Broadband Feasibility Study

Version 1.0

09-25-2023

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1. Executive Summary

Over the past several years, the City has heard from residents and businesses that the availability, speed, price, and reliability of internet services in the City is not at the level desired in today's technologically driven age. The City believes that residents and businesses are not served equally with broadband services today, which creates social and economic inequalities within the Superior community.

To remedy these issues, the City is planning to deploy a fiber-optic ("fiber") infrastructure that will enable Internet Service Providers ("ISPs") to deliver new and improved internet services to the City's residents and businesses. The City does not intend to provide any retail broadband or other services directly, but instead partner with ISPs who will use the City's infrastructure to deliver all retail broadband services. The City's infrastructure will utilize open-access technologies, which allows multiple ISPs to provide internet services to subscribers, instead of just one. The City has branded this fiber infrastructure "ConnectSuperior."

As part of the planning process, this study assesses the feasibility of the City constructing and managing the fiber infrastructure. It builds on findings from the City's Broadband Master Plan, developed in 2021 and incorporates 18 months of engineering design and planning that leads to the current plan for implementation of the project.

This study focuses on three areas to determine overall feasibility of the project:

1. **Constructing the fiber infrastructure within the City**

   A high-level engineering design and construction analysis was developed for the infrastructure. This analysis determined that the City could feasibly build the infrastructure in public rights of way using underground construction. The costs of construction are approximately $50M - $62M, including contingencies for the fiber infrastructure, which could be built over a 3-5 year period, or over a longer period if desired.

2. **Operating the fiber infrastructure**

   An operations and maintenance plan and accompanying financial plan was developed to assess the long-term operating plan for ConnectSuperior. The City can sustainably operate the network by adding several new positions and outsourcing more technical functions of the network. ISP participation is also critical to the success of the network and as of today, two ISPs have signed letters of intent with the City to provide services for ConnectSuperior.

3. **Financing the fiber infrastructure and demonstrating long-term sustainability**

   A pro forma financial plan was developed to test long-term sustainability of the infrastructure. The City would utilize grants and new debt funding for construction of the network over a 3-5 year timeframe, or longer if desired. Under these scenarios, the infrastructure is able to cover all of its costs, fund renewal and replacement, and pay debt service through system revenues; thus demonstrating the infrastructure's ability to meet its financial obligations.

2. Project Background

In 2021, the City developed a Broadband Master Plan as part of a planning effort to improve high-speed internet services in Superior. The strategic priorities from the Broadband Master Plan include[1]:

1. **Improve Affordability** – The City of Superior seeks to promote policies and initiatives that will reduce the cost of internet access by 20%-25%.

2. **Improve Network Speed & Reliability** – City leaders seek to promote network attributes that will increase reliability for residents, businesses, and anchor institutions within City limits.

3. **Foster Innovation & Economic Development:** The City seeks to ensure that city residents and businesses have access to infrastructure that will foster innovation, economic development, and growth.

4. **Promote Abundant Bandwidth** – City leaders seek solutions that move from the current practice of treating bandwidth as a scarce commodity toward policies and programs which treat bandwidth as an abundant resource.

5. **Foster Competition & Choice** – The City seeks to promote initiatives that will increase the number of service providers and types of services that are available to Superior residents.

6. **Solve the Digital Divide** – The City of Superior seeks to promote policies and initiatives that will make internet access universally available and affordable.

7. **Establish Local Control over Essential Infrastructure -** The economy is now an information economy, and the importance of digital infrastructure continues to grow. The City of Superior has an interest in ensuring that City residents and businesses have robust digital infrastructure and promoting initiatives that will give the City greater influence over this important infrastructure. In building these systems, the City seeks to provide resilience in the event there is a natural disaster or other public safety event.

The Broadband Master Plan also suggested that due to the monopolistic nature of existing ISPs in Superior, residents and businesses "are significantly overpaying for internet connectivity."[2] The Broadband Master Plan provided a set of alternatives that the City could consider to improve internet services in Superior and recommendations that the City should consider in determining its role in broadband, namely:

[1] Superior, WI – Broadband Master Plan – 08-10-2021.pdf – Page 3
[2] Superior, WI – Broadband Master Plan – 08-10-2021.pdf – Page 9

- The City possesses certain advantages to deploying open access fiber infrastructure, including ownership of rights of way, property and sources of funding, all of which may reduce the total costs of building and managing a broadband network.

- The most feasible way for the citizens of Superior to obtain broadband services is to position the City as a wholesale provider of broadband rather than a retail internet service provider. In this model, the City will finance the fiber infrastructure while inviting Internet Service Providers ("ISPs") to deliver Internet Protocol ("IP") retail services to residents and businesses.

The favored alternative was for the City to build a fiber infrastructure that would improve internet services for residents and businesses. This infrastructure would be owned by the City; however, retail internet services would be provided by participating ISPs, rather than the City itself. For regulatory and operational reasons, the City did not want to become an ISP.

To fully understand this alternative, the City contracted with Magellan, a broadband consulting engineering firm that has provided its services to over 200 municipal broadband providers, to assess the feasibility of deploying this network. Magellan's work included:

1. A high-level engineering design and cost estimates
2. A pro forma financial plan
3. A broadband feasibility study that incorporated the findings of the design and financial plan

This feasibility study provides a summary of the work completed.

3. High-Level Engineering Design

The high-level engineering design provides a "blueprint" for building the fiber infrastructure, including physical route, splicing, termination and electronics design. It also provides an overall analysis of the constructability for the network within the City. Several underlying assumptions were utilized as inputs to the design:

The City plans to own the entire network, including backbone, distribution, fiber drops and electronics. This includes all underground duct, underground fiber aerial fiber and facilities needed to establish the network. ISPs will be responsible for installation of any ancillary customer premise equipment if required for establishment of their service. Additional technical details include:

- 100% fiber to the home infrastructure
- Active Ethernet or XGS-PON
- Symmetrical speeds
- 300 Megabit up to 10 Gigabit (and greater) connections to households and businesses
- Dedicated connections for large businesses and anchors
- Open access, allowing for multiple ISPs to utilize the infrastructure simultaneously
- Option that allows subscribers to switch ISPs in real-time if they desire

Final network architecture and requirements are subject to change based on the City's preferences, ISP input and the final business case for deployment.

The fiber infrastructure was designed utilizing a carrier-grade fiber to the home architecture to maximize redundancy and availability to subscribers utilizing the system. A feeder-distribution design was developed to connect residents and businesses to a 100% fiber-optic network through a series of fiber distribution hubs and points of presence within the City. City right of way easements were analyzed to determine viable fiber routing to complete a full 30% design of the network. The 60% and 100% design of the network will be completed in Q4 of 2023, which will produce a final set of construction prints, splice and termination diagrams and related documents for construction of the network.

A constructability assessment was completed to understand how the infrastructure could be built within the City's existing rights of way. Based on the availability of rights of way, the infrastructure would be placed utilizing directional boring and trenching in 95% of cases with minor alternative methods such as saw cutting where existing obstructions were noted. Alternative aerial placement cable could potentially be utilized to reduce the overall cost of the infrastructure; however, City staff noted the risks of wind and ice loading issues in the Superior environment, which redirected the effort to an all-underground network.

General Overview:

- Homes Passed: 12,101
- Businesses Passed: 650

- Miles of fiber: 120 – 150 miles of feeder, distribution and fiber drops
- Fiber huts: 2-3
- Fiber Placement:
    - Primarily underground
    - Directional drilling, trenching
    - Utilizes City rights of way
    - 24” – 36” depth
    - Quantity 2 2” conduit
    - 432 count backbone cable
    - 48 – 96 count feeder and distribution cables
    - 2 count fiber drop cables to each home
- Permitting
    - City of Superior
    - Douglas County
    - Wisconsin Department of Transportation
    - BNSF Railroad
    - SWL&P
- Architecture
    - Active Ethernet or XGS-PON (Final decision by City)
    - If XGS-PON, 1x32 or 1x64 way split, depending on final preferences
    - Fiber distribution hubs: 288 – 576 subscribers per cabinet
    - 100 gigabit ring connected points of presence
    - Up to 10 gigabit subscriber services

Figure 1: ConnectSuperior Fiber To The Home Infrastructure Design

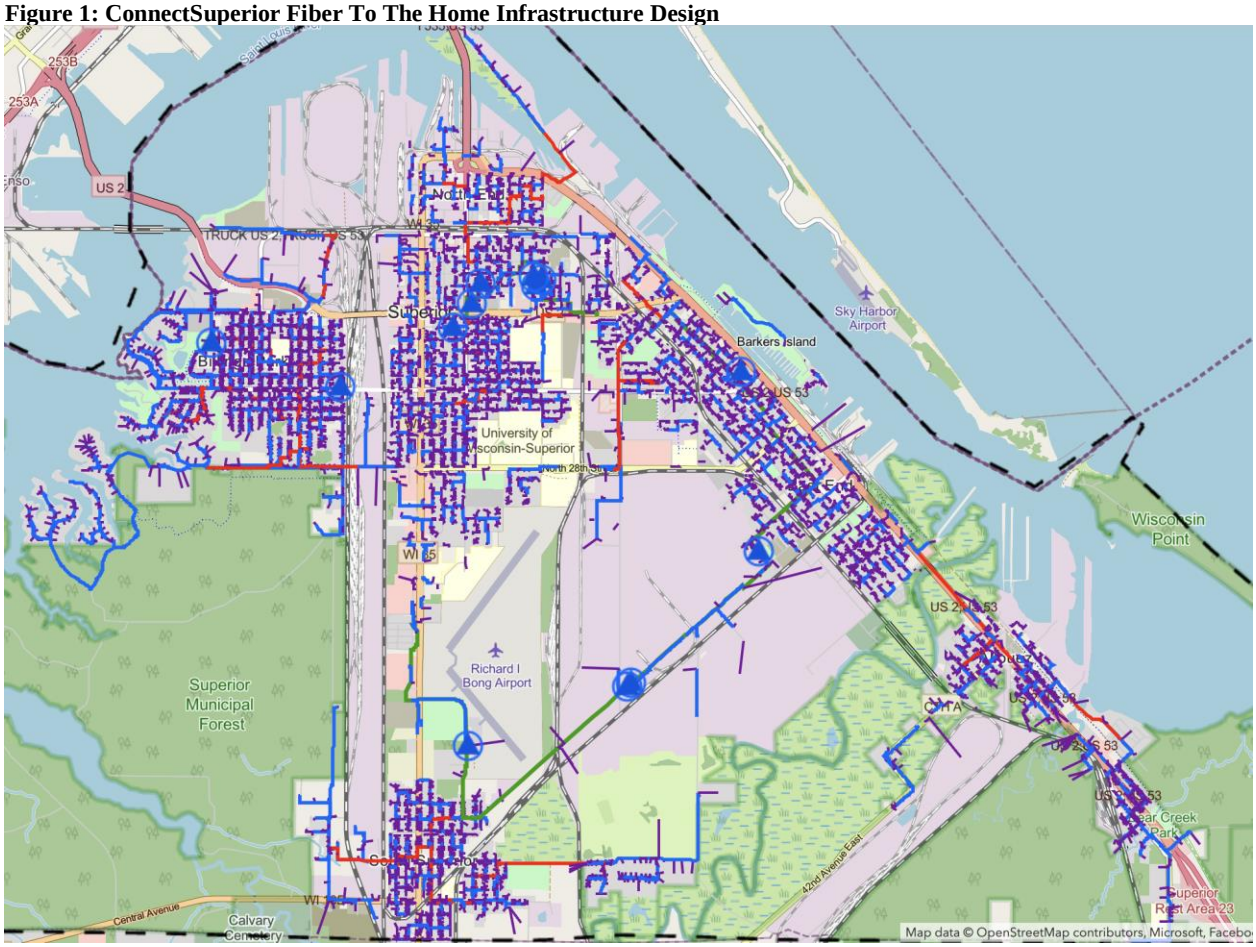
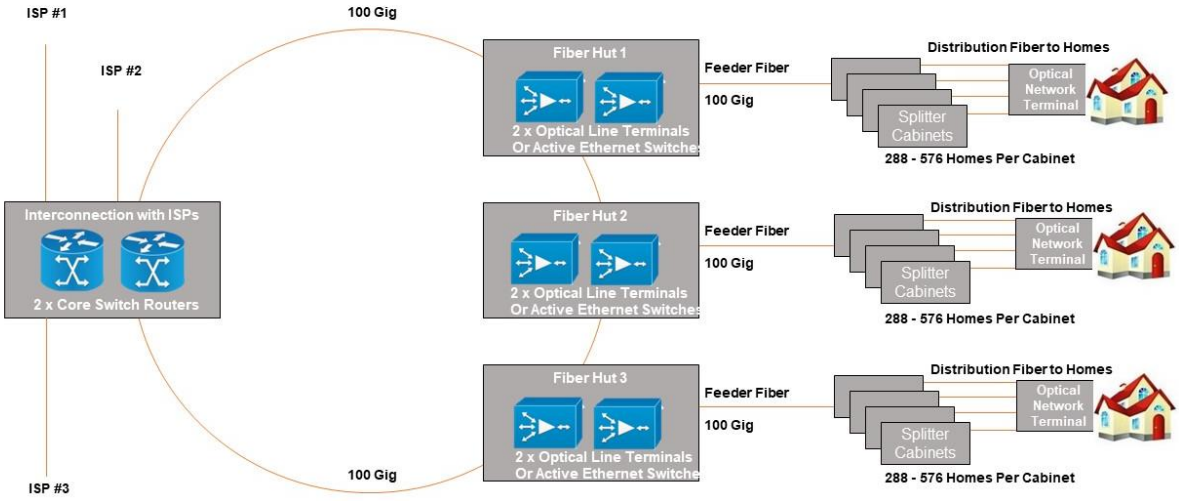


Figure 2: ConnectSuperior Fiber To The Home Architecture



The City's network will be designed as an XGS-PON or active ethernet architecture to support high bandwidth broadband services while minimizing operational costs. The final decision on XGS-PON versus active ethernet will be made by the City in the coming months.

3.1 Fiber Backbone

The fiber backbone will contain 432 fibers and serves two critical functions of the network's operation, including protected connection of the distributed customer access equipment to the core network and connection of the core network to commercial data centers and service providers for access to third party services.

The backbone will connect points of presence ("POP") or huts to one another. The connections will be made using redundant uplinks to reduce the possibility of fiber cuts or equipment failures from taking down large groups of customers. These POPs may consist of powered cabinets, prefabricated shelters, or existing structures with sufficient space for equipment racks and other components. The backbone routes may also serve to connect other critical city facilities as well, saving operating costs and supporting increased functionality and operational benefits.

The City's existing data center may be utilized to house the core routing/switching equipment needed to connect the backbone and interconnect with ISPs serving Superior customers. The facility would need to be retrofitted to support the space requirements for the broadband network. Further investigation will be completed to ensure that environmental components (e.g. dual cooling/dehumidifying units, dual utility power feeds, generator backup, fire suppression, and alarm monitoring) are included in any buildout or renovation.

3.2 Feeder Distribution Fiber

The feed/distribution fiber will extend services from the access POPs to the customer premise. Feed fiber will connect fibers in the access POP electronics to fiber distribution hubs ("FDHs") in the field, placed strategically throughout the service area. Feeder fibers will be sized based on the number of homes and businesses served in each FDH to ensure that each service area is well equipped for both XGS-PON and Active Ethernet services.

Distribution fiber extends from the FDHs to network access points (NAPs) which provide access to the individual fibers required for customer connections. NAPs may be attached to aerial strands, located in ground level pedestals or placed in underground vaults (handholes) located near the sidewalk or curb in residential neighborhoods or business districts. Fiber distribution to NAPs will be sized based on the service area density to provide service to between 8-12 premises per NAP.

3.3 Fiber Service Drops

Fiber service drops connect from the NAP to the customer premise equipment will be mounted on the side of each home or inside the home. A drop will extend fiber from the closest NAP to each business or residence procuring service within the NAPs service zone. Drop fiber will be connected to the NAP then buried to the outside of the customer premise. At the customer premise, the drop cable will be routed to a protective "clamshell" enclosure attached to a home or building for storage of slack and connection to the CPE. Drop fiber installation costs in the model are based on a maximum to 250' from the NAP/handhole to the premise.

3.4 Network Electronics

The network electronics required to deliver broadband services to customers is comprised of several functional groups and multiple components within each group. Each functional group and a brief overview of how it is used to deliver service to the end customer follows below. The City will operate a mixed access network consisting of XGS-PON and/or Active Ethernet.

3.5 Core Electronics

The Core electronics serves to aggregate all of the access equipment connecting customers and route their network traffic to and from the edge equipment to interconnect with the City's ISP partners. This equipment makes use of standard network protocols to provide link redundancy and dynamic traffic re-routing in the event of an equipment failure or fiber cut. Core electronics include carrier-grade routers and switches that transmit and receive traffic at very high volumes. Core electronics specified for the ConnectSuperior network includes dual chassis with fully redundant CPUs, power supplies and fan blades. High-capacity line cards support 10 and 100 gigabit ethernet connectivity with link-aggregation and high availability.

3.5 Optical Line Terminals/Active Ethernet Switches

An optical line termination ("OLT"), also called an optical line terminal, is a device which serves as the service provider endpoint the XGS-PON network. It provides two main functions:

- to perform conversion between the electrical signals used by the service provider's equipment and the fiber optic signals used by the passive optical network.
- to coordinate the multiplexing between the conversion devices on the other end of that network (called either optical network terminals or optical network units).

Active Ethernet switches will perform the same function in an Active Ethernet network that OLTs provide in an XGS-PON network. Active Ethernet switches aggregate customer connections and route them to the core network and to the ISP that provides them with service.

The City will make the decision whether to utilize XGS-PON, Active Ethernet or a combination of the two in the coming months.

3.6 Optical Network Terminals

Customer Premise Equipment (CPE) or Optical Network Terminal ("ONT") serves as the demarcation point between the City's fiber infrastructure and the router or firewall connecting to the customer's local area network (LAN). There are two general methods for installing ONTs. The first method involves mounting an outdoor rated ONT on an exterior wall of the structure and extending service wiring inside the premise. The second method involves extending the fiber into the premise and installing an indoor-rated ONT inside. In either case, the ONT is typically installed somewhere near the fiber entrance and an AC power source.

The ONT terminates the fiber coming from the City's infrastructure and provides customer access to their services through traditional copper interfaces. In addition to the ONT, ISPs may also provide a managed residential gateway (RG) to customers who do not have an existing router or who are interested in receiving managed services from the City. The ONT will provide a demarcation point between the City's infrastructure and the customer's premise. The ISP will be responsible for adding their own RG in case they want visibility into the customer's premise to manage the customer's service. The RG looks and operates similar to a consumer router or modem. However the RG contains software that allows the ISP to diagnose problems with the customer's service and provide managed Wi-Fi and other services for incremental revenue.

4. Business Model

The City will utilize a lit fiber open-access model for the ConnectSuperior infrastructure. In open-access networks, the physical fiber infrastructure and layer 2 electronics are owned and controlled by the City. The City interconnects with retail ISPs that utilize the infrastructure to deliver services to retail customers.

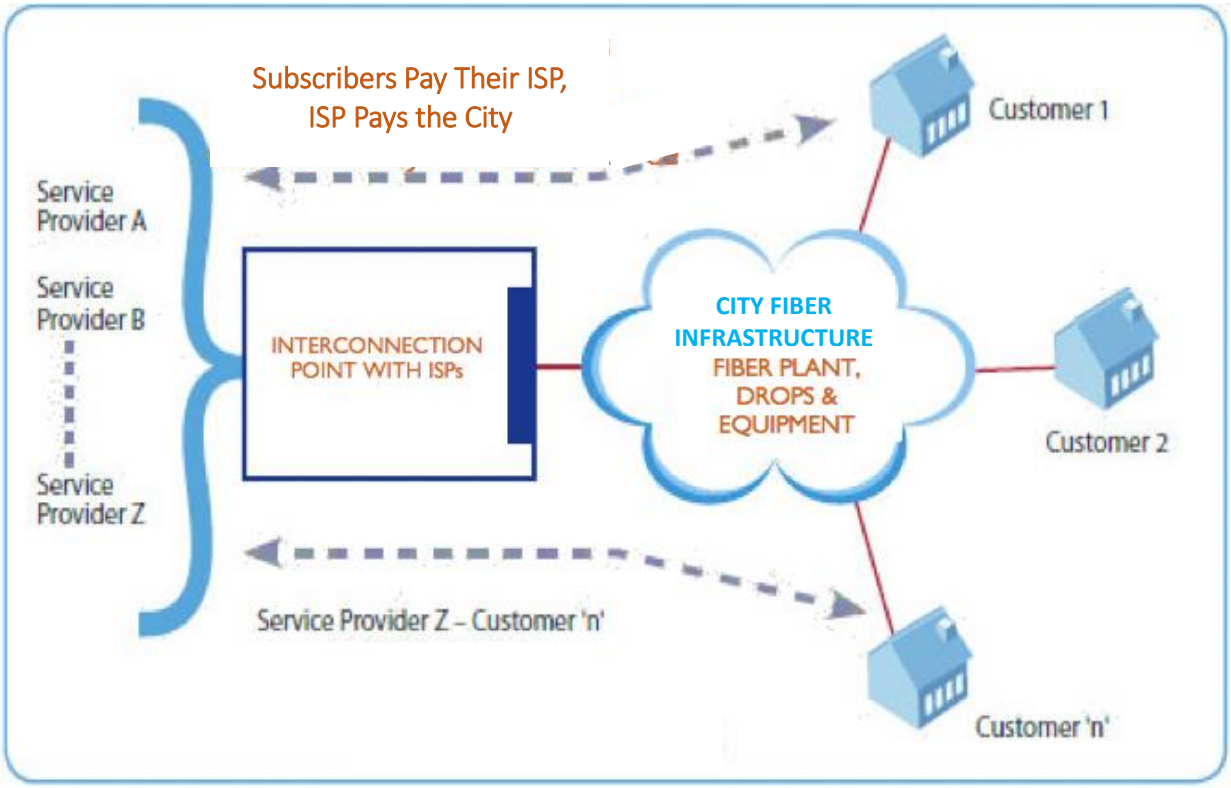
ISPs provide internet services over the open access network and maintain full control and management of customers using the network. Whereas all operational functions are assumed by the provider in a retail network, in an open access network, the City owns and manages the plant and layer 2, while ISPs provide services to customers.

The open access business model gives ISPs the opportunity to serve the local Superior market without the high capital expense of building the infrastructure. It also allows more than one ISP to serve the market since the City's infrastructure is logically partitioned in the electronics that power ConnectSuperior.

The benefit of open access is threefold:

1. The City is not required to be in the business of providing internet, only infrastructure
2. The community receives the benefit of choice in terms of more ISPs and competition
3. The costs can be lower since the City is financing the costs of the infrastructure over a longer term and a lower rate than ISPs, this tends to reduce end user pricing when open access networks perform well (in terms of high take rates)

Figure 3: ConnectSuperior Open Access Diagram



5. Market Analysis

The City's Broadband Master Plan provides a comprehensive analysis of the broadband market in Superior. Building on information contained in the City's Broadband Master Plan, this market analysis adds information key to the overall market position for ConnectSuperior.

5.1 Competitive Analysis

The competitive landscape remains similar to that reported in the City's Broadband Master Plan in 2021 with two providers dominating the market, Spectrum and CenturyLink (now BrightSpeed). According to BroadbandNow and provider rate card filings, competitor products include several updated prices and speeds from the prior reported data.

CENTURYLINK/BRIGHTSPEED	**42% AVAILABILITY IN SUPERIOR**	
SPEED	**Promotional Pricing – First 12 Months**	**Standard Pricing**
100 MEG	$55.00	N/A
1 GIG	$79.00	$100

SPECTRUM	**79.9% AVAILABILITY IN SUPERIOR**	
SPEED	**Promotional Pricing – First 12 Months**	**Standard Pricing**
300 MEG	$49.99	$ 84.99
500 MEG	$69.99	$104.99
1 GIG	$89.99	$124.99

In each case, BroadbandNow[3] reports less than 100% availability of internet products in the City of Superior. BrightSpeed has communicated that it intends to expand its fiber services in Superior in the future, but no timeline was communicated to the City.

This is a key business opportunity for the City's infrastructure. The City's network proposes 100% coverage of homes and businesses in Superior. At the current rates of deployment, if the City moves quickly enough to construct the infrastructure, it will have a first mover advantage in neighborhoods where BrightSpeed and Spectrum have yet to deploy services.

Based on existing pricing, the City and participating ISPs can deliver services for less than existing providers' standard pricing. Although providers continue to "promo" their services at considerably lower prices, prices will revert to standard pricing after one year. The City proposes no promotional pricing and standard flat rate pricing for subscribers utilizing the fiber infrastructure (through retail ISPs) at lower costs than existing providers.

The City will charge a fee per month per subscriber to ISPs using the network. Prices were tested between $30 - $45 for residential wholesale connections. At these rates, retail ISPs prices are expected between $50 - $80 per month, depending on the speed contracted. Prices for businesses will vary between $45 and up to $350 per month, depending on the type of service, speed and service level agreement contracted with each business. This allows small business pricing from ISPs to potentially start around $70 per month. This pricing also includes custom dedicated

[3] Broadbandnow.com, data accessed on 09-01-2023.

connections to large enterprises and community anchors (such as schools and hospitals). Final pricing will be determined by the City's go to market strategy and marketing campaign.

5.2 Take Rates

As evidenced in the Broadband Master Plan, mature take rates realized from municipal broadband providers range between 40% - 80% depending on the type of provider and stage of deployment. Although a full quantitative take-rate analysis was not completed as part of the Broadband Master Plan, propensity of subscribers to utilize the infrastructure can be inferred from the market research in the following ways:

- 73.24% of households support the network
- 34.57% of households rate their current ISP as fair
- 16.17% of households rate their current ISP as poor
- 72.12% of households believe that choice in ISP and plans is very important

An alternative high-speed internet offering would likely gain favor with residents and business who:

1. believe choice and options are important
2. are dissatisfied with current services
3. support a City endeavor to build a fiber infrastructure

The City and its ISPs would also be introducing a high-speed internet product that is differentiated from existing providers in the following ways:

1. provides ubiquitous coverage of the community
2. provides symmetrical gigabit and greater speeds to residents and businesses
3. provides a locally owned network where dollars stay local and are reinvested in the City's fiber infrastructure

Short of a full quantitative take-rate analysis, utilizing a benchmark from other municipal broadband providers can be utilized as a starting point for take rate forecasting. In Superior today, existing providers have less than full market penetration which creates an opportunity for the City and its ISPs to gain market share if a superior product is presented to consumers.

This study assumes a 40% take rate could be achieved if the City:

1. Develops a successful marketing and sales strategy with the participating ISPs
2. Makes it easy for customers to switch to the City's infrastructure
3. Constructs the network in a timely fashion
4. Connects customers in a timely fashion
5. Works with ISPs to price services competitively
6. Works with ISPs to deliver quality service

5.3 Value Proposition

The City's mission is different than those of other competitive ISPs, and as such, the City can have a tremendous social and economic impact on the communities it serves. While competitive and commercial providers focus on the short-term returns on investment, municipalities can realize fiber infrastructure investments across longer horizons and without the high rates of return required by private providers. The "off balance sheet" benefits of the improved connectivity are far reaching for the City's customers and the region. These are competitive differentiators that the City can utilize to market, sell and retain subscribers:

Increase Broadband Adoption and Utilization

Broadband adoption is influenced by two key factors: relevancy and affordability. The City can improve both affordability and relevancy by making measured investments in infrastructure. Affordability, adoption and utilization of broadband services are positively correlated; as affordability increases, so does adoption; when adoption increases so does utilization; following utilization comes the anticipated socioeconomic benefits.

Improve Affordability

Whereas private ISPs must meet their annual rate of return requirements, the City's infrastructure will have only a social return. The City can maintain lower rates that the existing market because it has no required rate of return and rather, the infrastructure can be operated closer to a break-even. This allows the City to maintain lower rates for services year after year.

Enhance Economic Development

Increasing the availability of fiber services into the main business corridors and parks will allow the City to enhance the economic development message regarding broadband capabilities. Through the deployment of fiber in commercial areas, communities, and business parks within the City's footprint, the communities can designate these areas as being "Gigabit ready," allowing any business moving to the area to recognize that fiber services are readily available at competitive rates.

Reduce Lead Times for Installation

The time to install and activate customer broadband services is significantly determined by the availability of infrastructure in the area. Businesses are negatively impacted by fiber construction lead-times that may result in delays to activate their services. Thirty to sixty days is the typical industry standard lead-time for activation of fiber services, without a provision for special construction. In many cases, the lead-time may double or triple depending on how much additional fiber construction is necessary to reach the end user's location.

Improve Public Efficiency and Effectiveness

Leveraging new City fiber to connect public institutions throughout the community creates the opportunity to connect local government, education, healthcare and other types of public organizations, reducing their spend and increasing their capabilities with fiber connectivity.

Establishing institutional access to the City's fiber would create an inter-governmental backbone through which public organizations can collaborate on relevant projects and initiatives, while creating an additional source of revenue for the City's infrastructure.

Reduce Taxpayer and Ratepayer Spend

Improving public efficiency and effectiveness could reduce the costs of government to the local taxpayer. The City's infrastructure can become a tool that facilitates cost reductions, not only for the City, residents, and businesses themselves, but also for government and public organizations across the region, including schools, libraries, healthcare firms and community organizations. The network can "futureproof" the connectivity needs of these agencies and protect them from cost increases as they require additional bandwidth. In addition, the money that residents and business save can be spent elsewhere in the community, and the monthly revenue for operating the network will stay local, further churning local tax dollars.

Support Reliability and Performance

The City's fiber infrastructure will support the reliability and performance of broadband services across the region. The City's fiber can be employed to provide new physical route diversity to the networks of existing broadband service providers and increase capacity in existing routes. They can be used to increase backhaul capacity in areas of the City that are approaching their limit and equip more commercial wireless or cell towers with dark fiber connectivity, increasing the bandwidth available to mobile carriers serving the wireless needs of citizens and businesses.

5.4 Services Offered

The City's services will consist of wholesale transport connections that are provided to retail ISPs. The City will not provide any retail internet or other services directly to the market. These services will provide reliable, secure communications channels between a customer's location (residential, business, school, etc.) and the point of interconnection with the ISP that serves the customer.

The City will charge a wholesale rate per subscriber type per month to each ISP. For example, the preliminary pricing schedule was developed in this feasibility study to determine overall revenues for its wholesale services. Final pricing for all services will be developed by the City through its rate setting process.

Wholesale Services	Monthly Recurring Charge
Residential 1 Gigabit	$35.00 - $45.00
Small Business - 500 Megabit	$40.00 - $50.00
Small Business – 1 Gigabit	$100.00 - $120.00
Medium Business - 1 Gigabit Dedicated Ethernet	$250.00 - $350.00
Enterprise - 10 Gigabit Dedicated Ethernet	Custom
Community Anchor - 10 Gigabit Dedicated Ethernet	Custom

The City's goal is to maintain competitive wholesale pricing to allow ISPs to pass through lower overall retail prices to the end consumer. ISPs will be responsible for setting their own rates for service. Since the City's fiber infrastructure will provide a platform to establish competitive rates for ISPs using the network, each ISP will need to determine its own pricing structure and compete for subscribers. The City's goal of investing in this infrastructure is to bring the cost down for ISPs and in turn residents and businesses utilizing the infrastructure.

6. Financial Plan

6.1 Capital Budget

Capital Budget	2024	2025	2026	2027	2028
Fiber Engineering Design	$240,000	$213,512	$328,418	$600,847	$1,291,576
Permitting	$32,000	$21,351	$32,842	$60,085	$129,158
Fiber Construction	$2,261,505	$4,270,236	$6,568,355	$12,016,933	$25,831,521
Fiber High Level Design, Business Plan	$450,000				
Construction Management	$160,000	$42,702	$65,684	$120,169	$258,315
Point of Presence (10' x 10' Shelter)	$75,000	$75,000	$75,000		
Fiber Service Drops (2 Fiber Drop, Installation)	$287,350	$473,550	$642,250	$1,197,000	$775,950
Home Equipment (ONT, UPS, Wiring)	$164,200	$270,600	$367,000	$684,000	$443,400
Access (Chassis, Cards, Installation)	$45,000	$45,000	$45,000	$45,000	$45,000
Core Routers/Switches (Chassis, Cards, Installation)	$400,000				
Firewalls (Chassis, Cards, Installation)	$60,000				
IP Addressing (Brokered, 1 /24, 5 year lease)	$40,000				
Subtotal	**$4,215,055**	**$5,411,951**	**$8,124,548**	**$14,724,034**	**$28,774,920**
Grand Total	**$4,215,055**	**$5,411,951**	**$8,124,548**	**$14,724,034**	**$28,774,920**

6.2 Capital Budget Financial Analysis

- The total capital budget for the project over 5 years is estimated between $50 and $62 million. The broadband industry has experienced significant inflation in materials and labor costs over the past 2 years due to increased demand from (1) government funding programs and (2) private ISPs upgrading their networks to fiber. Costs projected in the City's original Broadband Master Plan were arrived at prior to the increase in demand across the broadband industry, thus many of the original costs needed to be recast in this feasibility study.

- As such, 20% and 30% construction contingencies have been applied to the overall budget. In effort to maintain conservative projections of future cost, a 30% contingency has been added to future years of construction beyond 2025 to accommodate inflation. Some forecasters also expect construction costs to flatten in the next 24 months, which would yield a lower 20% contingency to be applied to the future years, resulting in a $50 million total budget. To be conservative, this study uses a "worst case scenario" whereby it tests overall feasibility of the project using the higher 30% contingency level. If construction costs do indeed flatten, it will yield only stronger financial performance for the project as less funding and potential debt service costs will be required to complete the project.

- Construction costs were estimated utilizing recent and similar fiber construction projects in the upper Midwest between 2020 and 2023. These costs included labor rates for underground boring and trenching in similar terrain as the City's project.

- The most significant costs are in construction of the fiber plant, which makes up 89% of total costs. Engineering design makes up 4% of total costs. The remaining 5% of costs include all electronics to light the network and provide services to ISPs. Electronics costs are substantially lower than traditional fiber to the home infrastructures since the City will only be providing layer 2 transport services. This eliminates the requirements for any layer 3 routing/switching, DNS/DHCP, IP layer firewalling, denial of service mitigation and other equipment necessary to support retail internet services. The wholesale model also simplifies the requirements for the City to provide equipment to the home and in the overall monitoring and management of the network.

- Permitting costs include the costs of the City permitting its own project (public right of way permits) as well as third-party permits required by Douglas County, Wisconsin Department of Transportation railroads, and SWL&P.

6.3 Pro Forma

Pro Forma	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032
Year #	1	2	3	4	5	6	7	8	9	10
Annual Residential Passings		821	1,353	1,835	3,420	2,217				
Cumulative Residential Passings		821	2,174	4,009	7,429	9,646	12,101	12,101	12,101	12,101
Annual Commercial Passings		170	170	170	170	170				
Cumulative Commercial Passings		170	340	510	680	850	850	850	850	850
Residential Subscribers		246	870	1,604	2,972	3,858	4,823	4,823	4,823	4,823
Commercial Subscribers		51	136	204	272	340	425	425	425	425
Residential Revenues	$0	$66,501	$301,293	$667,764	$1,235,304	$1,844,100	$2,343,978	$2,604,420	$2,604,420	$2,604,420
Commercial Revenues*	$0	$82,620	$302,940	$550,800	$771,120	$991,440	$1,239,300	$1,377,000	$1,377,000	$1,377,000
Total Revenues	**$0**	**$149,121**	**$604,233**	**$1,218,564**	**$2,006,424**	**$2,835,540**	**$3,583,278**	**$3,981,420**	**$3,981,420**	**$3,981,420**
Expenses										
City Oversight, Billing, Reporting & Finance		$212,180	$218,545	$225,102	$231,855	$238,810	$245,975	$253,354	$260,955	$268,783
Network Operator		$50,170	$182,445	$346,534	$661,421	$884,569	$1,138,883	$1,173,049	$1,208,241	$1,244,488
Outside Plant Operations & Maintenance		$50,000	$150,000	$175,000	$200,000	$206,000	$212,180	$218,545	$225,102	$231,855
Software Maintenance		$159,135	$163,909	$168,826	$173,891	$179,108	$184,481	$190,016	$195,716	$201,587
Debt Service	$0	$0	$0	$249,389	$701,355	$1,584,623	$1,584,623	$1,584,623	$1,584,623	$1,584,623
Total Expenses		**$471,485**	**$714,900**	**$1,164,852**	**$1,968,521**	**$3,093,111**	**$3,366,142**	**$3,419,587**	**$3,474,636**	**$3,531,337**
Net Income	**$0**	**-$322,364**	**-$110,667**	**$53,712**	**$37,903**	**-$257,571**	**$217,136**	**$561,833**	**$506,784**	**$450,083**
Renewal & Replacement - Customer Equipment					**$64,144**	**$118,864**	**$154,336**	**$192,920**	**$192,920**	**$192,920**
Renewal & Replacement – Network Electronics								**$45,000**	**$45,000**	**$45,000**
Total Renewal & Replacement	**$0**	**$0**	**$0**	**$0**	**$64,144**	**$118,864**	**$154,336**	**$237,920**	**$237,920**	**$237,920**
Total Cash Deficit/Surplus	**$0**	**-$322,364**	**-$110,667**	**$53,712**	**-$26,241**	**-$376,435**	**$62,800**	**$323,913**	**$268,864**	**$212,163**
Working Capital	**$784,945**									
Cash Balances	**$784,945**	**$462,581**	**$351,914**	**$405,627**	**$379,386**	**$2,951**	**$65,751**	**$389,663**	**$658,527**	**$870,690**

6.4 Pro Forma Financial Analysis

- The pro forma anticipates a 5-year buildout schedule for the fiber infrastructure to reach 100% of homes and businesses across the City. The City may opt to slow down or speed up the rate of build depending on overall funding availability. The buildout schedule for the first phase of the project encompasses approximately 800 homes in the downtown corridor. Phase 2 completes the downtown corridor and moves west into Billings Park. Phases 3 through 5 expand to cover the remainder of the City. Final determination of the build plan and schedule will be determined by City leadership.

- Take rates are estimated at 40% of the residential and business market. Over the first 6 years, the City will connect 4,823 residential subscribers and 340 business subscribers.

- Revenues are generated through the monthly fees that ISPs pay the City for access to customers. ISPs will pay $45 per month for a 1 gigabit connection to each residential customer. ISPs will pay $270 for connections to business customers. The $270 is an average cost across different speeds of service. Since business connection speeds and service levels vary, this rate represents a blend of small, medium and large business customers, as well as large community anchor customers such as schools, healthcare organizations and libraries.

- Total revenues include all wholesale fees from ISPs serving residential and business customers on the City's infrastructure.

- Major expenses for the infrastructure include the City's oversight, including staffing expenses associated with managing the network. The City will outsource a significant portion of technical support to a third-party provider in efforts to keep costs down. The City's direct staffing costs will be allocated to several new positions needed to manage the overall network, contracts, third-party vendors and ISPs utilizing the network.

- Network Operator expenses include costs for a third-party to manage technical support, outages, ticketing, work orders and related operational functions on the City's infrastructure. A $16 per subscriber fee is estimated for the network operator to manage the network, which is commensurate with the current market of vendors who provide such services. These costs will rise incrementally with subscribers. As more subscribers are connected to the network, the network operator will charge $16 per month for each additional subscriber. The network operator may also opt to utilize another billing method; however, the overall costs will be similar whether using a per subscriber charge or another fee for service model. Network operator costs will grow linearly with growth in subscribers. Over time, the network operator will represent about half of the total operating budget, as they will provide critical functions to ensure reliable services are delivered to ISPs and their customers over the network.

- Other operations and maintenance expenses include fiber maintenance and software maintenance. Fiber maintenance will entail ongoing support for the physical fiber network, including costs for repair of cable, splicing, termination, utility relocations and related maintenance. These costs will escalate over time as the City builds more infrastructure and are expected to be about $600 per fiber mile per year, which is commensurate with standard operating costs for providers. Software maintenance will be required for any electronics or systems needed to manage the City's infrastructure. Based on the value of

the electronics, the starting budget for software maintenance, which includes licensing, is estimated at $150,000 and will grow over time at 3% per year.

- Depending on the City's buildout schedule and availability of grant funding, the City may take on new debt to finance some of the project. This plan anticipates that 50% of the total project costs are financed through debt, using an interest rate of 4.5% per year over 30 years (30 years is the typical financing term for municipal broadband networks). For the purposes of this study, debt was structured as a straight-line principal and interest payment each year, starting in the year after a construction draw was taken. If more than 50% of the network is financed through debt, an increase in debt service will increase overall expenses and reduce overall cash flows. Actual amounts will depend on the final capital financing and terms on the debt.

- In the first two years of deployment, net income is negative as expenses exceed revenues. The City will need to gain enough customers to ensure that wholesale revenues cover its fixed operating costs. This occurs at the point where about 1,700 customers are connected to the network. Beyond 1,700 the infrastructure begins to generate positive net income for the City. Net income is highly dependent on the final wholesale rate charged by the City, the number of customers connected, and the final level of operating expenses incurred on the network. The City should closely analyze revenues and costs every month to ensure that the infrastructure is covering its expenses with sufficient revenues.

- Renewal and replacement are set aside from cash flows beginning in year 5 of the deployment. The City will need to reserve for electronics with shorter lifespans such as optical network terminals (ONTs) and equipment with longer lifespans such as core routers and optical line terminals. Typically, electronics have lifespans of 5-10 years. The pro forma reserves for each type of equipment based on its specific lifetime.

- After debt service and renewal and replacement are taken out of cash, the available cash deficit/surplus is calculated. In nearly all municipal broadband networks, a working capital fund is required in the first few years of the project to bridge cash deficits. This is required until revenues are sufficient to pay all expenses, debt service and renewal and replacement. In the City's case, a working capital set aside of just under $800,000 is set aside to fund any cash deficits in the early years of operations. This would be funded out of the City's current ARPA allocation of $5,000,000 for the project.

- Free cash flow is the best measure of a municipal broadband network's financial sustainability. The "bottom line" number indicates that the network is able to meet its obligations year after year and still have some cash available to support future expansion or contribution to other City funds. Under the current assumptions, the network maintains positive cash flow each year and grows over time in the later years (years 8-10). Free cash flow gives the City the opportunity to accelerate the buildout, pay down debt early or make contributions to other programs. Free cash flow is affected by changes in revenues and costs. The City should track its free cash flow balance carefully to ensure that it always maintains a positive fund balance.

6.5 Assumptions

Global Variables	
Annual Cost Escalator	3%
Total Homes Passed Phase 1	821
Total Homes Passed Phase 2	1,353
Total Homes Passed Phase 3	1,835
Total Homes Passed Phase 4	3,420
Total Homes Passed Phase 5	2,217
Expected Take Rate	40%
Renewal & Replacement Rate Per Year	10%
Interest Rate on Debt	4.5%
Term on Debt	30 Years
Grant/Debt Ratio	50%/50%
Wholesale Residential Rate	$45
Wholesale Business Rate*	$270
City Oversight Cost Per Year	$200,000
Network Operator Cost Per Subscriber Per Month	$16
Software Maintenance Per Year	$150,000
Fiber Maintenance Cost Per Year	$200,000
Annual Cost Escalator	3%
Annual Rate Escalator	3%

*Averaged across small, enterprise and community anchor business revenues

Capital Budget	UOM	Unit Cost	
Fiber Engineering Design	Per Foot	$	1.50
Permitting	Per Foot	$	0.20
Fiber Construction	Lump Sum		
Fiber High Level Design, Business Plan	Lump Sum	$	450,000
Construction Management	Months	$	30,000
Point of Presence (10' x 15' Shelter)	Lump Sum	$	75,000
Fiber Service Drops (2 Fiber Drop, Installation)	Per Home	$	700
Home Equipment (ONT, UPS, Wiring)	Per Home	$	400
Access (Chassis, Cards, Installation)	Per Unit	$	45,000
Core Routers/Switches (Chassis, Cards, Installation)	Per Unit	$	100,000
Firewalls (Chassis, Cards, Installation)	Per Unit	$	30,000

6.6 Conclusions

This study and the City's companion Broadband Master Plan demonstrate a feasible approach for the City to build and operate an open-access fiber infrastructure. The infrastructure as designed will support the City's goals of improving access to high-speed internet in Superior for its residents and businesses. The open-access architecture allows the City to deploy the fiber infrastructure itself without the requirement of becoming a retail ISP. ISPs have demonstrated interest in the project by providing letters of intent to the City with details on how they would participate as providers on the network.

To execute this approach, the City will need financial, operational, and technical resources to support the deployment of the network. Funding will be required in the form of grants and loans (or other financing alternative). The City has already approved a $5 million set aside of its ARPA allocation to provide seed capital for the project. The City is also actively investigating and applying for additional funding to supplement its initial $5 million of ARPA funding. This includes the State of Wisconsin Public Service Commission Broadband Grant Program and the federal Broadband Equity Access and Deployment Program. These programs, among others, may be utilized to introduce new funding to the project along with the City's own financial resources.