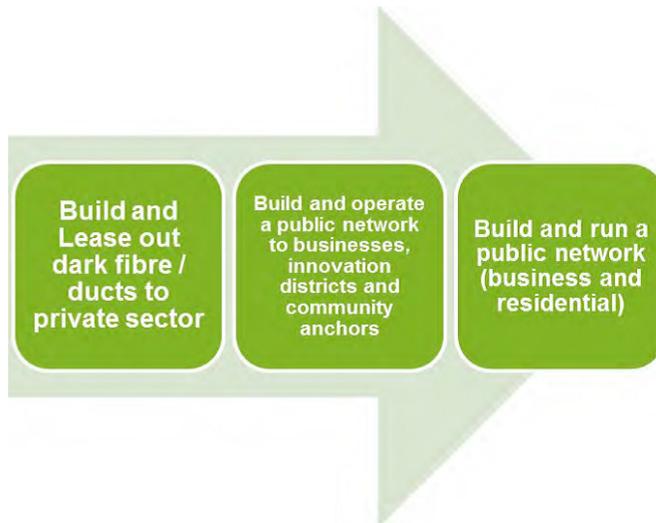
A complete hands off approach will likely result very limited improvement of broadband services in the Town, and as other municipalities begin to take an active role, the Town risks falling further behind national averages for broadband services. **Not Recommended.**

### Private Sector Partner

The market size of Canmore makes it difficult to attract investment partners as most private equity in the municipal broadband space are currently focused on investment opportunities in the \$100M range or greater. The size of the US municipal market dominates the attention of most equity investment in the municipal fibre optic domain, **Not Recommended.**

### Public Private Partnership (PPP)

Again the market size of Canmore makes it difficult to attract the attention of partners in the PPP domain. Within the Canadian context, most PPP arrangements for broadband networks are focused on opportunities in the range of \$200M to \$400M investment. The structures of PPP projects require a significant up front cost to create and this overhead is challenging to the relatively small market size of the Town. **Not Recommended.**



### Build and Lease Dark Fibre

This option is available to the Town and is a relatively low cost/ low risk option as an entry point into offering municipal broadband services. Larger municipalities (e.g. Calgary, Edmonton, York Region) have successfully used this strategy to leverage existing fibre optic network builds for municipal operational needs. Most customers of dark fibre are typically (i) Wholesale purchasers – carriers looking to connect to cellular tower sites or large enterprise customers; (ii) Public Institutions (e.g. schools, hospitals and RCMP) looking for long term, high bandwidth connections between locations and (iii) larger ‘enterprise’ business customers who have the sophistication to implement networking equipment and backhaul strategies to make use of dark fibre connections. While it is recommended the Town offer these services, it is not expected that the demand for these services will be high from the 3 customer groups identified above, and therefore the revenue streams from such services will not be significant relative to the capital investment in the network. **Recommended.**

### Build and Operate a Public Network to Businesses, Innovation Districts and Community Anchors

This option builds on the Dark Fibre option described above and can be undertaken simultaneously with the Dark Fibre approach. This option allows the Town to strategically prioritize areas of focus and align the offering of broadband services with its economic development strategies and priorities. In addition, the Town can partner with other public institutions (e.g. schools, hospitals, etc.) to share costs and enhance community value with their participation. Due to the smaller size of the Town, it is suggested that the town pursue outsource operational agreements with experienced network operators in order to minimize operational costs and the risk of finding qualified staff to support operations. **Recommended with outsourced operations.**

### Build and Operate a Public Network to all Businesses and Residents

This model is simply an expansion of the preceding model “Build and Operate a Public Network to Businesses, Innovation Districts and Community Anchors” and would be implemented using the same parameters as previously described. A ubiquitous network that serves all businesses and residents is an ambitious goal, and should likely be considered in the long range as part of the overall strategy. This approach could be staged in terms of approaching new community developments with this in mind and, over time, implementing the required fibre optic infrastructure in existing developments on a longer term neighborhood improvement/ upgrading program that could be aligned with other road or utility construction programs. **Recommended with outsourced operations.**

## Ownership Structures

In this section, various ownership structures have been reviewed to determine the best approach for the Town’s consideration, ranging from the establishment of an arms-length telecommunications utility that offers services to residents and businesses, to a wholesale provider of fibre optic cable/duct and radio tower capacity. Benefits and risks of each model have been discussed. Functional overview of P3 project model approach along with associated benefits and risks are also discussed in this section. Ownership options are divided into three (3) options:

### Option 1: Arm’s Length Utility

Under this option, Town of Canmore will act as a utility provider with mandate for operations and financial sustainability. Investment will be made by the Town for building the network and the investments will be recouped from the operations. Target set of customers will need to be established (initially municipal partners and businesses). Asset ownership will split from operational entity. The arm’s length utility option will allow selling dark fibre and bandwidth to other service providers and small businesses. It will bring focus and remove perception that Town is subsidizing private business.

Benefits of this approach are listed below:

BENEFITS	RISKS
Targets the immediate needs of the municipal partners by building a purposeful dedicated dark fibre network and selling of bandwidth to TSPs; faster decision making and governance processes.	Overhead costs to establish legal entity, legal agreements, etc.
Lease out dark fibre to municipal partners and let them define the required capacity/bandwidth.	Need to setup a Town organization for profit with a mandate for financial and operational sustainability.
Consolidate other infrastructure development programs to enable efficient builds – e.g. road redevelopment.	Relatively high dependency on financial budgets and other programs.

### Option 2: Town Owned

Under this option, Town of Canmore will invest in building the network and appoint an Operations and Maintenance (O&M) agency for providing services. Town would potentially compete with the other service providers in the vicinity. In this option, Town can target all customers including municipal partners, businesses and residential. This option is comparably slower than arm’s length utility option.

BENEFITS	RISKS
Simplified Ownership Structure.	Capital intensive program requiring strong financial support.
Low overhead costs.	Speed of decision making and governance may not be suitable for the commercially competitive marketplace.

**Option 3: Public-Private Partnership (PPP)**

Under this option, Town owns the network after PPP tenure completion. Town appoints a third party for O & M of the network effectively becoming a bandwidth reseller and can target all customers including municipal partners, businesses and residential. Benefits of PPP option are listed below:

BENEFITS	RISKS
Target all potential users and act as an owner.	Limited investment still can be large as currently no incentive for service providers to build their fibre network.
Invest in only limited part of the community to cultivate equitable access to broadband network.	Market acceptance of such a model in Canmore may require further analysis and buy-in.

**Ownership Structure Recommendations**

In our experience with municipal ownership structures for broadband assets and infrastructure, many municipalities begin with a Town Owned (Option 2) approach in order to minimize startup costs and complexity and allow a focus on internal connectivity requirements. As these Towns evolve to service providers (e.g. leasing of Dark Fibre and delivering broadband services) we feel it is strategic to transition to an Arm’s Length Utility structure (Option 1) as quickly as possible in in order to achieve the following benefits:

- Creates financial transparency in that the broadband utility must set rates for services that recover all costs
- Allows for flexibility in managing the operations of the utility in terms of adjusting rates to reflect market pricing, entering into revenue and supply contracts on procurement terms that are competitive with the telecommunications industry
- Provides council oversight into operations and financial matters without the need to involve council to create additional bylaws to establish rates for new service offerings or unique revenue contracts that may be negotiated
- Creates a corporate entity to hold the assets and operations of the network such that, if desired, an exit strategy from the broadband services business could be executed involving the sale of the assets, customers and operational contracts to a private sector entity.

## Selected Case Studies

This section provides some additional information on selected municipal networks.

### Rhizome Networks – Stratford, Ontario

Rhizome Networks is a data infrastructure utility which is owned by the City of Stratford. It operates independently while being a part of Stratford's overall broadband strategy for economic development.



It launched as a commercial and residential Internet Service Provider (ISP) in 2011 to the public in the City of Stratford. Rhizome Networks operates a 70km loop of data transmission optical fibre cable running throughout the city, and has built a city-wide wireless network that accesses the fibre grid to provide mobile high-speed Internet access through Wi-Fi at over 400 access points across the city and six smaller rural communities.

Rhizome Networks developed a wireless network using wireless mesh technology as part of an initiative to connect all the residential and commercial energy meters, which were installed in the city-wide. Rhizome Networks further became a wholesale service provider for fibre and Wi-Fi to other ISPs in the region as well. Services like dark fibre, lit fibre and co-location (for other service providers) are also provided by Rhizome Networks.

#### Governance Model – Municipal Only

Rhizome Networks is a subsidiary of Festival Hydro Services Inc. (FHSI), which itself is owned by the City. Rhizome Networks was originally created to meet the demands of the Provincial government's mandate to switch all residential energy meters to smart meters. By leveraging the infrastructure developed to connect all smart energy meters, Rhizome Networks started offering broadband and Wi-Fi services to other ISPs and the public.

Rhizome Networks worked in collaboration with private parties including Motorola and Solution Inc. to build a city-wide wireless network. A city-wide municipal services network based on Motorola's 802.11n Mesh Wide Area Network (MWAN) technology was used by the city that supported both smart metering and high-speed mobile Internet access. Further, the city works in collaboration with Solution Inc., which is responsible for billing, location based marketing and registration of users over the Wi-Fi Network.

#### Financial Indicators

\$1.2 Million was invested by 2009 in fibre optic network by the City. Financial statements of Rhizome Networks are published as a part of Festival Hydro Services Inc. (FHSI). Last financial statement was published in 2015.

#### Benefits to the Community

Rhizome Networks has been one of the initiatives taken by City of Stratford for their Smart City Programme. Wireless broadband initiatives have been able to stimulate economic growth by attracting and retaining businesses. Since the deployment of wireless networks was planned as part of smart metering network, it has been beneficial in promotion of electricity conservation, and accurate forecasting and billing for residents and businesses among other benefits. Through the high speed wireless network, the entire community has access to all of city services, library and other local services

electronically which has further improved the inclusiveness of the community. Stratford is also a strong candidate for testing of self-driving cars due to availability of city-wide wireless network and was recently featured as a 'test city' by the CBC.

## **WREPNet – Waterloo, Ontario**

WREPNet (Waterloo Region Education and Public Network) is a partnership between the Region of Waterloo, City of Kitchener, the City of Waterloo, the City of Cambridge, the local school boards,



Waterloo library boards and Conestoga College, which implemented and operates an affordable, dedicated, high speed fibre optic network to the educational and public sector institutions within the Region of Waterloo. This fibre optic network, which is referred to by the acronym of WREPNet, is widely utilized and has grown from the original 227 sites to over 325 sites since its launch in 2000.

Original vision behind the development of WREPNet was to link public organizations in the Waterloo region via a dedicated high speed network. Prescient International Inc. partnered with Waterloo Region District School Board (WRDSB) and the Waterloo Catholic District School Board (WCDSB) to design and implement the network.

After development of the business case and design of the network, tenders were floated, after which WREPNet partnered with Atria Networks, MFP Financials and other sub-contractors for implementation of the network.

Each partner's staff and clients have access to the network. Decision is made by each partner on what services and information is made available to its users.

### **Governance Model**

Each partner in WREPNet shares the development, operation and maintenance cost of the network. The partnership created a governance model comprised of committees and teams with all WREPNet partners. The governance model was established to facilitate business and technical planning processes for development of the network. It was also established to ensure the thorough participation of all WREPNet partners in the processes used to define technical solutions and make business decisions about the approach used in defining, implementing and managing WREPNet. Governance model consisted of following committees:

#### *Steering Committee:*

The Steering Committee, co-chaired by the Superintendents of Business from WRDSB and WCDSB, comprised of Chief Financial Officer (CFO) level representatives of the WREPNet participant organizations. The committee provides an overall corporate direction and oversight to the project and program resources and was the top approval body.

#### *Business Planning Group:*

The Business Planning Group (BPG), co-chaired by the WCDSB Chief Information Officer (CIO) and the City of Kitchener Director of IT, comprised of IT Directors and managers from the participant organizations and Prescient International. The BPG provides operational direction to the project, reviewing all technical and business subjects and made recommendations to the Steering Committee for approval.

*Technical Team:*

The Technical Team comprised of IT technical staff of the WREPNet participant organizations and Prescient International. Technical experts from Prescient International and vendor organizations provide direct consultation to the Technical Team. The Technical Team is co-chaired by the City of Kitchener Technical Support Supervisor and the WCDSB Manager of Technical Support Services. The purpose of the Technical Team is to solve technical problems and make recommendations to the BPG on technical issues and subjects.

*Project Management Office:*

The Project Management Office (PMO) comprised of key representatives of the WREPNet partnership and the business partners. To ensure the utmost continuity between the Business Planning Group, Technical Team and the PMO, the co-chairs of both committees are present on the PMO. Considering the number of board sites to be implemented, one Technical Team representative from the Waterloo Region District School Board is also present on the PMO. The PMO is responsible for the day-to-day management of the network implementation and ended once full implementation had been achieved.

WREPNet has a lease agreement to supply and maintain dark fibre optic cabling for the WREPNet network. The original agreement was signed between the partners and Fibretech Telecommunications Inc. on August 1, 2000. This agreement was then assumed by Atria Networks in 2005, which was then acquired by Rogers Communications Partnership in 2013. This agreement was renewed in August of 2006, and again in November of 2010.

WREPNet also has an agreement to provide support and implementation services and management of the overall network for the partners. The original agreement was signed between the partners and Unis Lumin Inc., and was assumed in 2011 by Softchoice LP. This agreement was renewed for a five year period beginning January 1st 2016.

There exists a cost sharing agreement amongst the partners based on number of sites. This agreement outlines the responsibility of each partner to manage billing of the agreements made with Rogers Communications Partnership and Softchoice, and all shared costs are broken out by partner on a per site basis.

The Region of Waterloo coordinates renewals of contracts on behalf of the WREPNet partners for lease agreements and management of network. Partners are a participant in voting for the renewal agreements.

**Financial Indicators**

Ministry of Education in Ontario provided a one-time infrastructure grant of \$10 Million for implementation of the network around the year 2000. Expenditure by the Region is catered by 2015 Information Technology Services (ITS) Operating Budget. Financial statements regarding the costs/benefits are published by some partners. Key financial indicators of the agreement of WREPNet with Rogers and Softchoice over their last five year contract is presented below.

PARAMETER	VALUE
Total cost for WREPNet partners (Contract with Rogers)	\$2,206,634 annually
Total cost for Region (Contract with Rogers)	\$415,449 annually
Total cost for WREPNet partners (Contract with Softchoice LP)	\$685,649 annually
Total cost for Region (Contract with Softchoice LP)	\$129,087 annually

**Benefits to the Community**

WREPNet led to economic growth and development to the Region while reducing the costs of broadband connectivity for partners and providing advanced services to citizens through electronic delivery of services.

The cities and the Region use WREPNet to manage and access internal data that is needed to conduct their day-to-day business. The libraries use the network to provide Internet-based products and services directly to their customers.

**Public Sector Network (PSN) – Peel Region, Ontario**

PSN is a formal partnership which was created to provide a shared fibre optic network between the Region of Peel and its municipalities. Ownership of the network is limited to Region of Peel and Municipalities within the Region, consisting of City of Brampton, City of Mississauga, and Town of Caledon.



PSN was launched in 1999 and has a fibre optic network of approximately 693 km (96 count) with a majority of network (almost 90-95%) being aerial installation (hydro utility poles were the major facilitators), connecting almost 580 partner sites and 18 subscribers by 2015. It is mainly a dark fibre network where any public sector agency working within the Peel Region can have access to this network through the partners.

**Governance Model**

PSN is a non-dominant telecom carrier registered with the CRTC. Each partner is responsible for implementation and maintenance of fibre optic network within its own boundaries and maintains ownership of what is built within their respective boundaries. Included under the municipal umbrella are various services operated by related boards and commissions, including Police, Fire, Transit and Libraries. The municipalities contribute to the development of the PSN through their respective municipal budgets. Each Partner complies with the common design, construction and operating standards and must grant access to the network to all other partners and subscribers. Each partner also assumes a lead role in one aspect for the business, as follows.

- Region of Peel is responsible for administration, contracts, legal agreements, marketing and subscriber relations
- City of Mississauga is responsible for network repair and maintenance
- Each municipality is responsible for new construction within their regional boundary.

PSN is for the “business use” of the participating organizations, primarily for communications between their own facilities to conduct every aspect of municipal business. Spare fibre is made available for the use of other partners on a case-by-case basis. Through these builds, the partners are able to connect various subscribers within their respective municipal boundaries which results in revenues for the partners. Examples of the partners include:

- Region of Peel
- Peel Region Police
- City of Mississauga
- City of Brampton
- Town of Caledon

The following are some of the requirements needs to be fulfilled by the subscribers to become part of the network:

- Only public sector organizations are eligible to become PSN subscribers
- Subscribers are responsible for all costs to connect to the network. They must also pay an annual access fee, which is set at a fraction of commercial rates for dark fibre. Fee structure of PSN is based on an allocated share of long term amortized costs for network construction, maintenance and replacement.
- Where a subscriber builds an extension to PSN to connect one or more of its facilities, PSN may assume ownership of the extension, if it wishes to make it available to other users. In such cases, the subscribers are fully compensated for its construction costs through a reduction in its annual fees.
- Subscribers must accept that PSN is a co-operative in spirit, if not in legal form. Since it is providing access to public sector organizations, essentially at cost, the partners do not accept the same legal liability as a private carrier.
- Ultimately, the subscribers pay for connecting the PSN to their respective sites called as subscriber sites, which contribute to the revenues for PSN.

Following are the examples of some of the subscriber sites who are part of PSN:

- Sheridan College
- William Osler Health Centre
- Trillium Health Centre
- Credit Valley Hospital
- University of Toronto, Mississauga Campus

### **Financial Indicators**

\$17 Million has been invested by the Partnership till 2015 for development of the PSN. Subscriber sites such as Sheridan College, Trillium Health Centre which are connected to the network, are responsible for all the revenue generated by PSN.

Subscriber revenue and expenditure statements are published by the Partners, latest in 2014. Subscriber revenue of PSN for 2014 is presented in below:

SUBSCRIBER SITES	REVENUE
Sheridan College	\$82,200
University of Toronto	\$6,024
Trillium Health Centre	\$64,509
William Osler Health Centre	\$62,796
Credit Valley Hospital	\$159,458
<b>Total</b>	<b>\$374,987</b>

PSN achieved break-even in 2014 and has accrued a reserve fund of \$469K by that time.

The Reserve Fund balance at the end of 2015 is approximately at \$490K.

In accordance with the PSN Partnership Agreement, subscriber revenues are applied to offset shared costs for operation and support of the network, thereby reducing the partner's cost of ownership.

### Benefits to the Community

PSN has been able to bring administrative efficiency within the Region and has provided the ability to share data amongst the partners and subscribers at a minimal cost. It has been able to cultivate a program within a Region where various municipal and public sector partners have a shared vision of a fibre optic network and invest financially to support this build through contributions from their respective budgets.

### QNet – Coquitlam, British Columbia

The Coquitlam Optical Network Corporation (QNet) is a wholly owned subsidiary of the City of Coquitlam which provides businesses, schools and residential high-rises with access to high speed broadband access through City's state of the art fibre optic network.

QNet leases unused capacity in the city's carrier-grade fibre optic network to telecommunications companies that offer high-speed internet, phone, TV/video and cellular services in Coquitlam.

Coquitlam began running ducting throughout the city in the 1980s for the traffic signal system, later taking advantage of this underground network to install carrier-grade fibre optic cabling to support traffic cameras and telecommunications services in city facilities. To leverage a considerable amount of unused capacity of fibre network, QNet was formed in 2008 to lease out the unused fibre optic capacity to competitive telecom service providers with the aim of enabling economic growth and development by providing accessible and affordable broadband services across the city.

Length of QNet's fibre optic network is approximately 60 km which covers almost the whole of the community. Eight telecommunication companies are operating in Coquitlam by leasing dark fibre from QNet. Data centre co-location services are also available to QNet subscribers.



**Governance Model**

Coquitlam City Council is the sole shareholder of QNet. It is registered as a non-dominant telecom carrier required to file annual reports with the CRTC, and is governed by a Board of Directors. Internal organization of QNet consists of the following teams:

- Council and Executive Team – responsible for shareholder and board oversight
- Financial Services – responsible for accounting and billing
- Economic Development – responsible for business and economic development
- Corporate Communications – responsible for branding, advertising, media relations
- Planning and Development – responsible for developer relations, bylaws and policies
- Engineering – responsible for design, permitting, GIS and infrastructure installation
- Facilities – responsible for data centre and co-location facilities support
- ICT – responsible for business systems, cable management software and website

**Financial Indicators**

QNet is economically dependent on City of Coquitlam for its operation. \$5.1 Million was provided by the city (20 years loan) for start-up costs etc.

QNet became cash positive as of 2013 and started repaying its loan.

Yearly financial statements are published by QNet, with latest one being in 2014. Key financial indicators of QNet for the year of 2014 are presented below.

PARAMETER	VALUE
Total Revenue	\$434,060
Operating Expenses	\$168,158
Earnings before adjustments	\$94,341
Cash flow surplus	\$26,369
Loan Balance	\$5,171,033

**Benefits to the Community**

QNet has played a critical role in attracting and retaining businesses, and residents due to the availability of high-speed Internet and data centre co-location services, which has led to city’s economic growth and job creation. QNet realized the City of Coquitlam total annual operating savings of \$360,000 on telecom costs since its launch in 2008. QNet’s dark fibre network has enabled competition among ISPs which has resulted in improved choice and prices for the businesses and residents of Coquitlam, connecting more than 2,500 businesses and 20,000 homes in residential high-rises.

## EPB – Chattanooga, Tennessee

Electric Power Board of Chattanooga (EPB) is an electricity distribution and telecommunications company owned by the City of Chattanooga, Tennessee which acts as an ISP (also provides phone and TV) to residents and businesses.

EPB was established in 1935 as an Agency of City of Chattanooga for the sole purpose of providing electric power. In 1996, Board of EPB decided to connect the electrical assets through a communications network. Upon implementation, the communications network was under-utilized, which resulted in EPB entering into the telecom business in 2000 by launching EPB Telecom that provided telecommunication services to local area businesses.

EPB, as a part of the smart grid initiative, started installing fibre optic cable to connect all smart energy meters in the City. EPB leveraged the fibre installed for this project and launched Fibre to the Home (FTTH) service to residents and businesses in 2009 as ‘EPB Fiber’. Today, the fibre infrastructure has grown to approximately 12,900 km and connects almost 61,000 homes, 5000 businesses and all the smart meters within the City and is considered to be the first city in United States to offer Gigabit internet service.

### Governance Model

EPB is a non-profit utility owned by the City of Chattanooga and is governed by a five member board appointed by the City of Chattanooga.

Internal organization of EPB consists of the following teams:

- President and Chief Executive Officer
- Finance and Chief Financial Officer
- Economic Development and Government Relations
- Strategic Systems
- Customer Relations
- Corporate Communications
- Strategic Research
- EPB Fiber Optics
- Human Resources
- Information Technology and Chief Information Officer
- Marketing
- Technical Operations
- Field Operations

### Financial Indicators

\$330 Million USD were invested for the deployment of smart grid and Gigabit broadband service. Out of this amount, \$111.5 Million USD was provided by the federal stimulus funding from the U.S. Department of Energy. To raise additional funds needed to build the fibre optic network, EPB issued \$229 Million USD of local revenue bonds in 2008. About 70% of this bond issue (i.e. approximately \$162 Million USD) was used to fund the



fibre optic build out. By 2012, EPB’s ‘Fiber Optics Division’ had borrowed approximately \$50 Million USD from the Electric Division to finance the costs of adapting the broadband network to provide telecommunications services to its customers.

Financial statements of EPB is published every year, which includes the financial performance of ‘EPB Fiber’. Key financial indicators for the last financial statement in 2015 is presented below:

PARAMETER	VALUE
EPB Fiber Optics Revenue	\$118.2 Million
EPB Fiber Optics Expenses	\$101.3 Million

**Benefits to the Community**

Broadband initiatives have helped to spur economic development in Chattanooga which has been vital in attracting new businesses and in generation of jobs. The community has greatly benefitted due to wide-spread access to affordable high speed fibre optic Internet. An independent study shows the city-owned utility’s fibre optic infrastructure has generated \$865.3 Million USD to \$1.3 Billion USD in economic and social benefits in the areas of education, healthcare, businesses, arts, wired and automated homes and municipal services while creating between 2,800 and 5,200 new jobs. Smart grid and the fibre communications network has been instrumental in improving services to electric utility customers. The smart grid system uses fibre network to analyze power parameters from smart meters about distribution and consumption of energy on a real-time basis because of which has resulted in providing efficient and optimized services to the community and has delivered \$237 Million USD in benefits that include avoiding power outages.

# 7 | Broadband Strategic Plan Recommendations

## Broadband Strategic Plan Recommendations

Based on the findings from the survey results and the bandwidth tests performed, the state of broadband within the Town is below Canadian averages, and well below the internet basic service standard identified by the CRTC in 2016. There is also a strong indication from the community that they want the Town to take an active role in improving broadband services to businesses and residents.

The following summary recommendations identify standards and policy recommendations that the Town should consider adopting. We recommend developing a fibre optic backbone and distribution network within the Town that would support the Town's needs for decades to come and position it with an open network approach to facilitate future development. Further recommendations include:

### Recommended Broadband Standards

1. That the Town adopt broadband standards identified in this report to move it from its current state of average 14.8/ 7.3 Mbps (download/upload) towards increased speeds of 100/20 Mbps and future symmetrical speeds of 1000/1000 Mbps. These standards would apply to existing Town facilities and provide guidance on any future investment or partnership with other providers that are focused on delivering services in the Town. These new standards would be phased in over several years, as the Town will require a fibre optic backbone network to support these speeds.

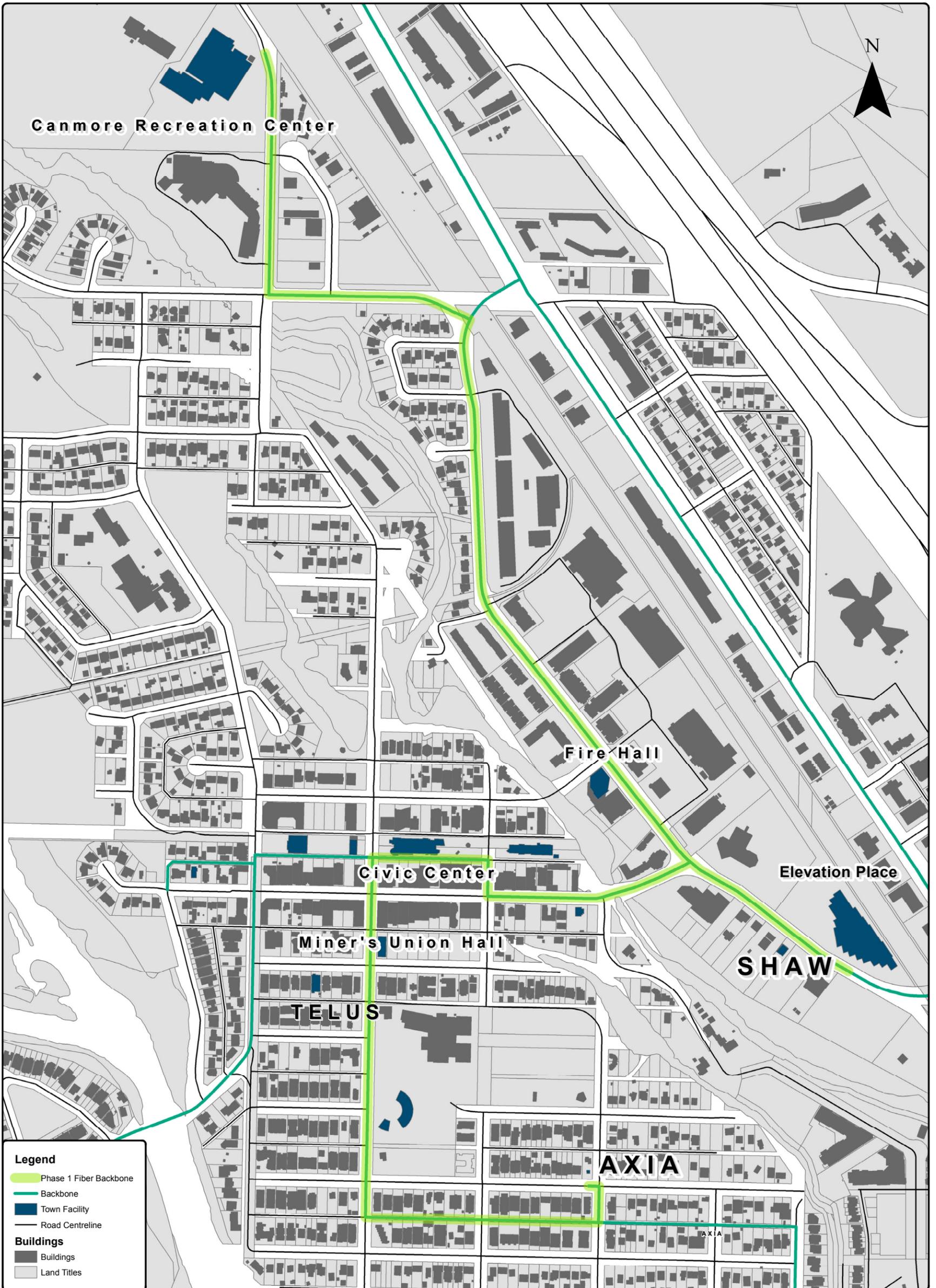
### Town of Canmore Recommended Broadband Standards

Metric	Current State	Proposed Standard (2017)	5 Year Target	10 Year Target
<b>Average Download / Upload Speed</b>	16.0 / 7.5 Mbps	100 / 20 Mbps	1 / 1 Gbps	10 / 10 Gbps
<b>% Above 15 Mbps Download</b>	32%		40%	80%
<b>Latency (North America destinations)</b>		Less than 150ms		
<b>Reliability</b>		99.99% service uptime with a mean time to repair (MTTR) objective of 4 hours		
<b>Open Access to Carriers</b>		Yes		
<b>% of Properties Connected</b>			90%	100%

## Construction of a Fibre Optic Backbone

2. The construction of a fibre optic backbone network be planned and budgeted to connect Town facilities. This would also provide an anchor investment enabling the extension of a future fibre optic distribution network to businesses and residents, either by direct Town investment or by 3rd parties, who could license dark fibre capacity on the Town's backbone and construct network extensions from the backbone. A recommended Phase 1 backbone would connect key Town facilities on the west side of Highway #1 and provide an interconnection to the long haul network providers located in the Town, namely Axia, Shaw and Telus. The fibre optic backbone is estimated to cost \$2.2M which could be spread over several years. The initial Phase 1 network is estimated to cost \$334,000. Please see **Exhibit 5**.

# Town of Canmore Backbone



## Improved Broadband Services to Businesses and Residents

3. IBI Group recommends the Town pursue a further evaluation of a pilot project to provide broadband services to businesses and residents within close proximity to the fibre optic backbone identified in recommendation #1. Additional efforts would need to be undertaken to fully develop the business case, based on expected take rates and business/ resident adoption, as well as the additional costs of service electronics and operational costs for fibre optic network maintenance (locates and repairs), operational costs to operate the network and provide broadband services. Due to the relatively small size of the market within the Town, it is recommended that that Town pursue an outsource arrangement with a broadband operator to minimize the fixed operational costs of supporting such a network. In Alberta, O-Net (Town of Olds) does provide these services on an outsource basis. The development of the business case would further define outsource options (vendors) as well as outsource costs based on the scope of the trial and the number of customers that are forecasted. The creation of a detailed business plan to support this pilot is recommended.
4. It is recommended the Town adopt the following business approaches to achieve improved services, including the sale of dark fibre services as well as the offering of broadband services to businesses and residents on selective basis with a view to providing services of a ubiquitous nature in the long term. This business approach would be best executed using an Arm’s Length Utility structure.
5. Pending the success of the pilot identified in recommendation #3 above, should the Town wish to pursue a Town wide broadband program for businesses and residents, high level capital investment program costs have been identified as:

Backbone:	\$2.2M
Businesses:	\$1M
Residential:	\$11M
<b>Total:</b>	<b>\$14.2M</b>

## Funding Sources

6. Investments in municipal broadband networks have been identified as eligible under many federal government infrastructure programs such as the Building Canada Fund and the Connect to Innovate Programs. These programs do require provincial matching dollars, so planning and coordination with provincial representatives is required. Follow up is recommended to determine program eligibility and timing.
7. Internet as a Basic Service (Telecom regulatory policy CRTC 2016-496): in December 2016 the CRTC announced this policy which provides for broadband internet as a basic service, defined as 50Mb/s download and 10Mb/s upload. The announcement created a fund of \$750M over the next 5 years to support investment in broadband networks to achieve these service goals. Announcements are expected in late 2017 to define the details of the funding mechanisms that will be available and eligibility of broadband projects to receive consideration for funding. Follow up is recommended to determine program eligibility and timing.

8. On November 23, 2017 Infrastructure Canada announced the details of the Smart Cities Challenge program. Preliminary information on this program indicates that the intent of the Smart Cities Challenge program is to fund investments in technology that would require the use of broadband services, however, the Smart Cities Challenge program would expect that municipalities use existing programs, such as the Connect to Innovate and Internet as a Basic Service (referenced in items #6 and 7 above) to fund investments in broadband networks.

### **Dig Once Policy**

9. It is recommended that a Dig Once Policy be reviewed by the Town's engineering department to support the inclusion of underground conduit, handwells (splice/access boxes) in any Town road works, bridge or utility projects that involve the excavation of roadways, trenching on public rights of way, etc. Specific recommendations on conduit sizing and handwell placement are provided in section 3 of this report.

# APPENDIX A | Broadband Survey Comments

The Broadband Survey enabled participants to provide comments for certain questions posed. This was intended to provide additional context with respect to those questions.

The following are the specific questions and unedited feedback that was provided for the residential and business surveys.

## Residential Survey Questions and Comments

### Question

If available, would you upgrade your internet service (Yes/No)? Please comment why or why not?

### Responses

Yes	Currently unreliable
Yes	Need a better speed
No	Cost
No	Current speed is more than fast enough.
Yes	Faster and more reliable for wi-fi
Yes	If the price is reasonable, I would consider it as I have found that a given speed can seem to slow over time.
Yes	Community based internet services are great : local business.'
Yes	Currently unreliable
Yes	Feed a better speed
No	Cost
No	Current speed is more than fast enough.
Yes	Faster and more reliable for wi-fi
Yes	If the price is reasonable, I would consider it as I have found that a given speed can seem to slow over time.
No	What we have suits the needs fine. We are paying a promotional price of less than \$55/mo. Want to get the best value for the price. Once the promotion period is up we will negotiate the best rate as valued customer. Shaw will provide a discount if you ask for it. I am completing this survery remotely so not using the Canmore internet connection.
	My husband and I both often work from home and all our business is done online (email, software, video chat, etc)
Yes	As more and more family members are using internet based services, and that the majority of our media consumption is online, having a fibre optic based system would be ideal for our household
No	Satisfied with existing service

Yes	I would pay more to upgrade IF I was guaranteed to receive a lot faster and much more reliable internet service.
Yes	At peak times our internet is pretty much useless
Yes	Faster, better, more reliable, cost for value
No	I would not want to pay twice as much as I do now.
No	Shaw 150 is too expensive for the product offering
Yes	When i work from home i need the same good connection i get at work
Yes	Unreliable international video calls and streaming.
Yes	The internet I have with Telus is horrible.
Yes	Capacity and demand is always moving forward
Yes	I use it for work.
Yes	Currently on 25 as Telus can't provide more - only paying \$33/month as long customer - can't justify much more money to switch to Shaw at least at the moment
Yes	I'll take the best service for the money
Yes	If I can get a faster service for less cost. I am on Shaw cable.
Yes	Speeds too slow
Yes	Only if the price was right...
Yes	I would be very interested in upgrading to a type of fiber optic service.
Yes	It would make everything easier and faster
Yes	I'm opening an online business that will need more
Yes	Price is restrictive for upgrade however would prefer faster speeds
Yes	Under the current pricing model, upgrading is not an option. Were prices to lower, I would gladly upgrade to a better internet package.
Yes	We work from home often for our jobs.
Yes	Extremely poor value for money
Yes	For a reasonable price I'd love faster internet
Yes	Our speeds, bandwidth limitations, and prices are ridiculous when compared to the US, but we have no choice.
Yes	More speed is better, right?
Yes	I always upgrade to the fastest service available.
Yes	Depends on the Price.
Yes	great if faster speed where available
Yes	To get faster service
Yes	We have the top Shaw bundle and it still sucks.
Yes	I would upgrade if I thought I could get more reliable service (i.e. fewer service outages). I don't care as much about speed.

Yes	Would prefer fibre optic available in other communities
Yes	Current speed far too slow and intermittent
Yes	I would upgrade only if I were not paying more than I am currently. It would make working from home more efficient. Some tasks are current not possible at home due to slow upload and download speeds but it hasn't been a deal breaker yet.
Yes	I could do with a faster connection
Yes	Not at an additional cost to current billing, but rather new billing to replace current billing. \$30 is more than an adequate charge.
Yes	Because the internet we have we are paying for quadruple the speed we are actually getting
Yes	Looking for improved reliability and consistency. Hoping for better customer service as well.
Yes	Latency is quite high which sucks for gaming, the delay between sending a message to the game server and getting an answer back
Yes	better speed
Yes	Depending on price and features
Yes	Get rid of Cable TV, and put that towards internet
Yes	I use VPN along with other applications and more speed will make them work better. In the future, there is only going to be more and more emphasis on high speed internet access
Yes	Need better speed and reliability
Yes	We are very happy with our internet, so it would depend on price and how much faster a new connection would be.
Yes	In a second, Shaw loses signal all the time and cut their packages to force everyone onto the internet 150 package
Yes	Only if the price didn't increase
Yes	Can always be better
Yes	depedning on value of the upgrade
No	Very satisfied with current service
No	Just started a 2 year contract but would change after.
Yes	Looking to cut the cable cord
Yes	I would love a faster service
Yes	We would upgrade only if it made financial sense, possibly bundling television and phone services.
Yes	Better speed for same or lower price.
Yes	Work from home. Require internet to connect to corporate network
Yes	Speed is not consistent. I rarely get close to the bandwidth I pay for.
Yes	Depend on speed / price increase

Yes	Probably mostly that it would increase capacity, i.e. it slows down sometimes.
Yes	I need fast, reliable internet for my online job and connecting with clients.
Yes	I send a great deal of time online and it is frustrating and time wasting to have to wait for connections/ pay for a sub-par service
Yes	I want faster internet
Yes	I don't have a hardline, I have a tiny data cap on terrible speeds
Yes	Speed is imperative both up and down, especially for videography
Yes	If it's available at no cost, why not?
Yes	To improve service
Yes	Not satisfied with existing connection
Yes	Fiber Optic would be great
Yes	Current service is unreliable. It keeps going in and out. Not adequate. for current contemporary data requirements. Quick note...I can't do the speed test right now because my internet is down, so using Rogers LTE on my phone.
Yes	It actually depends on how much it costs versus how much better the service would be
No	Current service is great
No	No need to change
Yes	We both need it for our jobs, working from home. Need speed and reliability.
Yes	Speed
Yes	My internet connection continually drops, making my video calls painful. I also work on the g-suite for my company so all docs all cloud-based. When my internet drops I can't work on my docs. This happens multiple times throughout the day.
Yes	I pay too much at the moment and want cheaper, better service.
Yes	There is faster packages available (and cheaper) but not in our area.
No	I already have excellent internet service for about \$75 per month.
No	150 Mbps is plenty fast. Nobody needs today more than that.
No	Speed is adequate
Yes	Would like better speed and no monthly limit
No	Very satisfied with present Internet service
Yes	Internet is essential in daily life nowadays. I live far away from my family and to be able to have a clear Skype phone call would be amazing. Right now we spend almost \$200 on internet using Rogers data hub stick, as there is nothing else available (that actually works).
Yes	The internet can be too slow in canmore at peak times to stream movies, which is what most of my internet consumption is.
Yes	Access to high speed internet is a necessity in today's economy

## Commercial Survey Questions and Comments

### Question

What is your current internet service download speed in Mbps (Megabits per second)?

Participants were able to provide a number, or U, if unknown.

### Response

'u - it doesn't matter. It's so slow at times, it's dysfunctional'

### Question

What is your current internet service upload speed in Mbps (Megabits per second)?

Participants were able to provide a number, or U, if unknown.

### Response

'u - it doesn't matter. It's so slow at times, it's dysfunctional'

### Question

If you had access to a higher speed (e.g. 100 Mb/s or greater) reliable internet connection, would it allow you to operate more efficiently?

### Responses

'My digital team and contractors being able to load and upload webpages faster means their work gets done faster, cutting down on the hours I have to pay them for.'

'We pay contractors and employees who rely on the internet. Slow speeds results in longer times required to perform the work.'

'not yet, anyway'

'based on what you've said it will only increase my costs'

'Bandwidth is not as important as latency. Latency could potentially allow working faster.'

'Speed up access, downloads, etc less time waiting'

'We lose transactions for our POS machine, as well as waiting to process basic online actions for our programs.'

'cheaper cloud services, offsite hosting and backups.'

'Need 100/100 synchronous service for corporate WAN functions'

### Question

If you had access to a higher speed (e.g. 100 Mb/s or greater) reliable internet connection, would it allow you to grow your business?

### Responses

'maybe in the future'

'Mostly useful for management'

'Fast, effective internet is a bedrock for business moving forward.'

'Don't know'

'Would make Canmore office more attractive to host more employees and business'

**Question**

If you had access to a higher speed (e.g. 100 Mb/s or greater) reliable internet connection, would it allow you to provide improved customer service?

**Responses**

- 'don't need upload speeds faster than 100mps'
- 'not necessarily'
- 'Less hassles and dealing with down internet.'
- 'Currently speeds are limiting factors to buysiness growth in Canmore'

**Question**

What other changes would it allow you to make to your business?

**Responses**

- 'Offer wifi to customer'
- 'Offer our services to a wider range of clients.'
- 'We would actually be able to work with files on our company network, rather than having to do everything on the individual computer, which is unbacked up and at risk of loss of files.'
- 'Faster working speeds for employees/contractors = more efficiency. Better user of video to sell our business. Better use of cloud services.'
- 'Increase team productivity/satisfaction'
- 'work efficiently and faster and increase productivity.'
- 'go out of business'
- 'utilize more cloud services'
- 'Offer wi-fi services to customers, allow faster processing'
- 'Allows more cloud services and lower operating costs.'
- 'We would be able to work with files on our company VPN, rather than having to do everything on the individual computer, which is not backed up.'
- 'Faster payment processing'

**Question**

If available, would you upgrade your internet service? Please comment why or why not?

**Responses**

Yes	We have actually been planning on orgnaising the businesses of Bow Meadows Cres in order to petition the ISP to run better service to Bow Meadows Cres from Glacier Drive.
Yes	We need this to operate more effectively at this location.
No	Don't need more than wat I have

Yes	As above. Only improved latency would make a difference.
No	Cost
Yes	Currently unreliable
Yes	Need a better speed
No	Cost
No	Current speed is more than fast enough.
Yes	Faster and more reliable for wi-fi

**Question**

Do you feel the existing internet service providers will be willing or able to provide you with the speeds and reliability that you will require in the future (five years)? Yes/No was indicated by IBI Group with the comments from a Yes/No indication provided by participant.

**Responses**

Yes	We are unable to attract clients who need broadband in their daily scope of work e.g. software programmers and writers.
No	My blood pressure goes up when I have to deal with crappy internet and it takes away productivity when dealing with it.
No	Me and my team work building websites, uploading content and downloading files constantly. The slow speeds and unreliability of the internet on Bow Meadows Cres is a huge limitation to how quickly and effectively we can work. Disconnection is frequent, (often when the weather is bad), which results in loss of work and wasted time waiting for the internet to go back online.
No	We are the entire marketing and sales team for a very large company. We build, update, and run our websites, video streaming platforms and other web services. We also have a team of 30 + people who rely on reliable and fast internet to do our jobs on a daily basis. Without it we are sitting ducks.
No	Low reliability, regular slowdowns means we can't reliably use IP phones, conduct regular business or produce/consume/upload video.
	I am constantly email clients, providing large documents, files, and videos. The consistent disconnection is a loss of productivity, work, and wasted time while waiting for the internet to com back online.
No	The connection is unreliable and slow. Getting booted from phone/online meetings. As my job role is carried out online, not having access to services hosted online is an issue. Wait time because of slow internet decreases productivity.
Yes	They're not
'No	So Slow! Data transfers incredibly frustrating
No	Decreases quality of VOIP services, slow downloads, decreases ability to work remotely (accessing systems over VPN)

No	Quality of internet reliability is so pathetic that our POS machine drops transactions. As such, we miss out on making sales. Completely unacceptable in this day and age.
No	We have had to change providers and mix services to adapt and grow.
Yes	None
No	Not dependable
No	We are an engineering company that moves large amounts for data around to the people that need to work on projects. It's better to keep people in the place they live and move the data around or improve the access to Cloud data. This helps us utilize our staff more efficiently and grow offices where people want to live, such as would be the case with Canmore .... if we could get better speeds.