



# CLEAR CREEK AND GILPIN COUNTIES STRATEGIC BROADBAND PLAN

October 2017

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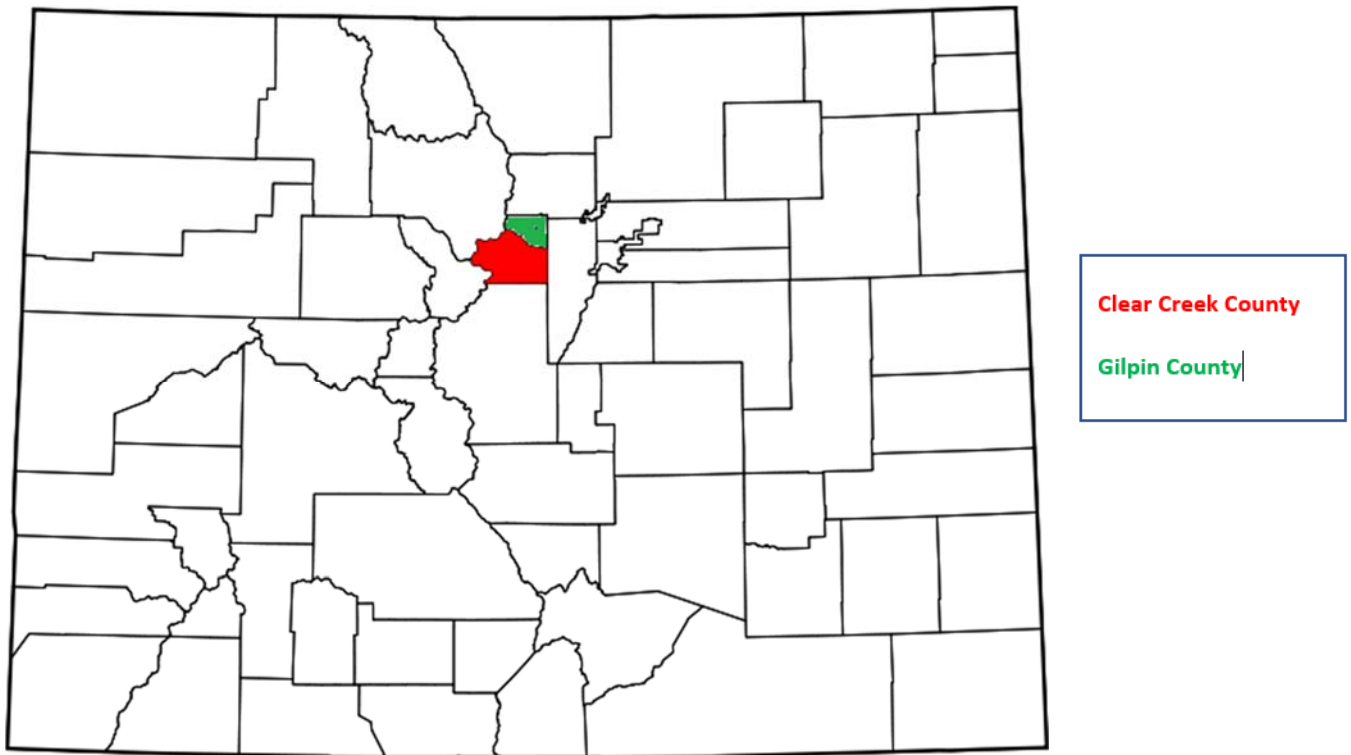
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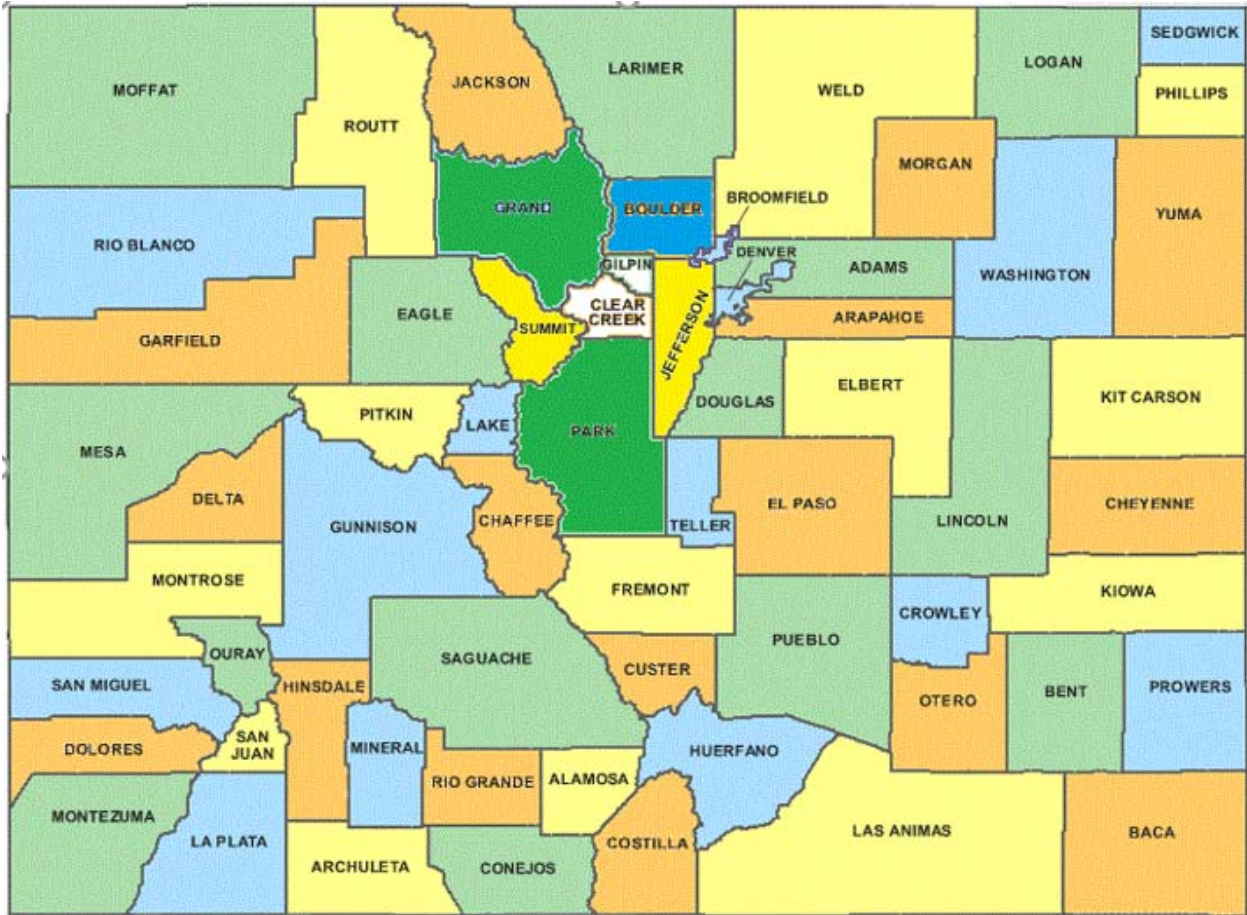
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# Introduction and Executive Summary

Clear Creek and Gilpin Counties engaged NEO Connect (NEO) to prepare a strategic broadband plan. The intention of the study is to identify strategies, capital costs and potential partnerships for making broadband services more abundant with higher capacity and speed, more affordable and more reliable.





Clear Creek and Gilpin Counties are located in central Colorado. Counties that share a border with both Clear Creek and Gilpin Counties are Jefferson County to the East and Grand County to the North. Boulder county also shares Gilpin County’s northern border. Summit and Park Counties share Clear Creeks Western and Southern borders respectively.

The counties have the following incorporated communities and population depicted below in black and unincorporated communities are shown in red.

**Clear Creek County:**  
 Downieville/Dumont  
 Empire  
 Floyd Hill  
 Georgetown

Idaho Springs  
 Lawson  
 Silver Plume  
 St. Mary’s  
 Upper Bear Creek

**Gilpin County:**

Black Hawk

Central City

Coal Creek

Rollinsville

## Methodologies and Activities Conducted During the Planning Process

There are a number of activities that were undertaken to put together a comprehensive plan for improving broadband services in the two Counties. These activities included:

1. **Surveys.** Surveys were made available for citizens and businesses to provide feedback on current levels of broadband, how homeowners and businesses currently use the Internet, what is currently being paid for services, current download and upload speeds, and what is most important in regards to high speed Internet service.
2. **Stakeholder Meetings.** NEO's team met with key stakeholders in the community. These meetings included discussions with focus areas including public safety, education, business and economic development, government services and residential services.
3. **Research.** Independent research was conducted in regards to national mapping and availability reported through Broadband USA, NTIA and the State of Colorado's Office of Information Technology.
4. **Request for Information from the Service Providers.** A formal invitation to provide information and input into the plan was provided for the local service providers.
5. **Tower Inventory and Assessment.** NEO's team provided an on-site inventory and assessment of the existing wireless towers in the Counties and the surrounding area. The assessment included evaluation of the existing tower's structural capacity, available space, and providers currently using the towers. From there, a propagation study was conducted to identify gaps in both wireless broadband coverage. A comprehensive wireless plan is included in this report to provide ways of improving wireless and cellular coverage throughout the study area.
6. **Existing Assets.** NEO's team researched what existing fiber optic and conduit assets were available within the County.
7. **Community Anchor Institutions.** A list of community anchor institutions was assembled, identifying addresses, needs and current levels of services.

8. **Subdivisions and HOAs.** A list of the subdivisions and HOAs was assembled and costs to bring Gigabit enabled broadband services or Fiber-to-the-Premises for each subdivision were calculated.
9. **Preliminary Design and Engineering.** Preliminary design was performed to connect anchor institutions with fiber optic cable as well as capital cost projections for a Fiber-to-the-Premise network for the communities within Clear Creek and Gilpin Counties. As mentioned above, preliminary capital costs were determined by subdivision. Design, engineering and capital cost estimates were also assembled for improving wireless capabilities in the Counties.
10. **Strategies and Plans.** And finally, this report was assembled to provide a path forward towards implementation of several strategies and plans to improve broadband and data connectivity for the Counties.

## Strengths, Weaknesses, Opportunities and Threats

NEO conducted an assessment of the current environment of the two counties in regard to broadband implementation. Below are the Strengths, Weaknesses, Opportunities and Threats (SWOT) of the findings for the study:

### Strengths:

- CDOT has fiber optic cable along I-70 from Denver to Glenwood Springs that passes through many of the communities in the study area. The map below depicts CDOT fiber in purple along the I-70 corridor that CDOT provides to both public and private entities. Comcast, CenturyLink and Crown Castle are using CDOT's fiber to serve customers in the study area. Additionally, CDOT has fiber from Golden to Black Hawk.





- Union Pacific also has fiber in the study area and currently leases fiber strands to Level 3, Comcast, CenturyLink and EAGLE-Net. Gilpin and Clear Creek Counties have access potentially to a number of service providers that have middle-mile fiber in place. Additionally, CDOT will lease their fiber along the I-70 corridor to public agencies.
- Several of the communities within the study area and Clear Creek and Gilpin Counties have opted out of SB-152, providing the ability to enter into public-private partnerships to solve broadband challenges, or build telecommunications facilities for end users.
- There are coordinated activities being conducted by various entities in the State for better broadband in rural areas. Additionally, there is discussion at a national level with the new administration that funding may be available for broadband infrastructure expansion. Having this strategic plan in place provides the region with a shovel-ready project. With this, the local governments may have an opportunity to apply for federal funding if it becomes available.

### **Weaknesses:**

- Implementing a broadband strategy in rural parts of the country is difficult. Capital costs to upgrade infrastructure are high and in less populated areas of the country, the business plan is difficult to make work for service providers. Over 40% of Gilpin County's population is located outside of incorporated areas.
- Although there are several providers that have middle-mile fiber to the communities, the costs of bandwidth are still high.

### **Opportunities:**

- There is an opportunity to drive down the cost for Internet services while dramatically increasing the bandwidth available to homes and businesses by implementation of any of the strategies provided in this plan.
- In cities that are implementing Gigabit services to homes and businesses, the pricing standard is .07 - .09 per Mbps for residential service (\$70 – 90/month for Gigabit Internet) and (.30 - .80 per Mbps for businesses or commercial service (\$300 - \$800 for businesses for Gigabit Internet).<sup>1</sup>
- Throughout this process, NEO and the broadband committee have engaged many key stakeholders and potential partners in improving broadband services throughout the region. There is an opportunity to work together to either share in the cost of leased circuits and/or leverage grant and funding opportunities and partnerships to build fiber connectivity between the communities and to more anchor institutions. The primary benefits include better redundancy, lower leased access costs, true aggregation of demand of anchor institutions, potential shared services between government agencies, collaboration opportunities amongst all stakeholders, and reduced backhaul and transport costs for the anchor institutions. Additionally, access to this infrastructure provides better redundancy and lower access costs for the service providers.

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<sup>1</sup> See [http://www.newamerica.org/downloads/OTI\\_The\\_Cost\\_of\\_Connectivity\\_2014.pdf](http://www.newamerica.org/downloads/OTI_The_Cost_of_Connectivity_2014.pdf) New America

### **Threats**

- Perhaps the greatest threat and challenge for the broadband strategy is determining who should implement which parts of the plan. Although it is beneficial to have a steering group of committed partners, it may be difficult to determine who will provide funding, oversight, implementation and operations of the network. Much of this is primarily about appetite and commitment. Although NEO can provide information on the risks, the capital costs, the financial implications, potential partners, etc. NEO cannot influence appetite amongst the local governments members.

### **NEO's Recommendations**

NEO recommends the following strategies for the Clear Creek and Gilpin Counties. These strategies will be addressed in detail in this report.

1. Hold an election to opt out of SB-152 for those communities that have not yet done so. This provides more options for public private partnerships to help solve broadband challenges throughout the study area.
2. Implement broadband-friendly policies and ordinances in each of the cities, towns and counties to help reduce the cost of broadband expansion. There has been much gas pipeline installed throughout the study area. Implementing a shadow conduit or dig-once policy may allow more telecommunications infrastructure to be built at a greatly reduced cost.
3. Leverage grant funding – namely, the Department of Local Affairs (DOLA), the High Cost Support Mechanism, the Economic Development Administration and USDA's Rural Utilities Services program to pay for a significant part of these builds. These grant programs will pay for 50-75% of the capital costs to connect government entities, schools and the medical establishments and may provide funding for placement of conduit and fiber to homes and businesses. Many of these grants will also pay for connecting anchor institutions with fiber and for wireless implementation. Service providers and local electric cooperatives are the only entities that can apply to the High Cost Support Mechanism, and therefore, a partnership with either type of entity would be beneficial.
4. Harder to serve areas within the Counties can improve services with the wireless plan detailed in Section 6. The Counties may decide to pay for this equipment and implement the plan, or the wireless plan could be shared with existing providers to discuss potential partnerships to share in the costs.

5. Continue to build fiber to key anchor institutions within each community, working with existing service providers.

## Why Expanding Broadband Service Matters

Our world is rapidly changing. Technology is impacting every part and parcel of our lives -- from where and how we conduct work, to whether or not we thrive economically and socially. The Internet has impacted the way we work and live including our entertainment, our culture, the way government services are provided and accessed, the way healthcare is being delivered, and the way we educate our children and provide education to better improve our workforce. With the introduction and accelerated advancement of technologies, having access to affordable, redundant and abundant broadband is quickly becoming the most critical infrastructure of our time, just like electricity and transportation were in the early 1900's.

The importance of broadband was reflected in the recent Federal Communications Commission's (FCC) determination that broadband Internet access is a utility, as necessary to contemporary life as electricity, roads, and water systems. Advanced broadband infrastructure has the potential to create more jobs, increase the community's competitive ability globally, create new technologies, increase opportunities for the region's companies, enhance public safety, provide better and less expensive healthcare, and provide greater educational opportunities throughout our communities.

Advanced broadband networks are creating seismic changes in local, state, national and global societies, as well as markets, business and in institutions around the world. Access to social media and the Internet has shifted governments, threatened political boundaries and changed us culturally. Advanced broadband networks are fundamentally changing our world in ways that were not expected or anticipated. Much like electricity, advanced broadband networks are the enabling technology in which all things are impacted. Electricity was invented to turn on the lights, but empowered -- literally, the transformation to an industrial society.

Just as it was impossible to predict the impact that electricity would have to power modern appliances, computers, health monitoring systems, manufacturing facilities, computers, radio and television, and financial markets; so too, is it impossible to predict the impact and reach of advanced broadband networks. We do not yet know the far-reaching impacts that the Internet will have on our lives and on generations to come. However, it is certain that NOT having access to advanced broadband networks would be equivalent to being in the dark without electricity.

# Section 1 - Current Services, Technology, and Speed Test Results

## Resources

A number of entities collect and map broadband availability by state in the U.S.

The FCC collects information from facilities-based Internet providers – providers that own their own network facilities. Facilities-based providers include telephone companies, cable system operators, wireless, satellite service providers and other facilities-based providers of advanced telecommunications capability. All facilities-based providers are required to file data with the FCC twice a year (Form 477) regarding where they offer Internet access service at speeds exceeding 200 kbps in at least one direction.<sup>2</sup>

Additionally, the National Telecommunications and Information Administration (NTIA), through the **Broadband USA Mapping Tool**, collects broadband datasets to be included in NTIA's National Broadband Map. This effort was started in 2009 and was kept updated through June 30, 2014, and is no longer being updated. The Federal Communications Commission (FCC) sought funding for Fiscal Year 2016 to continue to maintain and update the National Broadband Map, but this request was not granted. Therefore, the data presented within this report from Broadband USA is from June 30, 2014.

**BroadbandNow** is a website that summarizes datasets provided by NTIA, the FCC and other sources regarding broadband availability, speeds, government spending and pricing information.

The **State of Colorado's Office of Information Technology (OIT)** compiles actual speed test results from across the state and datasets are available for select cities and counties.

NEO has gathered information across the state and the U.S. from meetings and correspondence with the various service providers.

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<sup>2</sup> FCC mapping data on Form 477 is reported on a census-block basis rather than based upon whether or not service is available at a particular home, business or other location within the census-block.

## Minimum Definition of Broadband

There is much debate occurring in the U.S. on how to properly define “broadband”. Prior to February 2015, the Federal Communications Commission (FCC) defined broadband as having the ability to download 4 Mbps of data and upload 1 Mbps of data. In February of 2015, the FCC increased the definition of broadband by raising the minimum download speeds needed from 4 Mbps to 25 Mbps and the minimum upload speed from 1 Mbps to 3 Mbps<sup>3</sup>. The current definition of broadband can be supported by a number of technologies – including wireless, cable modem, DSL, and fiber optic technologies.

Although the current FCC definition for broadband is 25 Mbps download and 3 Mbps in upload speeds, it should be noted that broadband demand and consumption of broadband is growing very rapidly every year. The gold standard for bandwidth capability is quickly becoming offering Gigabit services or speeds that support 1,000 Mbps. With the tremendous growth in broadband demand, plans for long-term implementation of infrastructure must take into consideration the need for more fiber networks to be deployed and expanded.

## Broadband Technologies

Below is a brief description of the various technologies used in broadband deployment:

DSL (Digital Subscriber Line) uses existing copper phone lines to deliver download and upload broadband speeds typically of 1.5 Mbps to 7 Mbps. DSL speeds diminishes as distance increases from the telephone company’s central office. Homes or businesses located more than three miles from the central office will not receive as fast of speeds. There have been many improvements to DSL technologies to improve the speed available. In general, most forms of DSL service improvements support up to 10 Mbps. VDSL (Very High Bit Rate Digital Subscriber Line) can support up to 30 Mbps, but most Internet service providers do not support this type of service, including providers in the region.

Cable modem service uses coaxial cables already installed by the cable TV operators to provide broadband service. Most cable networks support speeds comparable to DSL. Cable operators are upgrading their cable networks by installing fiber optic cable closer to neighborhoods. These network improvements allow cable modem service to be able to support up to 30 Mbps. This connection type is a shared service, meaning, as more people are on the network within a neighborhood, the speed available to each customer diminishes.

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<sup>3</sup> 2016 *Broadband Progress Report*, Federal Communications Commission, [https://apps.fcc.gov/edocs\\_public/attachmatch/FCC-16-6A1.pdf](https://apps.fcc.gov/edocs_public/attachmatch/FCC-16-6A1.pdf).

Fiber optic technology converts electrical signals carrying data to light and sends the light through glass fibers about the diameter of a human hair. Fiber transmits data at speeds far exceeding current DSL or cable modem speeds, typically by tens or even hundreds of Mbps. Fiber is the best way to provide abundant broadband, but it often is the most capital-intensive to build. As fiber optic technology transmit pulses of light, more bandwidth can be delivered on a fiber optic network by adding various colors of light or additional spectrum. Fiber is unique because it can carry high bandwidth signals over long distances without signal or bandwidth degradation and it can provide that capacity in both directions – for both upload and downloading information.

Wireless broadband connects a home or business to the Internet using a radio link between the customer’s location and the service provider’s facility. Wireless technologies using longer-range directional equipment provide broadband service in remote or sparsely populated areas where DSL or cable modem service would be costly to provide or fiber network installations may be too capital intensive.

Wireless broadband can be mobile or fixed. Wireless speeds are generally comparable to DSL and cable modem. Wireless services can be offered using both licensed spectrum and unlicensed devices. Wi-Fi networks typically use unlicensed spectrum. Wi-Fi networks use wireless technology from a fixed point and often require direct line-of-sight between the wireless transmitter and receiver. Wi-Fi networks can be designed for private access within a home or business, or be used for public Internet access at "hot spots" such as restaurants, coffee shops, hotels, airports, convention centers, and city parks. Using licensed spectrum, greater amounts of bandwidth can be delivered and often do not require direct line-of-sight.

In some communities, especially sparse, geographically diverse rural communities, small providers build out a wireless solution since wireless infrastructure is not as capital-intensive as building out a fiber optic infrastructure. While wireless technology does have its limitations, needing to be designed to get around “line of sight” requirements as well as to support “shared” bandwidth on the network, smart engineering can deliver good connectivity.

Cellular 4G and LTE. Cellular service is often referred to as wireless service and it can be confused with Wi-Fi. Cellular and Wi-Fi are both wireless systems, meaning both use radio frequencies to transmit and receive data. But Wi-Fi has a radio transmitter and receiver that operates only at a range of 200 feet or so. The range of cellular is measured in miles. Wi-Fi's transmitter and receiver is called an access point. It is mounted in the corner of a room, or on a lamp post, or in a hotel lobby. A cellular transmitter and receiver is called a cell site, or a base station and can transmit for miles.

“4G” refers to the fourth and latest generation technology for data transmission over a cellular network. It can support greater data speeds than most public Wi-Fi networks and is used primarily when a customer is out of the range of a Wi-Fi network. LTE, which stands for “Long Term Evolution,” is the fastest, most consistent variety of 4G.

To date, the cellular companies have charged for data usage either by the amount of data used or with a flat fee for unlimited data use.

Wireless Local Area Networks (WLANs) provide wireless broadband access over shorter distances and are often used to extend the reach of a "last-mile" wireline or fixed wireless broadband connection within a home, building, or campus environment. An in-home Wi-Fi network is a WLAN – it does not use spectrum, rather it sends radio waves at a limited range. Mobile wireless broadband services are also becoming available from mobile telephone service providers. These services are generally appropriate for highly-mobile customers and require a special wireless card with a built-in antenna that plugs into a user’s laptop computer. Generally, they provide lower speeds, in the range of several hundred Kbps.

Satellite broadband is another form of wireless broadband, and is also useful for serving remote or sparsely populated areas. Typically, a consumer can expect to receive (download) at a speed of about 500 Kbps and send (upload) at a speed of about 80 Kbps. These speeds are slower than DSL and cable modem, but they are about 10 times faster than the download speed with dial-up Internet access. Service can be disrupted in extreme weather conditions and are typically oversubscribed.

As mentioned above, the “gold standard” in solving the last mile connectivity is in building more fiber out to homes and businesses. This is referred to in the industry as “Fiber to the Premise,” or “Fiber to the Home,” or “Fiber to the Business.” This methodology is currently the only reliable way of providing Gigabit or 1,000 Mbps of broadband services to end users. There have been dramatic improvements in wireless technologies and although we are now seeing the ability for wireless to support Gigabit speeds, the wireless access points need to be fed with fiber and have a Gigabit reach of less than 500 feet. Gigabit players, Google Fiber and AT&T have announced plans to trial Gigabit wireless services in select markets in the U.S. for serving homes and businesses, but are not yet commercially available. Siklu is a company that is currently providing wireless equipment that supports Gigabit capacity; again, wireless access points need to be fed with fiber.

# Clear Creek County Broadband Availability

Technology available to % of population					
City	DSL	Fiber	Cable	Wireless	Other
Georgetown	100.00%	0.00%	96.83%	100.00%	0.00%
Idaho Springs	94.71%	0.99%	90.09%	100.00%	0.00%
Silver Plume	98.70%	0.27%	100.00%	100.00%	0.00%
Empire	96.60%	0.00%	93.20%	100.00%	0.00%
Downieville Lawson / Dumont	34.86%	0.00%	16.73%	100.00%	0.00%
Floyd Hill	99.69%	3.94%	0.00%	100.00%	0.00%
St Mary's	93.33%	0.00%	2.75%	100.00%	0.00%
Upper Bear Creek	99.20%	0.00%	10.64%	100.00%	0.00%

According to Broadband Map USA<sup>4</sup>, CenturyLink provides DSL broadband technologies to most of the population in Clear Creek County. Fiber technology is only available in Idaho Springs, Silver Plume and

Floyd Hill, but only available to small percentages of the population (.99% in Idaho Springs, .27% in Silver Plume and 3.94% in Floyd Hill). The Downieville/Lawson/Dumont area has limited DSL, fiber and cable, but does have Wireless technology available. Cable technologies are not available to every community in Clear Creek.

### Wireline Broadband Availability and Speeds

There is a wide disparity of internet access across Clear Creek County. Most of the population in the incorporated towns in Clear Creek County (Georgetown, Idaho Springs, Silver Plume) have access to technology that meets the minimum definition of broadband: 25 Mbps in download and 3 Mbps in upload speed. 88.69% - 96.83% within these communities of Clear Creek County have wireline technology capable of supporting 25 Mbps in *download* speeds. Clear Creek County residents in Downieville, Lawson and Dumont are woefully underserved. Only 16.73% enjoy speeds meeting the minimum definition of broadband. Most of the population in St. Mary's and Upper Bear Creek do not have the minimum definition of broadband services.

<sup>4</sup> See <http://www.broadbandmap.gov/>



Wireline Broadband Availability								
Percent of Clear Creek County with Available Download Speeds								
	Georgetown	Idaho Springs	Silver Plume	Empire	Downieville Lawson Dumont	Floyd Hill	St Mary's	Upper Bear Creek
768k	100.00%	94.71%	98.57%	100.00%	51.58%	100.00%	93.33%	100.00%
1.5M	100.00%	94.71%	98.57%	100.00%	51.58%	100.00%	93.33%	100.00%
3 M	100.00%	94.71%	98.57%	93.20%	51.58%	100.00%	93.33%	100.00%
6 M	99.65%	94.71%	98.57%	93.20%	50.00%	99.69%	93.33%	51.51%
10 M	99.65%	93.13%	98.57%	93.20%	50.00%	97.30%	89.80%	51.51%
25 M	96.83%	90.09%	96.43%	93.20%	16.73%	88.69%	45.49%	10.64%
50 M	96.83%	90.09%	96.43%	93.20%	16.73%	3.94%	2.75%	10.64%
100 M	96.83%	90.09%	96.43%	93.20%	16.73%	3.94%	2.75%	10.64%
1 Gig	0.00%	0.99%	0.00%	0.00%	0.00%	3.94%	0.00%	0.00%

The Georgetown, Idaho Springs and Silver Plum residents (90.09-96.83%) have the opportunity to meet the FCC’s minimum of 3 Mbps in *upload* speeds. Higher speeds for uploading drop off after 10 Mbps. Only 16.73% of Downieville, Lawson and Dumont residents enjoy 3 Mbps *upload* speeds.

Wireline Broadband Availability								
Percent of Clear Creek County with Available Upload Speeds								
	Georgetown	Idaho Springs	Silver Plume	Empire	Downieville Lawson Dumont	Floyd Hill	St Mary's	Upper Bear Creek
200k	100.00%	94.71%	98.57%	100.00%	51.58%	100.00%	93.33%	100.00%
768k	100.00%	94.71%	98.57%	100.00%	50.00%	100.00%	93.33%	100.00%
1.5M	96.83%	90.09%	96.43%	93.20%	16.73%	92.43%	45.49%	100.00%
3 M	96.83%	90.09%	96.43%	93.20%	16.73%	92.43%	45.49%	100.00%
6 M	96.83%	90.09%	96.43%	93.20%	16.73%	87.55%	16.08%	10.64%
10 M	96.83%	90.09%	96.43%	93.20%	16.73%	87.55%	16.08%	10.64%
25 M	0.00%	0.99%	0.00%	0.00%	0.00%	3.94%	0.00%	0.00%
50 M	0.00%	0.99%	0.00%	0.00%	0.00%	3.94%	0.00%	0.00%
100 M	0.00%	0.99%	0.00%	0.00%	0.00%	3.94%	0.00%	0.00%
1 Gig	0.00%	0.99%	0.00%	0.00%	0.00%	3.94%	0.00%	0.00%

Wireless Broadband Availability and Speeds  
 Wireless broadband available in Clear Creek County does not support the minimum of 25 Mbps in download speeds but most (67.37-100%) of the population has access to wireless technology supporting 3 Mbps in upload speeds.

Wireless Broadband Availability								
Percent of Clear Creek County with Available Download Speeds								
	Georgetown	Idaho Springs	Silver Plume	Empire	Downieville Lawson Dumont	Floyd Hill	St Mary's	Upper Bear Creek
768k	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%
1.5M	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%
3 M	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%
6 M	99.00%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	67.37%
10 M	99.00%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	67.37%
25 M	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%
50 M	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%
100 M	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%
1 Gig	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%

Wireless Broadband Availability								
Percent of Clear Creek County with Available Upload Speeds								
	Georgetown	Idaho Springs	Silver Plume	Empire	Downieville Lawson Dumont	Floyd Hill	St Mary's	Upper Bear Creek
200k	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%
768k	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%
1.5M	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%
3 M	99.00%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	67.37%
6 M	0.00%	0.03%	0.00%	0.00%	0.00%	89.89%	0.00%	43.07%
10 M	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%
25 M	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%
50 M	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%
100 M	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%
1 Gig	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%

## Gilpin County Broadband Availability

Technology available to % of population					
City	DSL	Fiber	Cable	Wireless	Other
Black Hawk	57.39%	0.00%	100.00%	100.00%	0.00%
Central City	95.96%	0.00%	100.00%	100.00%	0.00%
Coal Creek	46.85%	0.00%	94.09%	100.00%	0.00%
Rollinsville	95.11%	0.00%	0.00%	100.00%	0.00%

In Gilpin County, according to Broadband Map USA<sup>5</sup>, CenturyLink provides DSL broadband technologies to the majority of Central City

<sup>5</sup> See <http://www.broadbandmap.gov/>

\*\* Broadbandmap.gov does not have a complete record set for Rollinsville and Coal Creek

and Rollinsville, but only 57% of the population in Black Hawk and 46.85% of Coal Creek have DSL service. Rollinsville does not have access to cable. Wireless connectivity is available in all the municipalities within Gilpin County.

Wireline Broadband Availability and Speeds

<b>Wireline Broadband Availability</b>				
<b>Percent of Gilpin County with Available Download Speeds</b>				
	<b>Black Hawk</b>	<b>Central City</b>	<b>Coal Creek</b>	<b>** Rollinsville</b>
768k	100.00%	100.00%	94.09%	95.11%
1.5M	100.00%	100.00%	94.09%	95.11%
3 M	100.00%	100.00%	94.09%	95.11%
6 M	100.00%	100.00%	94.09%	94.57%
10 M	100.00%	100.00%	0.00%	94.57%
25 M	100.00%	100.00%	0.00%	75.00%
50 M	100.00%	100.00%	0.00%	0.00%
100 M	0.00%	0.00%	0.00%	0.00%
1 Gig	0.00%	0.00%	0.00%	0.00%

<b>Wireline Broadband Availability</b>				
<b>Percent of Gilpin County with Available Upload Speeds</b>				
	<b>Black Hawk</b>	<b>Central City</b>	<b>Coal Creek</b>	<b>** Rollinsville</b>
200k	100.00%	100.00%	94.09%	95.11%
768k	100.00%	100.00%	94.09%	95.11%
1.5M	100.00%	100.00%	94.09%	75.00%
3 M	100.00%	100.00%	94.09%	75.00%
6 M	0.00%	0.00%	0.00%	72.83%
10 M	0.00%	0.00%	0.00%	72.83%
25 M	0.00%	0.00%	0.00%	0.00%
50 M	0.00%	0.00%	0.00%	0.00%
100 M	0.00%	0.00%	0.00%	0.00%
1 Gig	0.00%	0.00%	0.00%	0.00%

## Wireless Broadband Availability and Speeds

<b>Wireless Broadband Availability</b>				
<b>Percent of Gilpin County with Available Download Speeds</b>				
	<b>Black Hawk</b>	<b>Central City</b>	<b>Coal Creek</b>	<b>** Rollinsville</b>
768k	100.00%	100.00%	100.00%	100.00%
1.5M	100.00%	100.00%	100.00%	100.00%
3 M	100.00%	100.00%	100.00%	100.00%
6 M	100.00%	100.00%	100.00%	100.00%
10 M	100.00%	100.00%	100.00%	100.00%
25 M	0.00%	0.00%	0.00%	0.00%
50 M	0.00%	0.00%	0.00%	0.00%
100 M	0.00%	0.00%	0.00%	0.00%
1 Gig	0.00%	0.00%	0.00%	0.00%

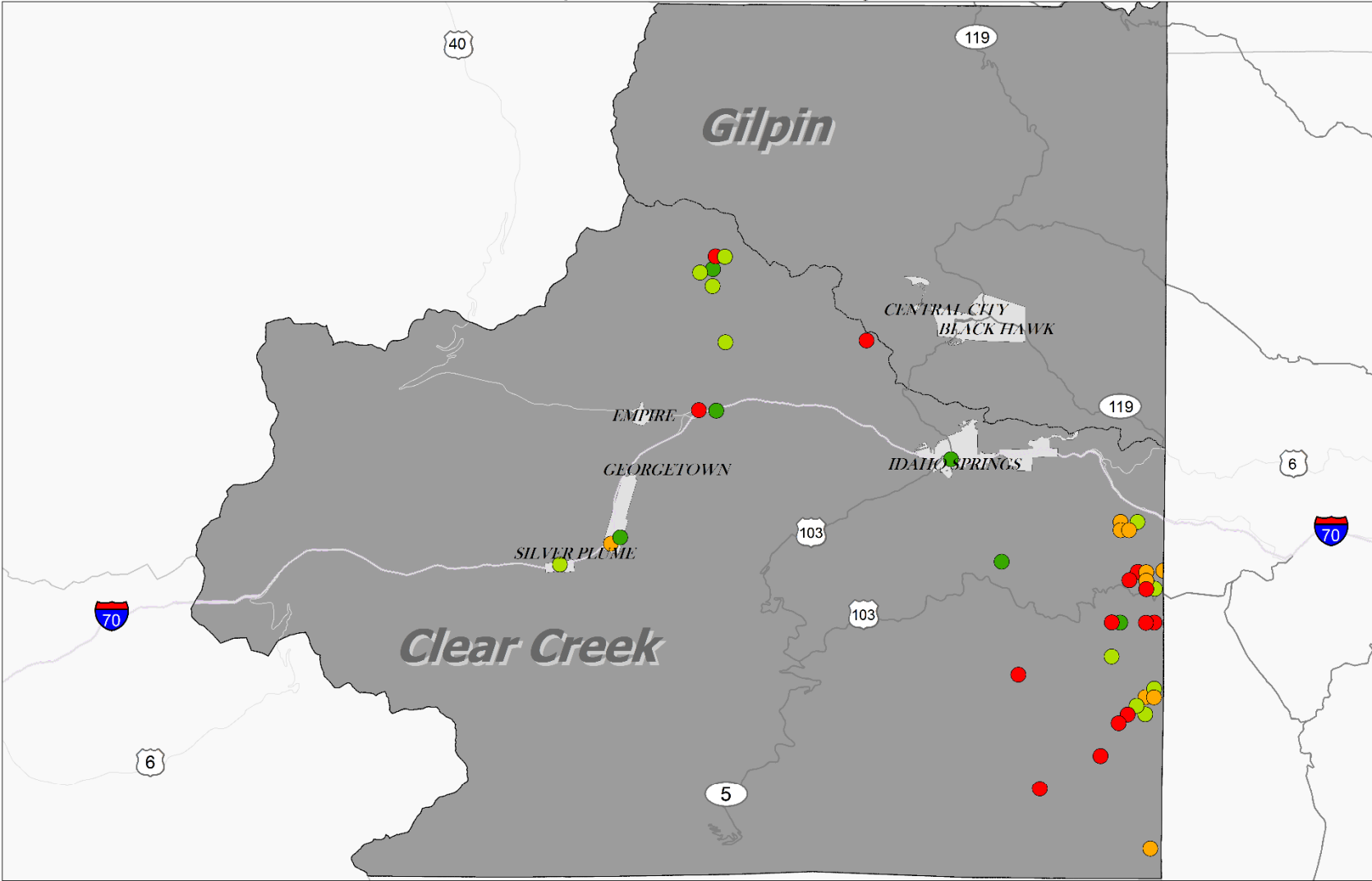
<b>Wireless Broadband Availability</b>				
<b>Percent of Gilpin County with Available Upload Speeds</b>				
	<b>Black Hawk</b>	<b>Central City</b>	<b>Coal Creek</b>	<b>** Rollinsville</b>
200k	100.00%	100.00%	100.00%	100.00%
768k	100.00%	100.00%	100.00%	100.00%
1.5M	100.00%	100.00%	100.00%	100.00%
3 M	100.00%	100.00%	100.00%	100.00%
6 M	22.61%	53.21%	93.70%	100.00%
10 M	22.61%	53.21%	0.00%	0.00%
25 M	0.00%	0.00%	0.00%	0.00%
50 M	0.00%	0.00%	0.00%	0.00%
100 M	0.00%	0.00%	0.00%	0.00%
1 Gig	0.00%	0.00%	0.00%	0.00%

The State of Colorado's OIT staff gathers statewide information from actual speed tests to validate and verify the data submitted by the service providers for the FCC database.

Consumer speed tests help to identify unserved and underserved areas within the state and provide real-world results, rather than advertised speeds. Other points of validation from the State of Colorado include drive testing of mobile services, and surveys from businesses and residences. During the broadband planning process, NEO conducted surveys from businesses and residences that directly respondents to the State of Colorado's speed test website.

Below is a map of the actual speed test results.

# Clear Creek & Gilpin Counties Broadband Speed Test Results by Location

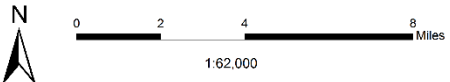


**Broadband Speed Test  
Download Speeds**

- <3 mbps Down
- 3 - 10 mbps Down
- 10 - 25 mbps Down
- > 25 mbps Down

- Interstate
- State Highways
- Major Roads
- Cities
- Counties

This map shows the broadband download speeds captured by OIT's speed test application. The information shown represents tests that were performed by the public from February 14th, 2017 through June 19, 2017, for Clear Creek and Gilpin Counties. The data has been classified based on the groups depicted in the legend. Only data with verifiable addresses are included, no tests results were beyond the classification cap.



**COLORADO**  
IT Economic Development  
& Broadband  
Governor's Office of Information Technology

Data: Colorado Broadband Data and Development Program  
Projection: UTM Zone 13N  
For questions or comments contact : [brent.seifeld@state.co.us](mailto:brent.seifeld@state.co.us)  
Date: 6/19/2017

Many of the speed tests show actual download speeds to be less than 3 Mbps, especially in unincorporated areas of the Counties.

## Section 2 – Survey Results and Community Outreach Meetings

NEO conducted two separate online surveys seeking community input on broadband services for Clear Creek and Gilpin Counties. The surveys were aimed at residential households and businesses and were distributed through the Counties' websites and newsletters.

As previously mentioned, as part of the survey, respondents were asked to conduct a speed test through the State of Colorado's website, noting actual residential Internet service speeds to determine whether or not citizens were meeting the new FCC definition of broadband service.

**For the residential survey respondents, xx% of the speed tests recorded were below the FCC's minimum broadband download threshold while xx% were below the upload threshold.**

### Summary of Residential Survey Results

The surveys were intended to seek additional comment and input from citizens regarding their broadband service. It could be said that only citizens that have a lack of broadband service or see broadband service as an important issue would respond to the surveys. This may very well be the case. Although the survey is a tool to solicit citizen engagement regarding broadband service, the 402 residential responses from both counties, strongly suggest the following:

#### What's Important

- Reliability is the most important factor for both counties, followed by speed and price. The greatest number of respondents in the residential survey support either having the local government step in or to have the local government work with the private sector to provide adequate service. Businesses responded in favor of the government working with the private sector to provide service.
- Most of the respondents indicated that upload and download speeds are slow.

- In Clear Creek County only 11% of respondents are happy with their download speed in terms of rating it “excellent” or “good”. In Gilpin county, more than half (54%) felt underserved.

### Telecommuting

Working from home is common among Gilpin and Clear Creeks homes as more than half (58%) of residential respondents have either one or two people working from home. Teleworkers typically need more robust service than the average residence.

Citizens are willing to pay on average \$65 per month for Faster Service  
 When asked how willing or unwilling they would be to switch to a service better service with a range of monthly prices, a large number residential respondents, roughly 80% would pay \$50/month.

<b>Respondents would spend</b>	<b>Gilpin</b>	<b>Clear Creek</b>
\$50	83.67%	76.19%
\$65	38.78%	42.38%
\$75	27.21%	37.62%
\$100 or more	19.05%	22.86%

This is significant because it provides insight for Clear Creek and Gilpin Counties on possible take rate percentages, or potential number of households that would sign up for better service at various price points. Take rate percentages are one of the most important components of the financial model for offering faster broadband services. For most Gigabit networks across the county, the financial model works with a take rate of 30-40%.

The City of Longmont is building out a Gigabit network and is offering services directly to their citizens and businesses. They have an introductory charter member rate of \$49.95 per month for residential services. On average, the City of Longmont is receiving a 47% take rate percentage of residents signing up for the service prior to even beginning construction of the network within their neighborhoods.

With survey results for the Clear Creek and Gilpin Counties showing 80% of the respondents would sign up for a service with \$50/month or even 19-23% stating they would sign up at a price point of \$100/month, there is a good indication that the financial model could support feasible take rate percentages with this range of price points. More due diligence and financial

modeling would need to be done in this regard; however, the preliminary data gathered from the survey can help inform the financial modeling process.

The range of what is currently being spent for Internet services varies. Thirty-six percent (36%) of Clear Creek and 47% of Gilpin residential subscribers pay at least \$56/month for Internet service while more than 1 out of 4 (26.5%) pay more than \$100/month.

### Role of Government

When asked about the primary role of the local government in broadband, the majority of respondents either support having the local government build a state of the art network or support a partnership between local governments and the private sector to provide adequate service to the public, including homes and businesses.

A question was posed to respondents who should step in if the private sector did not provide adequate or affordable broadband. Respondents had a choice between the local municipality, the county, the electric company, or a consortium or “I am not sure.” Most of the respondents responded with the last option – not sure who should fix it. This is often one of the most challenging areas of broadband planning – determining who is best received to step in and solve broadband challenges. Unfortunately, the survey responses do not give us the sure-thing solution on who should step in.

### Will Consider Moving if Broadband is not Adequate

One of the primary study areas in the survey explored the respondents’ thoughts regarding the role of government in solving broadband issues. The greatest number of respondents in the residential survey support either having the local government step in or to have the local government work with the private sector to provide adequate service.

## Summary of Business Survey Results

While the business surveys garnered fewer results than the residential survey (Gilpin had 29 and Clear Creek 33), findings are still informative:

- As with residences, reliability is the most important factor for businesses, followed by speed and price.
- In Gilpin County, 100% of the business respondents have employees that work from home at least one day a week. In Clear Creek County, the number is also significant at 93%.
- Three quarters (75%) of Gilpin County business surveyed businesses pay more than \$100/month for Internet service. Only 13% of surveyed businesses rate their Internet as “excellent” or “good.” 51% see their speed as “slow” or “very slow.”



- Fifty two percent (51.6%) of Clear Creek County businesses pay \$50-100/month for Internet Service. Only 12.9% of surveyed businesses rate their download speeds as “excellent” or “good.” 77.4% of respondents said they experienced “Very Slow” or “Slow” speeds.
- The average speeds recorded in Clear Creek County were 11.32 Mbps download and 3.65 Mbps upload. Gilpin County respondents reported average speeds recorded were 13.18 Mbps download and 2.56 Mbps upload.
- 75% of Clear Creek and 86% of Gilpin business owners think that Broadband is a utility.
- Respondents from both counties agreed strongly that their business operations are heavily tied to the Internet and that their demands on Internet bandwidth and speed are consistently increasing.
- Four out of five businesses say they would be more efficient followed but 36% saying they could expand their offerings with better broadband.
- Two-thirds of businesses either see it as “definitely” (26%) or “probably” (37%) the local government’s role to deliver adequate broadband service if the private sector does not provide adequate and affordable broadband service.

In addition to the surveys conducted to engage citizen feedback, NEO also engaged key stakeholders and the public through community outreach meetings. Detailed survey results and information from the community engagement meetings can be found in Appendix B, a supplement to this report.

# Section 3 - Current Funding Programs to Improve Broadband Service within Clear Creek and Gilpin County

There are several federal and state grant programs that have funded broadband implementation within the State of Colorado and the study area.

## Connect American Fund II

CenturyLink was awarded \$26 Million in annual grant funding per year for six years in Colorado through the federal high-cost program. The federal universal service high-cost program (also known as the Connect America Fund) is designed to ensure that consumers in rural, insular, and high-cost areas have access to modern communications networks capable of providing voice and broadband service, both fixed and mobile, at rates that are reasonably comparable to those in urban areas. The program fulfills this universal service goal by allowing eligible carriers who serve these areas to recover some of their costs from the federal Universal Service Fund.<sup>6</sup>

<b>CenturyLink CAF II Funding</b>			
<b>County Name</b>	<b>Homes and Businesses Supported</b>	<b>County Carrier Total Support</b>	<b>6 years Support</b>
Clear Creek, CO	326	\$ 148,779	\$892,676
Gilpin, CO	403	\$ 181,610	\$1,089,660
	<b>Total</b>	\$ 330,389	\$1,982,336

The goal of the Connect America Funding is to make infrastructure improvements to bring unserved and underserved areas to 10 Mbps in download availability and 1 Mbps in upload availability. Although this program will help some areas within the county, this program is more of a stop-gap measure than a good long-term plan. CenturyLink has received \$892,676 in funding over six years for Clear Creek County and \$1,982,336 for Gilpin County.

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<sup>6</sup> See <https://www.fcc.gov/general/universal-service-high-cost-areas-connect-america-fund>

## Previous Funding, EAGLE-Net

The American Recovery and Reinvestment Act of 2009 appropriated \$7.2 billion to expand broadband access to unserved and underserved communities across the U.S. Colorado's Centennial Board of Cooperative Educational Services (CBOCES), a state agency, was awarded \$100 Million to bring broadband service to school districts, libraries, and community anchor institutions across Colorado. The project was administered through the Educational Access Gateway Learning Environment Network (EAGLE-Net). EAGLE-Net is a hybrid of more than 1,600 miles of terrestrial fiber and 3,000 miles of microwave wireless broadband expanding services across each of Colorado's 64 counties<sup>7</sup>. This network infrastructure may also be leveraged for improving services in the study area.

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<sup>7</sup> See <http://www2.ntia.doc.gov/grantee/centennial-board-of-cooperative-educational-services-cboCES-transferred-to-eagle-net-alliance>

# Section 4 – Regulatory and Policy Recommendations

## Senate Bill 05-152

One of the barriers for improving broadband services in the State of Colorado has been the regulatory environment, specifically, the passing of a law that prohibits local governments from providing services to homes and businesses and limits local governments' involvement in building telecommunications infrastructure.

In 2005, the State of Colorado passed a bill that limits municipalities from building telecommunications infrastructure for end users (§ 29-27-101 to 304, C.R.S., commonly referred to as "SB-152".) This legislation is a barrier for Colorado communities in improving broadband capabilities and it limits the options for ownership and service delivery by municipalities, counties, and other local governments.

SB-152 generally requires an election before a local government may take various actions to provide Internet access service, cable television service, or telecommunications service to the public. The statute also requires "regulatory parity" between public and private providers of such services. Much of the statute concerns various exemptions from this requirement. For example, SB-152 provides that the law does not limit the authority of local governments to enter into agreements permitting private telecommunication service providers to lease space on government property for the placement of telecommunications equipment. Arrangements between municipalities and private telecommunication providers for placement of equipment such as cell phone antenna arrays are common. With this provision, no election is required in connection with such agreements. The statute also does not apply to government provision of various telecommunication service to citizens for governmental or intergovernmental purposes, including for use by persons "accessing government services." Governments commonly provide a variety of telecommunication services to citizens using its buildings and facilities; no election is required for this to continue. Furthermore, SB-152 makes clear that no election is required in order for governments to operate internal communications networks and to utilize such networks in cooperation with other governmental entities. Should local governments wish to sell insubstantial amounts of "excess capacity" on their networks, they may do so without an election, provided that the sale and use is made on an evenhanded, "competitively neutral" and "nondiscriminatory" basis.<sup>8</sup>

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<sup>8</sup> Geoff Wilson, Colorado Municipal League General Council brief of SB-152.

A local government can build any kind of a communications network, and can, without other authority, provide all of the services identified in this plan, but only to itself or other governmental/quasi-governmental entities. All of the services mentioned within this broadband blueprint would be considered advanced services if they are delivered at speeds in excess of 256 kbps. A government that has built a government network cannot expand and provide service directly to subscribers (as that term is defined in the statute), or enter into a public-private partnership without voter approval, unless it comes under one of the limited statutory exceptions.

Local governments can obtain exemption through a local ballot initiative to opt-out of SB-152. As of April 2017, more than 95 municipalities, counties and school districts have held public elections to opt out of SB-152. All of the favorable opt outs have passed overwhelmingly. Some communities (Estes Park, Durango and Telluride) passed with over 90% voting in favor of opting out of this restrictive bill, giving local governments the authority to solve broadband infrastructure gaps within their communities.

In November 2015 both Counties asked voters if they wanted to opt out of SB-152. Clear Creek County voters were in favor by 86%, Gilpin County's referendum passed by 75%. The Town of Black Hawk opted out in November of 2016 and Central City followed in the Spring of 2017. Voters in both communities passed the referendums with large margins.

In January 2017, there was proposed legislation to overturn SB-0152 completely. This did not go forward. Without an opt-out, cities and counties are limited in what they can do to improve broadband services. Cities and counties that have not opted out of SB-152 cannot enter into public-private partnerships to solve broadband issues for their constituents and they cannot build out telecommunications infrastructure except for government and quasi-government use.

## Broadband Friendly Policies and Ordinances

NEO recommends putting in place broadband friendly policies and ordinances to encourage further broadband infrastructure deployment by helping to reduce the capital costs of fiber builds. These policies also encourage the following:

- 1. Reduce the cost of construction for broadband networks.** 60-80% of a fiber optic network's capital costs are in opening a trench or in burying conduit that will house fiber optic cable. Policies that encourage placement of fiber in coordination with other government capital

projects (sidewalks, trails, lighting, and road projects) and coordination with other utility projects by others - may all be opportunities to install conduit.

NEO recommends implementation of a *Dig Once Policy* that has the following components:

- ✓ All public works or installation of other telecom, cable or utility infrastructure allows for conduit to be placed on behalf of the City and any other entities that want to participate. If there is an open trench, the policy provides for coordination of street cuts and excavations with utilities, public works, developers and other interested parties to maximize the opportunity for broadband conduit installation, and to minimize cost, disruption and damage.
- ✓ Allows for a notice period informing other entities that an open trench will be available for placement of their conduit and/or fiber optic facilities.
- ✓ Allows for shadow conduit to be placed for the Town, City or County. Installation of empty and/or space conduit by a public agency when excavations occur in the public right of way, with agency (Town, City or County) costs limited to incremental costs.

Additionally, NEO recommends that the various government agencies establish *Joint Trench Agreements* and *Joint Build Agreements* with other telecommunications, cable, gas line, or utility providers. Cost for placement of conduit or fiber will be shared amongst all entities, allowing each entity to take advantage of trenches that have been opened through each other's projects and allows for sharing of capital costs for any conduit and/or fiber builds. Standardization of these agreements across all potential owners of underground infrastructure can be established to ensure all parties are aware of the joint trenching opportunities as they become available.

NEO also recommends a *Streamlined Permitting Process* – placing responsibility for approval of broadband infrastructure projects solely in the public works department via encroachment permit processes. An *Abandoned Fiber and Conduit Policy* can be put in place if any abandoned fiber and/or conduit that are not claimed by the owner within a reasonable time period, the ownership of that conduit and/or fiber would revert to the local government agency.

We do realize that much of the gas line work does not necessarily follow easements or county roads; and therefore, the Dig Once policy may not apply. As there is still development of the Counties' unincorporated areas, implementing a *Land Use Policy* for new master planned communities or subdivisions to install conduit that will be used for fiber optic services may help mitigate the costs of installing fiber optic facilities after the trenches have been closed.

Another effective strategy may be to have the cities and towns within both Counties adopt these policies.

**2. Encourage standards for placement of conduit and/or fiber in new developments.**

Integrating broadband “utility” codes into land development policies and ordinances to ensure that new real estate developments incorporate a standard placement of conduit and/or fiber optic facilities. The land development codes could require new land developments, new real estate developments and/or newly built homes and office buildings to install fiber optic infrastructure. New building codes could describe specific compatible communications components and architectures into each new building, and could describe development and use of municipal/county right-of-way for communications connectivity, and could specify standardized specific wiring requirements for new buildings.

**3. Set up funding mechanisms to allow for adoption of these policies.** Conduit is not expensive. However, if the funding mechanism does not exist to place conduit, often opportunities to take advantage of open trenches or joint builds do not occur. A funding set-aside or budget process must be put in place to allow for adoption of these policies. The funding mechanism will allocate monies to build broadband infrastructure when opportunities arise and the fund would maintain a reserve or set-aside for unanticipated projects.

**4. Keep a GIS database of all infrastructure, and provide for a process to submit plans.** Any permit for work done within the right-of-way or for new developments would require as-built drawings to be submitted to routinely document conduit and other broadband asset data into a geographic information system. The policy could establish a requirement that plans and as-built drawings and other information be submitted by utilities, developers, contractors and others in an appropriate GIS format.

NEO provided sample policy and ordinance language that other communities have implemented for all of the above policy recommendations. NEO also provided information regarding compliance with the FCC Order on Mandatory Wireless Facilities Collocation.

# Section 5 – Middle Mile Infrastructure Connecting Communities and Anchor Institutions

## Middle Mile Infrastructure

Bringing high-speed Internet and data communications capacity into and between communities and to an Internet hub is often referred to as “Middle Mile Infrastructure.” Broadband networks require access to an Internet “supply” – locations where there is an Internet hub, backhaul or transport point, located in high population centers. These Internet hubs can either be accessed by building fiber directly to the location, utilizing a point-to-point digital microwave link or leasing existing infrastructure. The costs for leasing existing facilities or backhaul are often based upon mileage. In either of these options, the costs to build directly from the Internet “supply” to rural areas are extremely capital intensive and/or the monthly access charges for leasing infrastructure are too high.

In rural areas, incumbent providers have infrastructure to link fiber back to these Internet hubs. The Internet hubs for this region are based in Albuquerque, Farmington, Denver, Salt Lake City or Grand Junction. However, CenturyLink to date has not allowed other entities or local governments to “tap into their fiber” to extend a network, as is common for new homes to tap into a main waterline. CenturyLink has recently allowed other ISPs to lease dark fiber for connectivity to the various communities, but their excess fiber is limited and they, in most cases, are the only company that has fiber in the region and therefore, the lack of competition still does not drive down backhaul costs.

There are three approaches possible for building middle mile infrastructure between the communities:

- 1. Lease Dark Fiber or Lit High Speed Services from Existing Providers.** Mammoth Networks is a wholesale provider of CenturyLink’s services and could provide a monthly lease of dark fiber if CenturyLink has capacity on its network, or Lit High Speed Services.



**2. Build Middle Mile Fiber.** Instead of building a new fiber optic network connecting the communities, the Counties could consider leasing dark fiber through a monthly dark fiber lease or through an Indefeasible Right of Use (IRU) agreement. An IRU agreement typically is paid up front, with a discount factor, and gives the purchaser twenty years of exclusive use of this fiber.

**3. Build a Wireless Backhaul Network.** Section 6 discusses the capital costs and towers that could potentially be used to build a wireless backhaul network.

As discussed in the Introduction, CDOT has fiber along I-70 from Denver to Glenwood Springs and leases fiber to CenturyLink and Comcast. Union Pacific has fiber that is leased to Level 3, CenturyLink and Comcast. The capital costs to build fiber to all of the communities within the two Counties may be cost-prohibitive. As there is excess fiber available through the study area, the Counties may want to lease dark fiber facilities or acquire an IRU from CDOT to drive down costs.

### More on CDOT

CDOT has fiber that has been installed along the I-70 corridor from Denver to Glenwood Springs. This fiber is owned by CDOT and is shared amongst public and private entities. CDOT is investing in fiber optic facilities, per their website, to “facilitate the use of technology to quickly detect and verify traffic incidents, allowing CDOT to work with law enforcement and emergency responders to ensure fast, appropriate levels of response to incidents, thereby increasing the ability to save lives. Building out this technology will also allow the department to monitor and detect rapidly changing weather conditions and quickly relay this information to travelers.” Investments in telecommunications backbone or fiber facilities are connected to the CDOT Transportation Management Center in Golden. This center is responsible for disseminating statewide traveler information, including weather, traffic congestion, and travel route information. Information is disseminated to travelers via message boards, phone apps, and other means. CDOT also uses information from the backbone to make operational decisions such as when and how to initiate road maintenance projects.

CDOT is also implementing infrastructure to support its “Connected Vehicles” applications. These applications include vehicle-to-vehicle and vehicle-to-infrastructure communications, which is part of a federal traffic management initiative that envisions facilitating communication between vehicles and infrastructure to increase safety and mobility and decrease the environmental impact of driving. Through communications interconnection, the traffic management infrastructure will help vehicles to avoid crashes while reducing traffic

congestion and associated fuel use. A reliable, high-speed communications network is required to implement Connected Vehicles technology.

CDOT also uses this infrastructure to connect its network to the Nationwide Public Safety Broadband Network, and create a platform to work with neighboring states to provide levels of transportation services that travelers expect.

CDOT has implemented these strategies through deployment of their RoadX project. Again, according to the CDOT website, “The RoadX program will employ a multi-pronged DO-IT (deployment, operations, innovation, technology) approach with the objective of being the most efficient, agile, and flexible system for bringing transportation technology to market. The RoadX program will implement several efforts along the DO-IT spectrum in 2016–18. CDOT plans to partner with private industry and others to deploy advanced technology to reduce the cost of transporting goods by 25%; to turn a rural state highway into a zero-death road; and to improve congestion on Colorado’s critical corridors.”<sup>9</sup>

## Other Electric Companies as Potential Partners

Electric companies and cooperatives throughout the State of Colorado have deployed fiber between some of their substations and have been good partners to potentially help with middle mile infrastructure deployment. Xcel Energy and/or Intermountain Rural Electric may be good partners to further develop middle mile strategies. Both companies may have a need to connect their substations throughout Clear Creek and Gilpin Counties . Deploying fiber using existing utility lines and poles is sometimes a less expensive alternative than underground construction. Use of Xcel Energy’s utility lines and poles may be an attractive alternative to build fiber between communities in Clear Creek and Gilpin Counties .

One of the challenges with use of fiber deployed either by Xcel Energy or other electric companies, is the need to perfect easements for commercial use. Perfecting easements can be a time-consuming and uncertain endeavor, as not knowing how long it will take or how much it may cost can be concerning; however, there is much precedent that has been set across the state in gaining success throughout this process.

## Aggregate Demand, Connecting Anchor Institutions

One way to help improve broadband services within Clear Creek and Gilpin Counties is to build or lease middle mile and backhaul infrastructure and to aggregate the demand for high

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<sup>9</sup> See <https://www.codot.gov/programs/roadx>

speed Internet services. Instead of individual leases for high speed Internet at each anchor institution, Internet service could be shared amongst all communities and key community facilities if they were connected by a fiber optic network. This is referred to as aggregating demand for services. **Currently anchor tenants and service providers are paying \$3,000 - \$5,000 per month for 1 Gbps.** The network could be built in such a way to reduce the monthly access fees and to share in the costs of these monthly fees by aggregating usage over the regional network. **Targeted pricing for 1 Gbps service after the network has been implemented is \$1,200 - \$1,500 per month, a dramatic 75-90% less than what is currently being charged.** With the ability to aggregate and allocate bandwidth, the cost for backhaul charges based upon mileage is dramatically reduced.

### Capital Costs Connecting Anchor Institutions

NEO updated the Community Anchor Institution list provided by the Colorado State OIT Department and verified this information with key stakeholders on the Local governments. This list includes schools, municipal and county locations, medical facilities and clinics, and libraries.

NEO's team mapped the list of community anchor institutions and conducted a preliminary design to build fiber to each of the anchor institutions. Below is a map of the entire study area, showing the routes for connecting the anchor institutions. Following that are the maps of the preliminary design and the estimated capital costs for building fiber to each of the anchor institutions within each community for the study area.

# Building Fiber to the Anchor Institutions

## Clear Creek County

City	DUMONT	EMPIRE	EVERGREEN	GEORGETOWN	IDAHO SPRINGS	SILVER PLUME	TOTAL COST
Total CAIs	5	3	6	12	22	2	50
Healthcare	\$ -	\$ -	\$ -	\$ -	\$ 20,613	\$ -	\$ 20,613
Schools	\$ -	\$ -	\$ 2,686,550	\$ 30,022	\$ 99,365	\$ -	\$ 2,815,938
Other	\$ 255,104	\$ 39,155	\$ 287,612	\$ 92,130	\$ 1,579,027	\$ 56,088	\$ 2,309,116
<b>Totals</b>	<b>\$ 255,104</b>	<b>\$ 39,155</b>	<b>\$ 2,974,162</b>	<b>\$ 122,152</b>	<b>\$ 1,699,005</b>	<b>\$ 56,088</b>	<b>\$ 5,145,667</b>

Total without Evergreen: \$2,171,505

## Gilpin County

City	BLACKHAWK	CENTRAL CITY	GOLDEN	ROLLINSVILLE	TOTAL
Total CAIs	10	6	3	2	21
Healthcare	\$ 5,500	\$ -	\$ -	\$ -	\$ 5,500
Schools	\$ 342,656	\$ -	\$ -	\$ -	\$ 342,656
Other	\$ 78,761	\$ 81,471	\$ 1,360,052	\$ 22,563	\$ 1,542,848
<b>Totals</b>	<b>\$ 426,917</b>	<b>\$ 81,471</b>	<b>\$ 1,360,052</b>	<b>\$ 22,563</b>	<b>\$ 1,891,004</b>

Total without Golden: \$530,952

# Gilpin and Clear Creek Counties



## Clear Creek County Anchor Institution Builds

### Dumont

Charlies Place Animal Shelter	500 W Dumont Rd Dumont Co 80436	Dumont
Clear Creek Authority Fire Station 1	681 County Road 308 Dumont Co 80436	Dumont
Fleet Maintenance Shop	261 Cr 308 Dumont Co 80436	Dumont
Animal Shelter	3349 Cr 312 Dumont Co 80436	Dumont
Road & Bridge	3549 Cr 312 Dumont Co 80436	Dumont

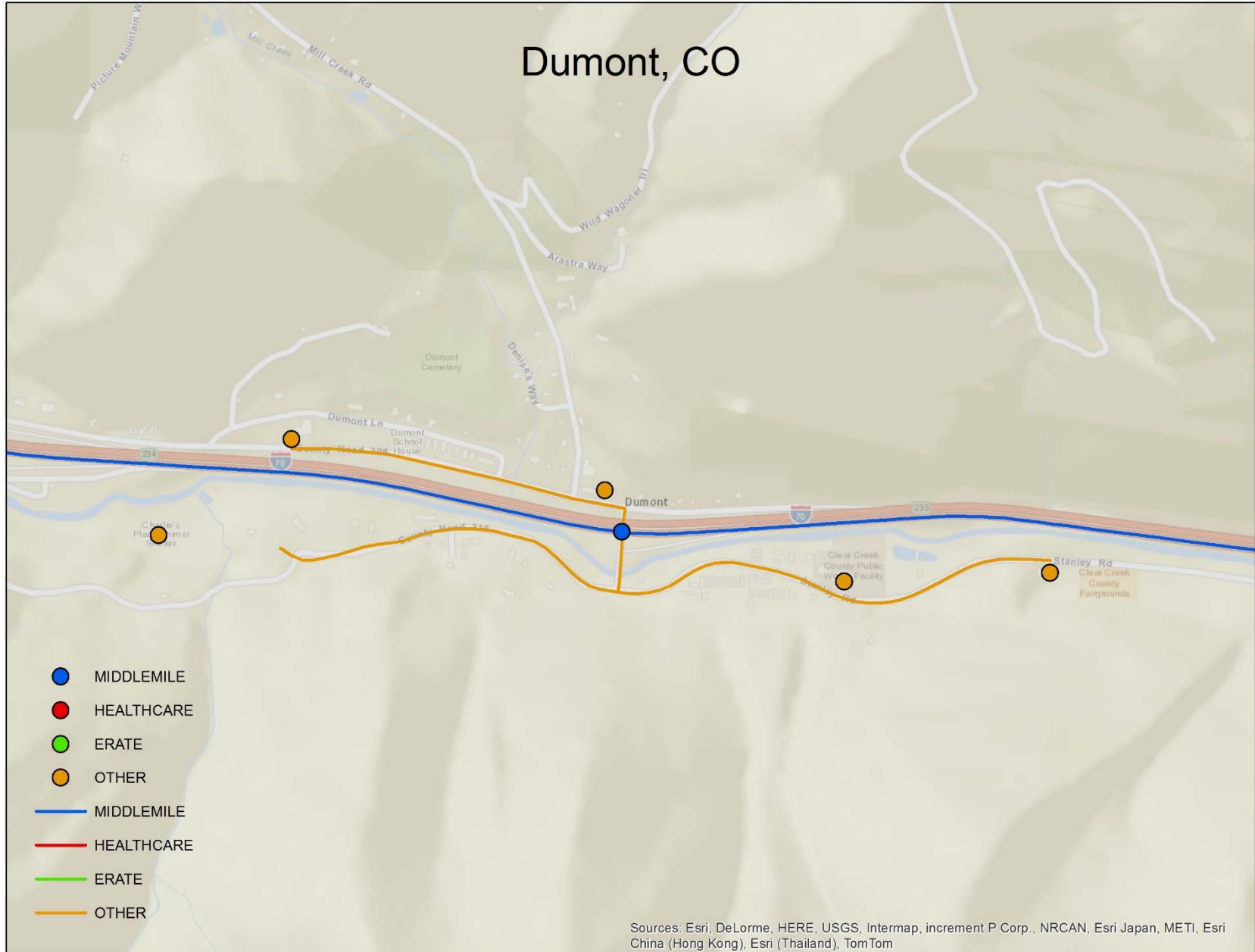
The anchor institutions were sorted by medical and healthcare, schools and the remaining anchor institutions are referred to as “other.” Since the community of Dumont does not have medical facilities, all anchors institutions fall under the “other” category. If Dumont were to build to all of the anchor institutions, the projected capital costs are estimated at \$255,104.

City	DUMONT
Total CAIs	5
Healthcare	\$ -
Schools	\$ -
Other	\$ 255,104
<b>Totals</b>	<b>\$ 255,104</b>

A detailed breakdown of the engineering, construction management, construction labor and materials is shown below.

<b>Other Anchor Institutions</b>	
<b>City</b>	<b>DUMONT</b>
New (FT)	8,208.00
New (Miles)	1.55
CAIs	5
Fiber Ct	0
Aerial Fiber (FT)	7,387.20
Underground Fiber (FT)	820.80
Engineering Costs	\$ 17,237
Permitting	\$ 466
Make Ready Cost	\$ 39,175
Aerial Labor Cost	\$ 88,646
Underground Labor Cost	\$ 28,728
Tech Services Cost	\$ 11,081
Materials Cost	\$ 27,907
Electronics	\$ 27,500
Construction Management	\$ 6,156
Project Management	\$ 8,208
<b>Total Construction Costs</b>	<b>\$ 255,104</b>

# Dumont, CO





Empire

Below are the anchor institutions within the Town of Empire.

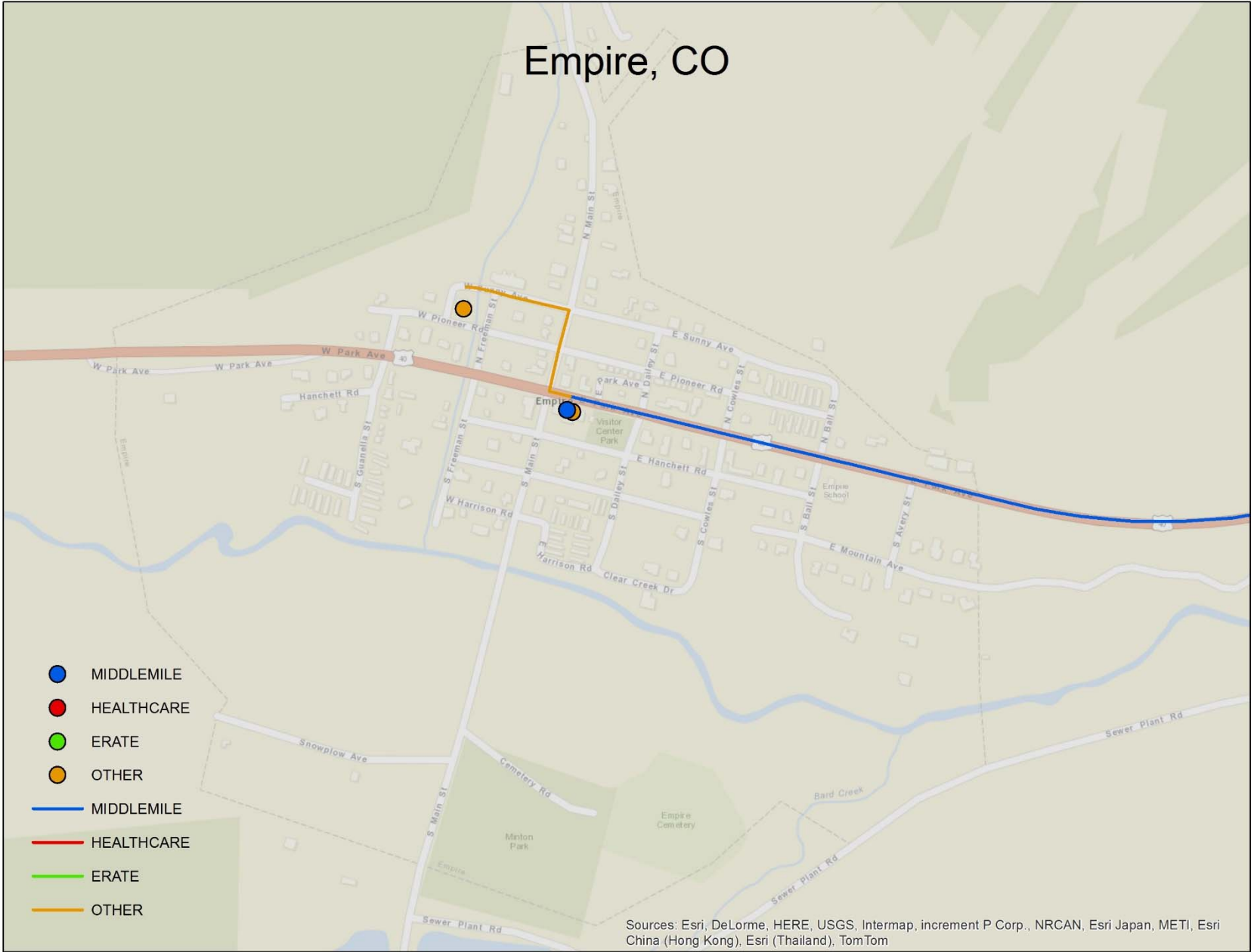
Empire Police Department	18 East Park Avenue Empire Co 80438
Clear Creek Authority Fire Station 3	203 North Guanella Street Empire Co 80438

City	EMPIRE
Total CAIs	3
Healthcare	\$ -
Schools	\$ -
Other	\$ 39,155
<b>Totals</b>	<b>\$ 39,155</b>

If the Town of Empire were to build to all of the anchor institutions, the projected capital costs are estimated at \$39,155. Empire does not have medical or educational Anchor Institutions.

Other Anchor Institutions	
City	EMPIRE
New (FT)	817.00
New (Miles)	0.15
CAIs	3
Fiber Ct	0
Aerial Fiber (FT)	735.30
Underground Fiber (FT)	81.70
Engineering Costs	\$ 1,716
Permitting	\$ 46
Make Ready Cost	\$ 3,899
Aerial Labor Cost	\$ 8,824
Underground Labor Cost	\$ 2,860
Tech Services Cost	\$ 1,103
Materials Cost	\$ 2,778
Electronics	\$ 16,500
Construction Management	\$ 613
Project Management	\$ 817
<b>Total Construction Costs</b>	<b>\$ 39,155</b>

# Empire, CO



Sources: Esri, DeLorme, HERE, USGS, Intermap, increment P Corp., NRCAN, Esri Japan, METI, Esri China (Hong Kong), Esri (Thailand), TomTom

Evergreen

Below are the anchor institutions within unincorporated Clear Creek County that have an Evergreen address. There is an estimate of the capital expenditure necessary to connect to each of them.

Clear Creek Middle School	185 Beaver Brook Canyon	Evergreen	Clear Creek
Clear Creek High School	185 Beaver Brook Canyon Evergreen Co 80439	Evergreen	Clear Creek
Clear Creek Authority Fire Station 6	35713 Highway 40 Evergreen Co 80439	Evergreen	Clear Creek
King-Murphy Elementary School	425 Circle K Road Evergreen Co 80439	Evergreen	Clear Creek
R&B Maint. Storage Bldg.	45 Apade Way Evergreen Co 80444	Evergreen	Clear Creek
Evergreen Fire Protection District Station 5	59 Echo Lake Drive Evergreen Co 80439	Evergreen	Clear Creek

If the Clear Creek County were to build to all of the Evergreen anchor institutions, the projected capital costs are estimated at \$2,974,162 .

City	EVERGREEN
Total CAIs	6
Healthcare	\$ -
Schools	\$ 2,686,550
Other	\$ 9,777
<b>Totals</b>	<b>\$ 2,974,162</b>

A detailed breakdown of the engineering, construction management, construction labor and materials is shown below.

E-rate, Schools	
City	EVERGREEN
New (FT)	96289
New (Miles)	18.24
CAIs	3
Fiber Ct	
Aerial Fiber (FT)	86660.1
Underground Fiber (FT)	9628.9
Engineering Costs	\$ 202,207
Permitting	\$ 5,471
Make Ready Cost	\$ 459,561
Aerial Labor Cost	\$ 1,039,921
Underground Labor Cost	\$ 337,012
Tech Services Cost	\$ 129,990
Materials Cost	\$ 327,383
Electronics	\$ 16,500
Construction Management	\$ 72,217
Project Management	\$ 96,289
<b>Total Construction Costs</b>	<b>\$ 2,686,550</b>

Other Anchor Institutions	
City	EVERGREEN
New (FT)	9,777.00
New (Miles)	1.85
CAIs	3
Fiber Ct	
Aerial Fiber (FT)	8,799.30
Underground Fiber (FT)	977.70
Engineering Costs	\$ 20,532
Permitting	\$ 556
Make Ready Cost	\$ 46,663
Aerial Labor Cost	\$ 105,592
Underground Labor Cost	\$ 34,220
Tech Services Cost	\$ 13,199
Materials Cost	\$ 33,242
Electronics	\$ 16,500
Construction Management	\$ 7,333
Project Management	\$ 9,777
<b>Total Construction Costs</b>	<b>\$ 287,612</b>

## Georgetown

Below are the anchor institutions within the Town of Georgetown and an estimate of the capital expenditure necessary to connect to them.

Loop Office Building - Railroad House	1111 Rose St Georgetown Co 80444	Georgetown
Georgetown Police Department - Headquarters	401 Argentine St Georgetown Co 80444	Georgetown
Georgetown Town Hall	404 6th Street Georgetown Co 80444	Georgetown
Clear Creek County	404 6th Street Georgetown Co 80444	Georgetown
Clear Creek County Jail	405 Argentine Street Georgetown Co 80444	Georgetown
Clear Creek County Sheriffs Office	405 Argentine Street Georgetown Co 80444	Georgetown
Georgetown Community School	405 Argentine Street Georgetown Co 80444	Georgetown
John Tomay Memorial Library	504 14th Street Georgetown Co 80444	Georgetown
Da Office	605 6th Street Georgetown Co 80444	Georgetown
Clear Creek Authority Fire Station 4	619 5th St Georgetown Co 80444	Georgetown
House - [Used As Office]	750 Brownell Street IGeorgetown Co 80444	Georgetown
	403 Argentine Georgetown Co 80444	Georgetown

If the Town of Georgetown were to build to all of the anchor institutions, the projected capital costs are estimated at \$510,286. This assumes using any existing City-owned fiber. If privately-owned fiber can be used, the capital costs would be \$122,152.

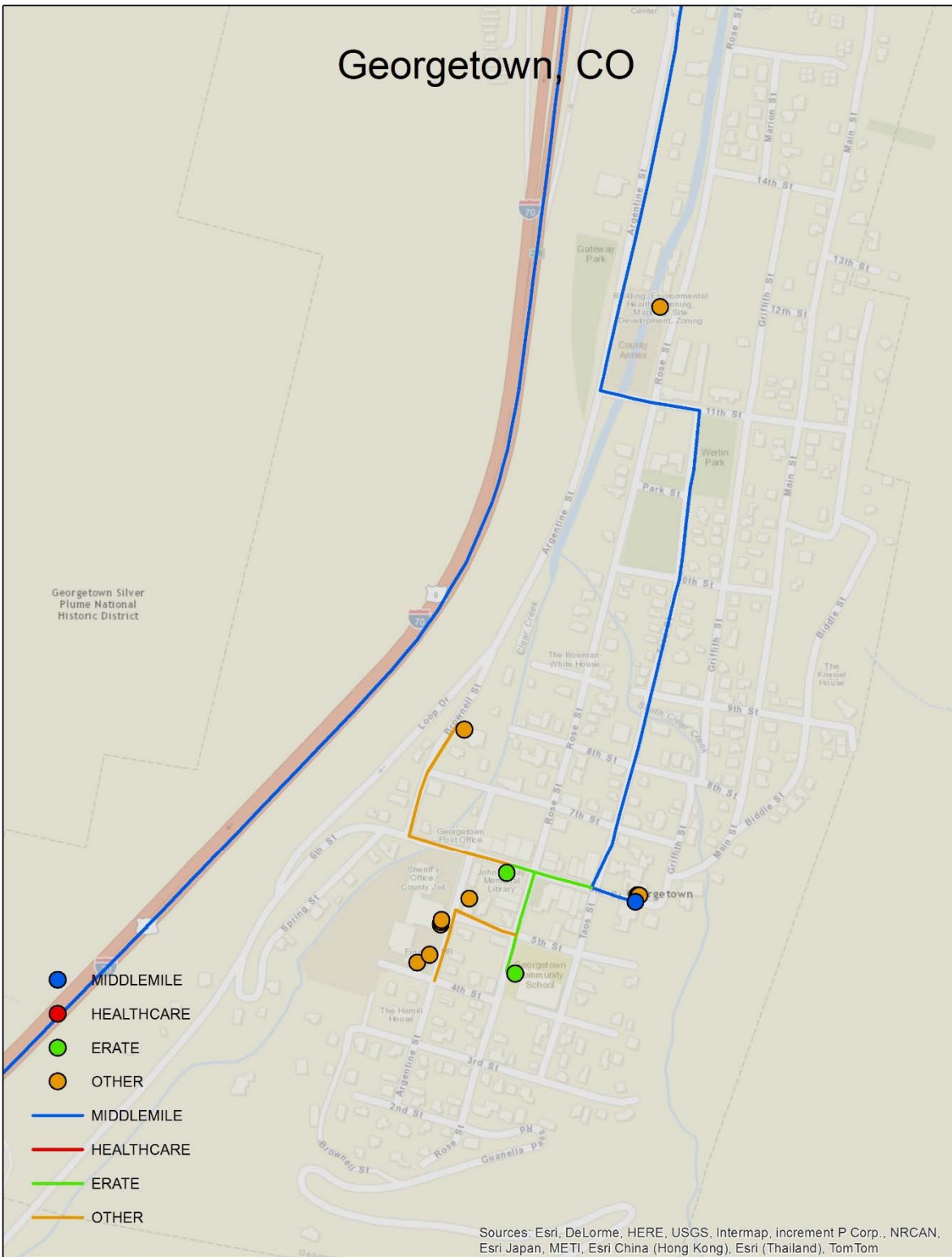
City	GEORGETOWN
Total CAIs	12
Healthcare	\$ -
Schools	\$ 30,022
Other	\$ 92,130
<b>Totals</b>	<b>\$ 122,152</b>

A detailed breakdown of the engineering, construction management, construction labor and materials is shown below.

<b>E-rate, Schools</b>	
<b>City</b>	<b>GEORGETOWN</b>
New (FT)	686
New (Miles)	0.13
CAIs	2
Fiber Ct	0
Aerial Fiber (FT)	617.4
Underground Fiber (FT)	68.6
Engineering Costs	\$ 1,441
Permitting	\$ 39
Make Ready Cost	\$ 3,274
Aerial Labor Cost	\$ 7,409
Underground Labor Cost	\$ 2,401
Tech Services Cost	\$ 926
Materials Cost	\$ 2,332
Electronics	\$ 11,000
Construction Management	\$ 515
Project Management	\$ 686
<b>Total Construction Costs</b>	<b>\$ 30,022</b>

<b>Other Anchor Institutions</b>	
<b>City</b>	<b>GEORGETOWN</b>
New (FT)	1,339.00
New (Miles)	0.25
CAIs	10
Fiber Ct	0
Aerial Fiber (FT)	1,205.10
Underground Fiber (FT)	133.90
Engineering Costs	\$ 2,812
Permitting	\$ 76
Make Ready Cost	\$ 6,391
Aerial Labor Cost	\$ 14,461
Underground Labor Cost	\$ 4,687
Tech Services Cost	\$ 1,808
Materials Cost	\$ 4,553
Electronics	\$ 55,000
Construction Management	\$ 1,004
Project Management	\$ 1,339
<b>Total Construction Costs</b>	<b>\$ 92,130</b>

# Georgetown, CO



## Idaho Springs

Below are the anchor institutions within the City of Idaho Springs

US Forest Service (Exit 240)	101 Highway 103, Idaho Springs Co 80452	Idaho Springs
Medical Building	115 15Th Ave Idaho Springs Co 80452	Idaho Springs
Clear Creek Authority Fire Station 9	1181 York Gulch Road Idaho Springs Co 80452	Idaho Springs
Carlson Elementary School	1300 Miner Street Idaho Springs Co 80452	Idaho Springs
Jordan Property	1335 E. Idaho Springs Road Idaho Springs Co 80452	Idaho Springs
Clear Creek County Public and Environmental Health Agency	1531 Colorado Boulevard Idaho Springs Co 80452	Idaho Springs
Colorado Workforce - Jeffco - Clear Creek Idaho Springs	1531 Colorado Boulevard Idaho Springs Co 80452	Idaho Springs
Storage	1532 Soda Creek Rd Idaho Springs Co 80452	Idaho Springs
City Of Idaho Springs	1711 Miner Street Idaho Springs Co 80452	Idaho Springs
Lumber Yard (potential future site of clinic)	1965 Miner St	Idaho Springs
Clear Creek Authority Fire Station 2	2000 Colorado Boulevard Idaho Springs Co 80452	Idaho Springs
Idaho Springs Public Library	219 14th Avenue Idaho Springs Co 80452	Idaho Springs
Ambulance Barn	240 Colorado 103 Idaho Springs Co 80452	Idaho Springs
Colorado State Patrol - Troop 6B	3000 Colorado Boulevard Idaho Springs Co 80452	Idaho Springs
Idaho Springs Police Department	3000 Colorado Boulevards Idaho Springs Co 80452	Idaho Springs
Clear Creek Re-1	320 Highway 103 Idaho Springs Co 80452	Idaho Springs
Clear Creek Emergency Medical Services	3400 Stanley Road Idaho Springs Co 80452	Idaho Springs
Clear Creek Authority Fire Station 7	463 Silver Creek Road Idaho Springs Co 80452	Idaho Springs
Control Building	1531 Soda Creek Rd Idaho Springs Co 80452	Idaho Springs
Old Office - County Administration	1531 Soda Creek Rd Idaho Springs Co 80452	Idaho Springs
Recycling	1531 Soda Creek Rd Idaho Springs Co 80452	Idaho Springs
Shult 47' Trailer - Social/Human Services	1531 Soda Creek Rd Idaho Springs Co 80452	Idaho Springs

If the City of Idaho Springs were to build to all of the anchor institutions, the projected capital costs are estimated at \$1,699,005.

City	IDAHO SPRINGS
Total CAIs	22
Healthcare	\$ 20,613
Schools	\$ 99,365
Other	\$ 1,579,027
<b>Totals</b>	<b>\$ 1,699,005</b>

A detailed breakdown of the engineering, construction management, construction labor and materials is shown below

Healthcare Anchor Institution Estimates	
City	IDAHO SPRINGS
New (FT)	545
New (Miles)	0.10
CAIs	1
Fiber Ct	0.00
Aerial Fiber (FT)	491
Underground Fiber (FT)	55
Engineering Costs	1145
Permitting	31
Make Ready Cost	2601
Aerial Labor Cost	5886
Underground Labor Cost	1908
Tech Services Cost	736
Materials Cost	1853
Electronics	5500
Construction Management	409
Project Management	545
<b>Total Construction Costs</b>	<b>\$ 20,613</b>

E-rate, Schools	
City	IDAHO SPRINGS
New (FT)	2790
New (Miles)	0.53
CAIs	4
Fiber Ct	0
Aerial Fiber (FT)	2511
Underground Fiber (FT)	279
Engineering Costs	\$ 5,859
Permitting	\$ 159
Make Ready Cost	\$ 13,316
Aerial Labor Cost	\$ 30,132
Underground Labor Cost	\$ 9,765
Tech Services Cost	\$ 3,767
Materials Cost	\$ 9,486
Electronics	\$ 22,000
Construction Management	\$ 2,093
Project Management	\$ 2,790
<b>Total Construction Costs</b>	<b>\$ 99,365</b>

Other Anchor Institutions	
City	IDAHO SPRINGS
New (FT)	53,572.00
New (Miles)	10.15
CAIs	17
Fiber Ct	0
Aerial Fiber (FT)	48,214.80
Underground Fiber (FT)	5,357.20
Engineering Costs	\$ 112,501
Permitting	\$ 3,044
Make Ready Cost	\$ 255,685
Aerial Labor Cost	\$ 578,578
Underground Labor Cost	\$ 187,502
Tech Services Cost	\$ 72,322
Materials Cost	\$ 182,145
Electronics	\$ 93,500
Construction Management	\$ 40,179
Project Management	\$ 53,572
<b>Total Construction Costs</b>	<b>\$ 1,579,027</b>



# Idaho Springs, CO



Sources: Esri, DeLorme, HERE, USGS, Intermap, increment P Corp., NRCAN, Esri Japan, METI, Esri China (Hong Kong), Esri (Thailand), TomTom

Silver Plume

Below are the anchor institutions within the Town of Silver Plume.

Clear Creek Authority Fire Station 8	345 Main Street Silver Plume Co 80476	Silver Plume
Town of Silver Plume	360 Main Street Silver Plume Co 80476	Silver Plume

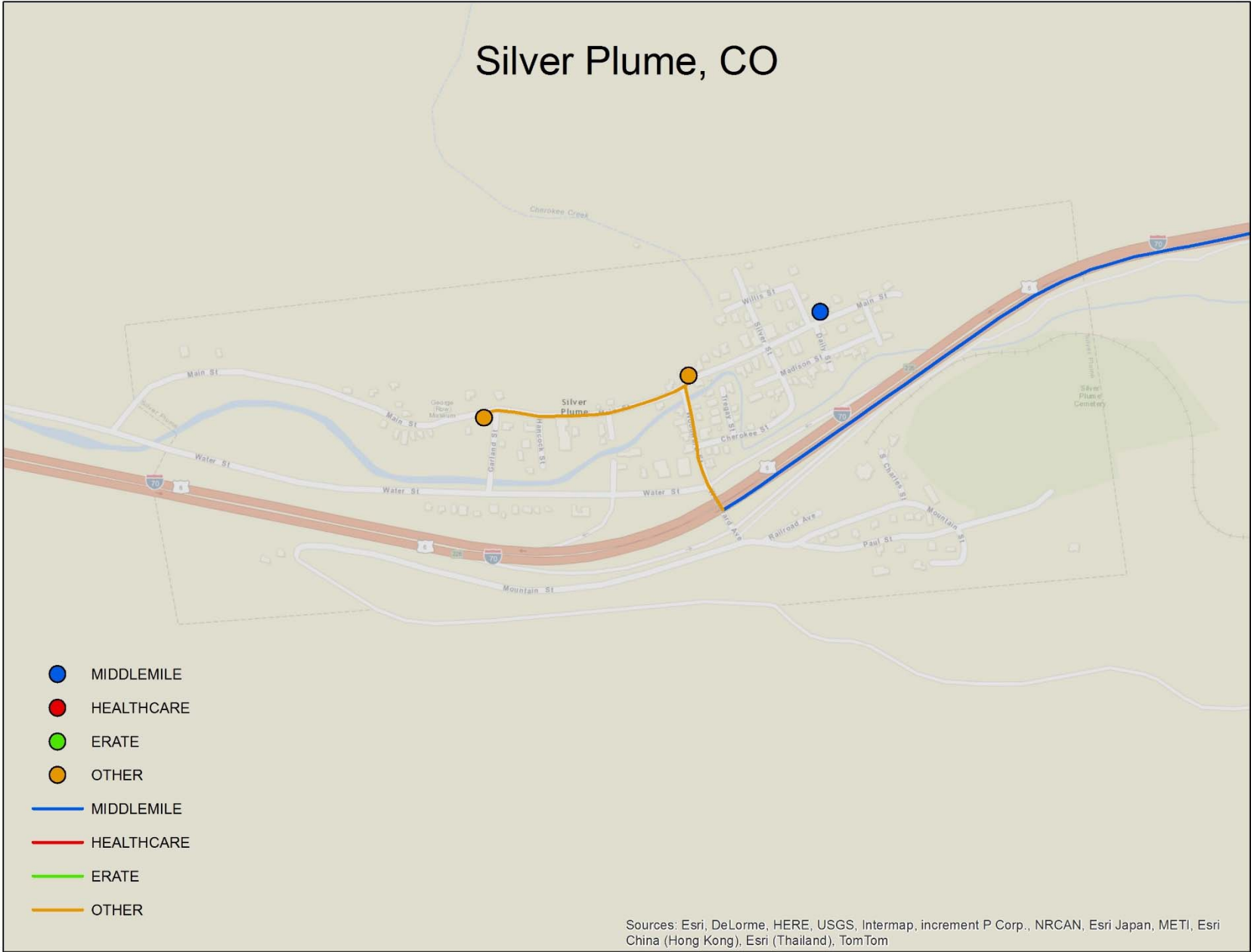
If the Town of Silver Plume were to build to all of the anchor institutions, the projected capital costs are estimated at \$56,088.

City	SILVER PLUME
Total CAIs	2
Healthcare	\$ -
Schools	\$ -
Other	\$ 56,088
<b>Totals</b>	<b>\$ 56,088</b>

A detailed breakdown of the engineering, construction management, construction labor and materials is shown below.

Other Anchor Institutions	
City	SILVER PLUME
New (FT)	1,626.00
New (Miles)	0.31
CAIs	2
Fiber Ct	0
Aerial Fiber (FT)	1,463.40
Underground Fiber (FT)	162.60
Engineering Costs	\$ 3,415
Permitting	\$ 92
Make Ready Cost	\$ 7,760
Aerial Labor Cost	\$ 17,561
Underground Labor Cost	\$ 5,691
Tech Services Cost	\$ 2,195
Materials Cost	\$ 5,528
Electronics	\$ 11,000
Construction Management	\$ 1,220
Project Management	\$ 1,626
<b>Total Construction Costs</b>	<b>\$ 56,088</b>

# Silver Plume, CO



## Gilpin County Anchor Institution Builds

### Black Hawk

Below are the anchor institutions within the City of Black Hawk.

Gilpin County Elementary School	10595 Highway 119 Black Hawk Co 80403	Black Hawk
Gilpin County Re-1	10595 Highway 119 Black Hawk Co 80403	Black Hawk
Gilpin County Undivided High School	10595 Highway 119 Black Hawk Co 80403	Black Hawk
Eagles Nest Early Learning Center	10597 Highway 119 Black Hawk Co 80422	Black Hawk
Central City Fire Department Station 1	116 Lawrence Street Central City Co 80427	Black Hawk
Black Hawk Post Office	145 Clear Creek Street Black Hawk Co 80422	Black Hawk
Timberline Station 6	146 North Dory Lakes Drive Balck Hawk Co 80403	Black Hawk
Timberline Station 7	14908 Highway 119 Black Hawk Co 80422	Black Hawk
Gilpin County Public Library	15131 Highway 119 Black Hawk Co 80403	Black Hawk
Black Hawk Fire Department	196 Clear Creek Street Black Hawk Co 80422	Black Hawk
Gilpin Ambulance Authority	196 Clear Creek Street Black Hawk Co 80422	Black Hawk
Black Hawk City Hall	201 Selak Street Black Hawk Co 80422	Black Hawk
Black Hawk Municipal Court	221 Church Street Black Hawk Co 80422	Black Hawk
Black Hawk Police Department	221 Church Street Black Hawk Co 80422	Black Hawk
Gilpin County Community Center	250 Norton Drive Black Hawk Co 80422	Black Hawk
Colorado Workforce - Jeffco - Gilpin Black Hawk	2960 Dory Hill Road Black Hawk Co 80422	Black Hawk
Gilpin County Department of Human Services	2960 Dory Hill Road Black Hawk Co 80422	Black Hawk
Gilpin County Jail	2960 Dory Hill Road Black Hawk Co 80422	Black Hawk
Gilpin County Sheriffs Office	2960 Dory Hill Road Black Hawk Co 80422	Black Hawk
Gilpin Ambulance Authority	416 Gregory Street Black Hawk Co 80422	Black Hawk
Gilpin Ambulance Authority	448 Pine Drive Black Hawk Co 80422	Black Hawk
Timberline Fire Protection Station 2	448 Pine Drive Black Hawk Co 80422	Black Hawk
Central City Fd Station 2	495 Apex Valley Road Black Hawk Co 80422	Black Hawk
Timberline Station 3	660 Highway 46 Black Hawk Co 80422	Black Hawk
Timberline Station 8	Smith Hill Road Black Hawk Co 80422	Black Hawk

If the City of Black Hawk were to build to all of the anchor institutions, the projected capital costs are estimated at \$426,917.

City	BLACKHAWK
Total CAIs	10
Healthcare	\$ 5,500
Schools	\$ 342,656
Other	\$ 78,761
<b>Totals</b>	<b>\$ 426,917</b>

A detailed breakdown of the engineering, construction management, construction labor and materials is shown below.

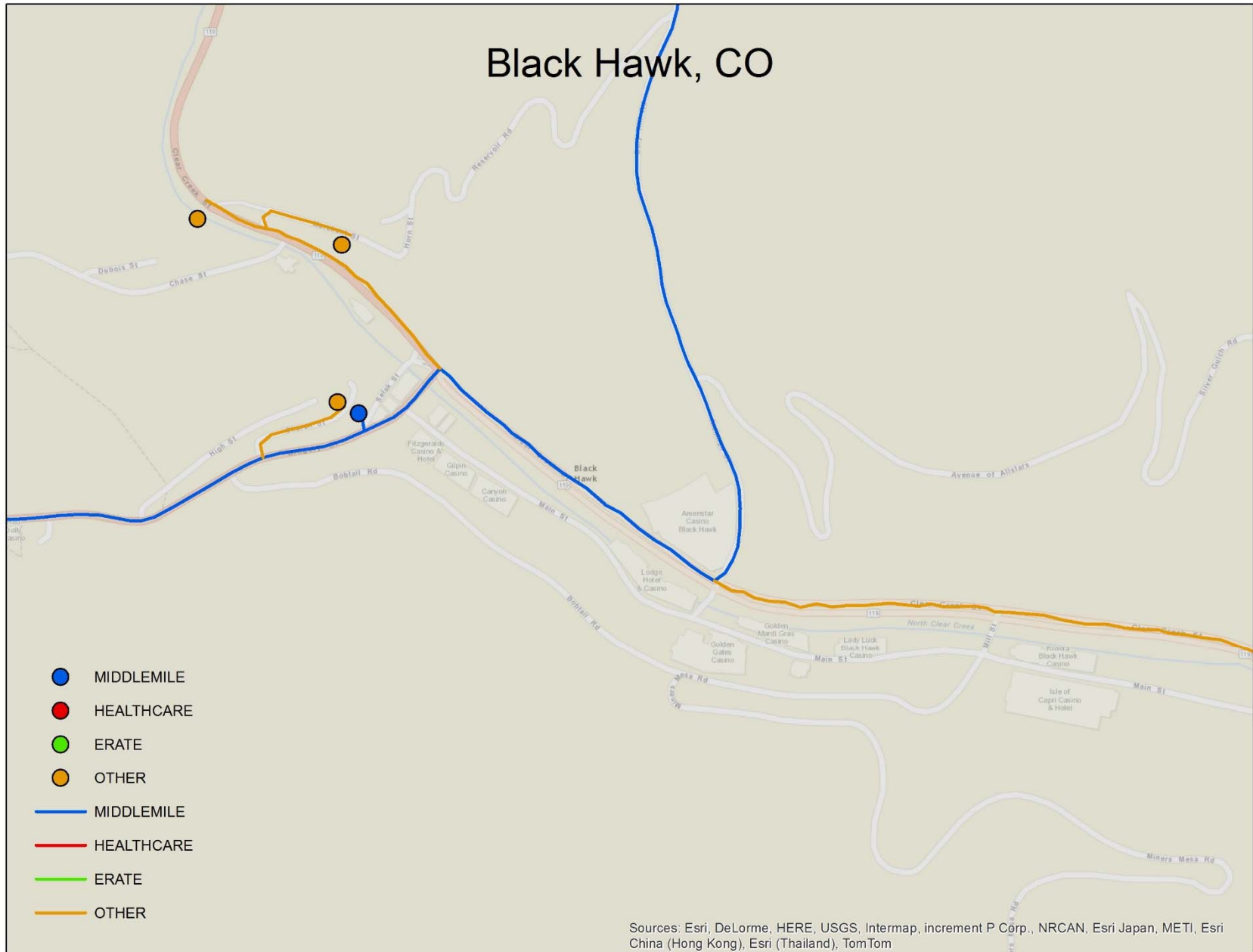
<b>Healthcare Anchor Institution Estimates</b>	
<b>City</b>	<b>BLACKHAWK</b>
New (FT)	-
New (Miles)	-
CAIs	1
Fiber Ct	0
Aerial Fiber (FT)	-
Underground Fiber (FT)	-
Engineering Costs	\$ -
Permitting	\$ -
Make Ready Cost	\$ -
Aerial Labor Cost	\$ -
Underground Labor Cost	\$ -
Tech Services Cost	\$ -
Materials Cost	\$ -
Electronics	\$ 5,500
Construction Management	\$ -
Project Management	\$ -
<b>Total Construction Costs</b>	<b>\$ 5,500</b>

<b>E-rate, Schools</b>	
<b>City</b>	<b>BLACKHAWK</b>
New (FT)	11,167.00
New (Miles)	2.11
CAIs	6
Fiber Ct	0
Aerial Fiber (FT)	10,050.30
Underground Fiber (FT)	1,116.70
Engineering Costs	\$ 23,451
Permitting	\$ 634
Make Ready Cost	\$ 53,297
Aerial Labor Cost	\$ 120,604
Underground Labor Cost	\$ 39,085
Tech Services Cost	\$ 15,075
Materials Cost	\$ 37,968
Electronics	\$ 33,000
Construction Management	\$ 8,375
Project Management	\$ 11,167
<b>Total Construction Costs</b>	<b>\$ 342,656</b>

A map of the design of the fiber network to connect the list of anchor institutions identified above is shown on the map below.

<b>Other Anchor Institutions</b>	
<b>City</b>	<b>BLACKHAWK</b>
New (FT)	2,245.31
New (Miles)	0.43
CAIs	3
Fiber Ct	
Aerial Fiber (FT)	2,020.78
Underground Fiber (FT)	224.53
Engineering Costs	\$ 4,715
Permitting	\$ 128
Make Ready Cost	\$ 10,716
Aerial Labor Cost	\$ 24,249
Underground Labor Cost	\$ 7,859
Tech Services Cost	\$ 3,031
Materials Cost	\$ 7,634
Electronics	\$ 16,500
Construction Management	\$ 1,684
Project Management	\$ 2,245
<b>Total Construction Costs</b>	<b>\$ 78,761</b>

# Black Hawk, CO



## Central City

Below are the anchor institutions within the City of Central City.

Central City Municipal Court	141 Nevada Street Central City Co 80427	Central City
Central City Police Department	141 Nevada Street Central City Co 80427	Central City
Colorado Department Of Revenue - Division Of Gaming Security	142 Lawrence Street Central City Co 80427	Central City
Colorado State Patrol - Troop 6D	142 Lawrence Street Central City Co 80427	Central City
Central City Post Office	149 Gregory Street Central City Co 80427	Central City
The Old Courthouse	203 Eureka Street Central City Co 80427	Central City

If the City of Central City were to build to all of the anchor institutions, the projected capital costs are estimated at \$ 81,471.

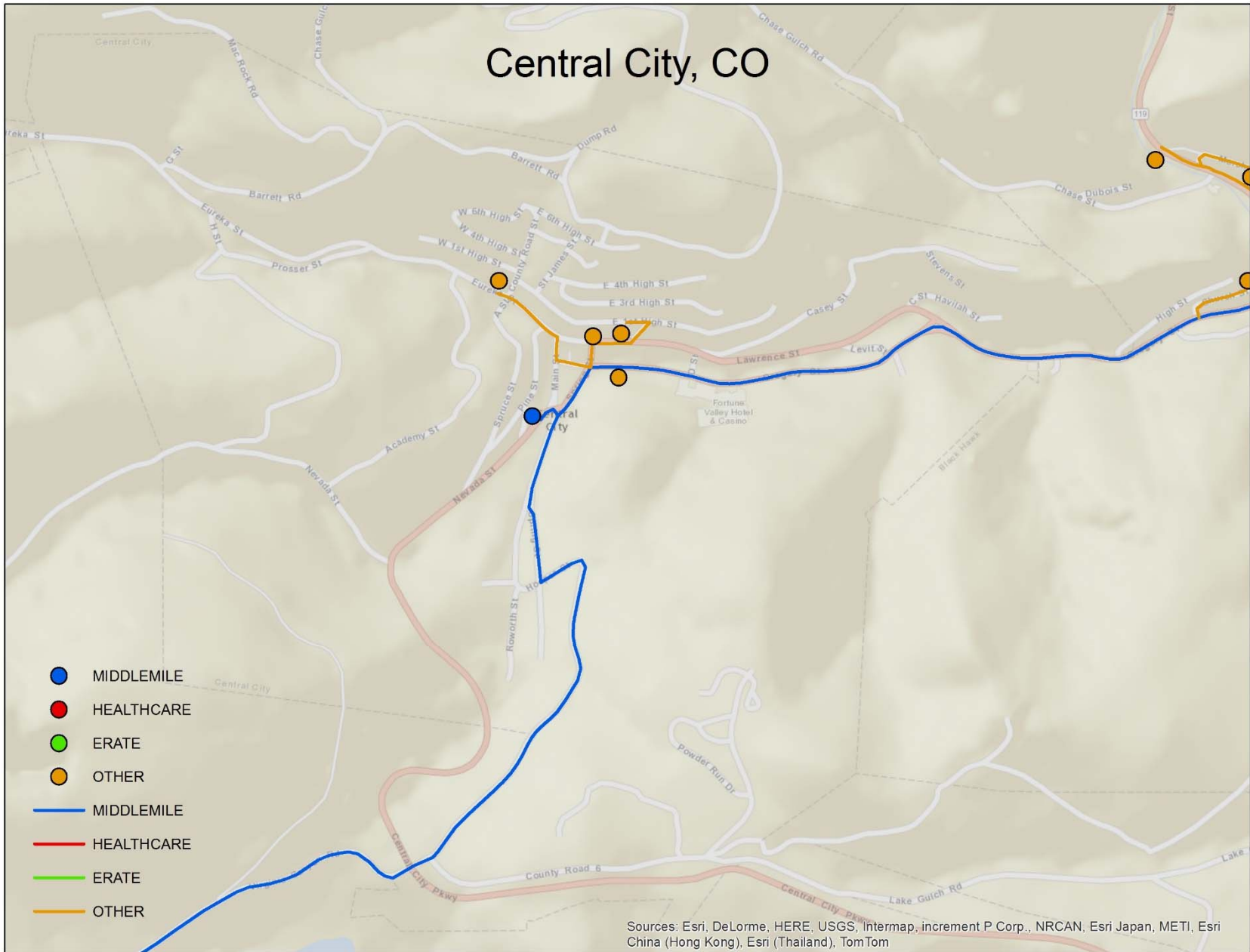
City	CENTRAL CITY
Total CAIs	6
Healthcare	\$ -
Schools	\$ -
Other	\$ 81,471
<b>Totals</b>	<b>\$ 81,471</b>

A detailed breakdown of the engineering, construction management, construction labor and materials is shown below.

Other Anchor Institutions	
City	CENTRAL CITY
New (FT)	1,748.00
New (Miles)	0.33
CAIs	6
Fiber Ct	24
Aerial Fiber (FT)	1,573.20
Underground Fiber (FT)	174.80
Engineering Costs	\$ 3,671
Permitting	\$ 99
Make Ready Cost	\$ 8,343
Aerial Labor Cost	\$ 18,878
Underground Labor Cost	\$ 6,118
Tech Services Cost	\$ 2,360
Materials Cost	\$ 5,943
Electronics	\$ 33,000
Construction Management	\$ 1,311
Project Management	\$ 1,748
<b>Total Construction Costs</b>	<b>\$ 81,471</b>

A map of the design of the fiber network to connect the list of anchor institutions identified above is shown on the first map below.

# Central City, CO





Golden

Below are the anchor institutions in unincorporated Gilpin County that have a Golden Colorado address.

Blackhawk Wastewater	1601 Highway 119 Golden Co 80403	Golden	Gilpin
Timberline Station 5	2236 Smith Hill Road Golden Co 80403	Golden	Gilpin
Golden Gate Canyon State Park Rangers	92 Crawford Gulch Road Golden Co 80403	Golden	Gilpin

If Gilpin County were to build to the three (3) Golden anchor institutions, the projected capital costs are estimated at \$1.4 Million.

City	GOLDEN
Total CAIs	3
Healthcare	\$ -
Schools	\$ -
Other	\$ 1,360,052
<b>Totals</b>	<b>\$ 1,360,052</b>

A detailed breakdown of the engineering, construction management, construction labor and materials is shown below.

Other Anchor Institutions	
City	GOLDEN
New (FT)	48,452.00
New (Miles)	9.18
CAIs	3
Fiber Ct	
Aerial Fiber (FT)	43,606.80
Underground Fiber (FT)	4,845.20
Engineering Costs	\$ 101,749
Permitting	\$ 2,753
Make Ready Cost	\$ 231,248
Aerial Labor Cost	\$ 523,282
Underground Labor Cost	\$ 169,582
Tech Services Cost	\$ 65,410
Materials Cost	\$ 164,737
Electronics	\$ 16,500
Construction Management	\$ 36,339
Project Management	\$ 48,452
<b>Total Construction Costs</b>	<b>\$ 1,360,052</b>

Rollinsville

Below are the anchor institutions within the Community of Rollinsville.

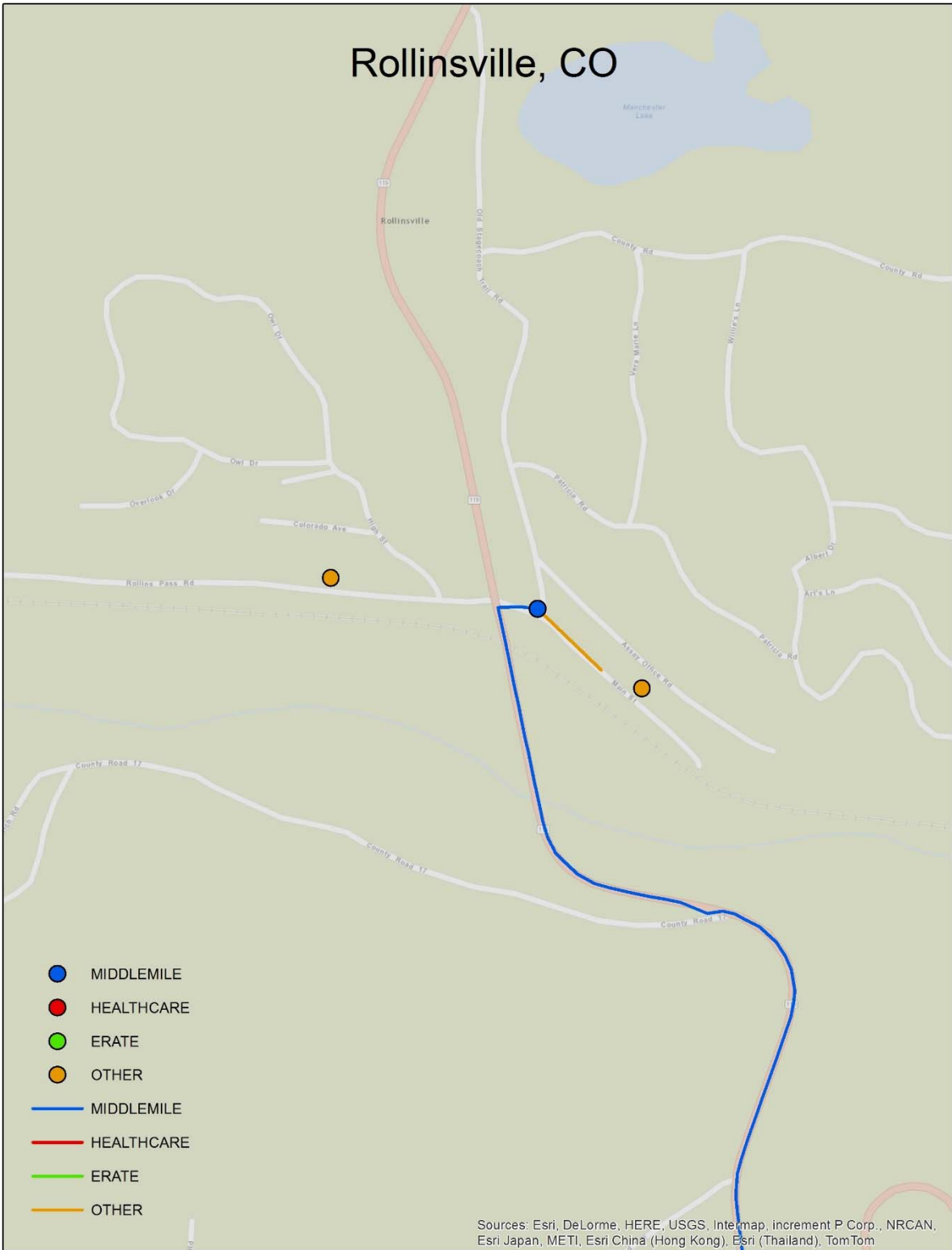
Rollinsville Post Office	143 Main Street Rollinsville Co 80474	Rollinsville
Timberline Station 9	East Portal Road Rollinsville Co 80474	Rollinsville

If the Community of Rollinsville were to build to both anchor institutions, the projected capital costs are estimated at \$22,563.

City	ROLLINSVILLE
Total CAIs	2
Healthcare	\$ -
Schools	\$ -
Other	\$ 22,563
<b>Totals</b>	<b>\$ 22,563</b>

A detailed breakdown of the engineering, construction management, construction labor and materials is shown below.

Other Anchor Institutions	
City	ROLLINSVILLE
New (FT)	417.00
New (Miles)	0.08
CAIs	2
Fiber Ct	24
Aerial Fiber (FT)	375.30
Underground Fiber (FT)	41.70
Engineering Costs	\$ 876
Permitting	\$ 24
Make Ready Cost	\$ 1,990
Aerial Labor Cost	\$ 4,504
Underground Labor Cost	\$ 1,460
Tech Services Cost	\$ 563
Materials Cost	\$ 1,418
Electronics	\$ 11,000
Construction Management	\$ 313
Project Management	\$ 417
<b>Total Construction Costs</b>	<b>\$ 22,563</b>



## Why Connect Anchor Institutions?

Local governments and state agencies have been connecting their community anchor institutions with fiber optic networks for over twenty years. Community anchor institutions are state, county and local government offices and buildings, schools and libraries, hospitals, medical facilities and first responders. In fact, in the U.S., thousands of schools, libraries, community centers, and public health and safety providers obtain their broadband connectivity from local government and state non-profit networks, including state research and education networks.

Connecting these anchor institutions with fiber allows each location to receive very high-speed Internet and data connectivity while eliminating or drastically reducing the monthly lease or access costs paid to the private sector service providers. Anchor institutions often cannot afford to purchase high-capacity circuits from the private sector service providers and therefore, simply cap their bandwidth purchased. Capping their bandwidth requires the anchor institutions to choose which applications to deploy and limits their ability to use applications that require high bandwidth. Building a municipally-owned, or locally-owned fiber network to anchor institutions allows these critical key facilities to have the bandwidth they need to support all of their applications and once these networks are in place, additional bandwidth needs can easily be met without additional capital cost for construction.

Clear Creek and Gilpin Counties or the local governments could consider connecting their community anchor institutions with fiber to ensure that they have the highest-quality broadband connectivity. This could be done in collaboration with the other agencies to share in the cost of construction. Then, once these networks are built, the Local governments could also consider leasing excess capacity of conduit or of fiber to the private sector for last mile build out and use. Once a network is built that serves schools, government offices, fire districts and the like, generally, this network reaches deep into neighborhoods and past business parks. These networks can then serve as an opportunity to allow the private sector to lease excess capacity and in turn serve homes and businesses with high-speed fiber. This trend is fast accelerating as hundreds of municipalities make available spare fiber optic capacity to private sector companies at rates designed to incentivize new private sector investment and opportunity.

## Anchor Institutions may include Smart City Applications

An additional benefit of building a community anchor institution network for municipalities is it will be equipped to support “smart city” applications when the time comes for city service innovation. Smart city applications may include connecting traffic lights, traffic management,

and smart journey planning. Smart journey planning systems use open city data in order to recommend how individuals can best navigate from one place to the next. The systems are becoming sophisticated enough to take into consideration personal preferences such as cost, safety concerns and CO2 footprint, as well as real-time traffic congestion and traffic patterns. Other smart city applications may include connecting smart parking meters, automated meter reading and utilities management. Street lights are often connected with fiber and applications are emerging that allow active safety; increasing light levels in city centers when the light system detects individuals or motion, at bus stops or along walkways.

Another top smart city application is environmental monitoring, where a city that uses monitoring stations for pollution or weather conditions can now connect and use these systems for real time data collection and can pinpoint potential sources of pollution or weather issues and quickly react and efficiently deal with potential problems.

Other smart city applications are emerging around transport sharing, whether it is sharing bikes or cars or rideshare. Smart cars and electric cars will be a key enabler for wider adoption of city center car sharing, providing information to individuals about location and availability of shared cars and up-to-date information of pick up times for rideshare applications.

A robust fiber network connecting all of the anchor institutions within the community aggregates demand for all entities for Internet connectivity, but it also creates very high-speed connectivity for data services. This network can also be used as a platform for emerging smart city applications. Having very high speed data connectivity between the anchor institutions can support connections for the schools to a public safety network. It could support an outsourced service such as help desk, shared IT, shared software, or GIS functions by allowing the smaller communities to lean on the larger communities for this staffing. Smaller communities within the region can rely on the staffing, resources and expertise of some of the larger communities. For example, smaller towns might receive significant benefit from having access to best-in-class administrative and public safety applications. Services that would otherwise be out of reach economically, but that significantly increase efficiency and productivity, while reducing cost. Having very high-speed access between the various government agencies and communities would facilitate shared services.

As shared services and data connectivity between all anchor institutions is a concept that could be further explored within Clear Creek and Gilpin Counties, NEO recommends that a working group be established to spearhead and implement cooperation amongst all member communities. This could continue to be supported by the Local governments or a separate working group could be formed. This could include collaboration and cooperation for shared services, shared data centers, and/or buying and negotiating power for potential public private

partnerships. This working group could be tasked with identifying common software applications amongst the communities and surrounding counties, shared applications and opportunities for cost reduction and greater efficiencies. Rio Blanco County is already providing a centralized data center for many of the anchor institutions within their county.

## Paying for Capital Costs: Funding Opportunities

USAC has two sister programs – the E-rate and Rural Healthcare Grant Programs. These two programs can be leveraged to pay for many of the capital costs associated with building to schools and libraries (E-rate) and to medical facilities and hospitals (the Rural Healthcare Grant program). NEO worked with Colorado Telehealth Network (CTN) to identify anchor institutions (medical facilities and hospitals) that would be eligible for the Rural Healthcare grant program.

The Rural Healthcare Grant fund is available for the following eligible entities:

- (1) post-secondary educational institutions offering health care instruction, teaching hospitals, and medical schools;
- (2) community health centers or health centers providing health care to migrants;
- (3) local health departments or agencies;
- (4) community mental health centers;
- (5) not-for-profit hospitals;
- (6) rural health clinics; and
- (7) consortia of one or more of such entities.

The grant program would potentially fund 60-65% of the capital costs to connect these medical establishments, including the middle mile portions of the fiber build between the communities. Targeting this grant, and building to the medical establishments “first” would allow for much of the desired routes to be built.

In addition to this strategy, there are other grant and loan programs that are also available for broadband build-out. Certain financing and funding programs restrict who is eligible to apply for and receive funding. A few of the state and federal grant and loan programs available for funding broadband construction are provided below.

The Colorado Department of Local Affairs (DOLA) in 2015 announced a \$20 Million broadband implementation grant program for regional councils of governments and municipalities. In 2015, DOLA had three rounds of financing applications with deadlines for grant submission being April 1<sup>st</sup>, August 1<sup>st</sup> and December 1<sup>st</sup>. DOLA did not announce funding availability for

2016 or 2017 specifically for broadband implementation; however, applicants are encouraged to apply for funding through the Energy and Mineral Impact Fund.

The Rural Broadband Experiments and Connect America programs are available to unserved areas; the definition for eligibility is 3 Mbps combined upload and download. As the FCC in 2015 raised the definition of served to 25 Mbps download and 3 Mbps in upload speeds, there may be funds available through the Connect America to a wider group of communities. One caveat currently of the Connect America program is that it is available for Eligible Telecommunication Carriers.

The Telecommunications Infrastructure Loan Program available through the USDA “makes long-term direct and guaranteed loans to qualified organizations for the purpose of financing the improvement, expansion, construction, acquisition, and operation of telephone lines, facilities, or systems to furnish and improve Telecommunications service in rural areas. The definition for “rural area” is within the boundaries of any incorporated or unincorporated city, village, or borough having a population less than 5,000 inhabitants.”

The Rural Broadband Loan Program, which is part of the Farm Bill, “is designed to provide loans for funding, on a technology neutral basis, for the costs of construction, improvement, and acquisition of facilities and equipment to provide broadband service to eligible rural communities.” Again, the definition of rural includes communities with a population less than 5,000 inhabitants.

There are grant programs that are available for Telemedicine and Distance Learning as well as program targeted specifically for Rural Health.

There are a number of other financing options some of which include; New Market tax credits, for which allocations would have to be secured; economic development retail sales tax funds, and bond financing through a number of different structures and types of bonds. Other sources of funding include internal loans, bonds, TIF, and revenue funds, economic development financing programs, and crowd sourcing.

A report written by NTIA referencing all federal programs available for broadband financing has been provided to the Local governments as a deliverable of this project.

## Tabor Laws

Financing of a broadband network, just like the financing of any other public project, is governed by state law, and primarily by the Constitutional Amendment known as the Taxpayer's Bill of Rights (TABOR). Colorado Constitution, Article X, Section 20. With respect to incurring debt, Section 20 (4)(b) of TABOR requires an election prior to "creation of any multiple-fiscal year direct or indirect district debt or other financial obligation whatsoever without adequate present cash reserves pledged irrevocably and held for payments in all future fiscal years." To the extent that the financing of a broadband network, or any components of a network would require the issuance of debt, the various municipalities and counties would be required by TABOR to seek a vote of the registered electors. To the extent that the municipalities or counties own or control existing network facilities that it wishes to use in a network, or has the financial resources to pay for new facilities, it may do so without an election.

Statutory municipalities are granted their authority in Title 31 of the Colorado Revised Statutes. Among the powers of statutory municipalities are the power to enter into contracts and the power to acquire, hold, lease, and dispose of both real and personal property. C.R.S. 31-15-1(b) and (c). The municipality also has the power to contract indebtedness (subject to TABOR) by borrowing money or issuing the bonds of the municipality "for *any public purpose* of the municipality, including *but not limited to* the following purposes: Supplying water, gas, heating and cooling, and electricity; purchasing land; and purchasing, constructing, extending, and improving public streets, buildings, facilities, and equipment..." C.R.S. 31-15-302(1)(d)(I). While this section of the statute does not specify telecommunications, the authority granted to the municipality is specifically not limited to the examples stated, and the broadband facilities the municipality is considered would, according to Denver-based attorney, Ken Fellman, be deemed a public purpose, and therefore permitted. That being said, the total amount of the municipality indebtedness for all authorized purposes may not exceed three percent of the actual value, as determined by the assessor, of the taxable property in the municipality. C.R.S. 31-15-302(1)(d)(II).



# Section 6: Wireless Plan

A Wireless Tower Assessment, Radio Frequency Wireless Plan and Analysis was conducted by NEO and its consultants for Clear Creek and Gilpin Counties.

The Wireless Plan is intended to be used as a general planning tool for consideration for wireless broadband deployment in Clear Creek and Gilpin Counties. For purposes of this Wireless Plan, a base station and tower are defined as follows:

Base Station - Equipment and non-tower supporting structure at a fixed location that enables wireless telecommunications between user equipment and a communications network.

Examples include transmission equipment mounted on a rooftop, water tank, silo or other above ground structure other than a tower. The term does not encompass a tower as defined herein or any equipment associated with a tower. "Base Station" includes, but is not limited to:

- Any structure other than a tower that supports or houses radio transceivers, antennas, coaxial or fiber optic cable, regular and back-up power supplies, and comparable equipment, regardless of technological configuration; and
- Equipment associated with wireless telecommunications services such as private, broadcast, and public safety services, as well as unlicensed wireless services and fixed wireless services such as microwave backhaul and broadband.

Tower- Any support structure built for the primary purpose of supporting antennas and associated facilities for commercial, private, broadcast, microwave, broadband, public, public safety, licensed or unlicensed, and/or fixed or wireless services. A tower may be concealed or non-concealed. Non-concealed towers include:

- Guyed - A style of tower consisting of a single truss assembly composed of sections with bracing incorporated. The sections are attached to each other, and the assembly is attached to a foundation and supported by a series of wires that are connected to anchors placed in the ground or on a building.
- Lattice - A self-supporting tapered style of tower that consists of vertical and horizontal supports with multiple legs and cross bracing, and metal crossed strips or bars to support antennas. This type of tower is designed to support itself without the use of guy wires or other stabilization devices.
- Monopole - A style of freestanding tower consisting of a single shaft usually composed of two (2) or more hollow sections that are in turn attached to a foundation. This type of tower is designed to support itself without the use of guy wires or other stabilization devices. These facilities are mounted to a foundation

that rests on or in the ground or on a building's roof. All feed lines shall be installed within the shaft of the structure.

This analysis began by identifying and assessing existing towers and base stations used for wireless communications including, but not limited to: public safety, microwave, personal wireless service facilities (PWSF), broadband and broadcast facilities. Visiting all known and accessible towers and base stations aids in data collection regarding ownership, equipment and use of the facility by owners and tenants. Theoretical propagation maps based on the assessment data are developed to identify gaps in wireless broadband coverage and solutions are provided to address these coverage gaps.

### Existing Wireless Facility Locations

The list of tower facilities that are included in the design are as follows:

## WIRELESS ASSESSMENT, SITE SURVEYS

### ◆ Clear Creek

- Empire (new tower)
- Saxon Mtn
- Georgetown
- Silver Plume
- Idaho Springs
- Dumont
- Bellview Mtn

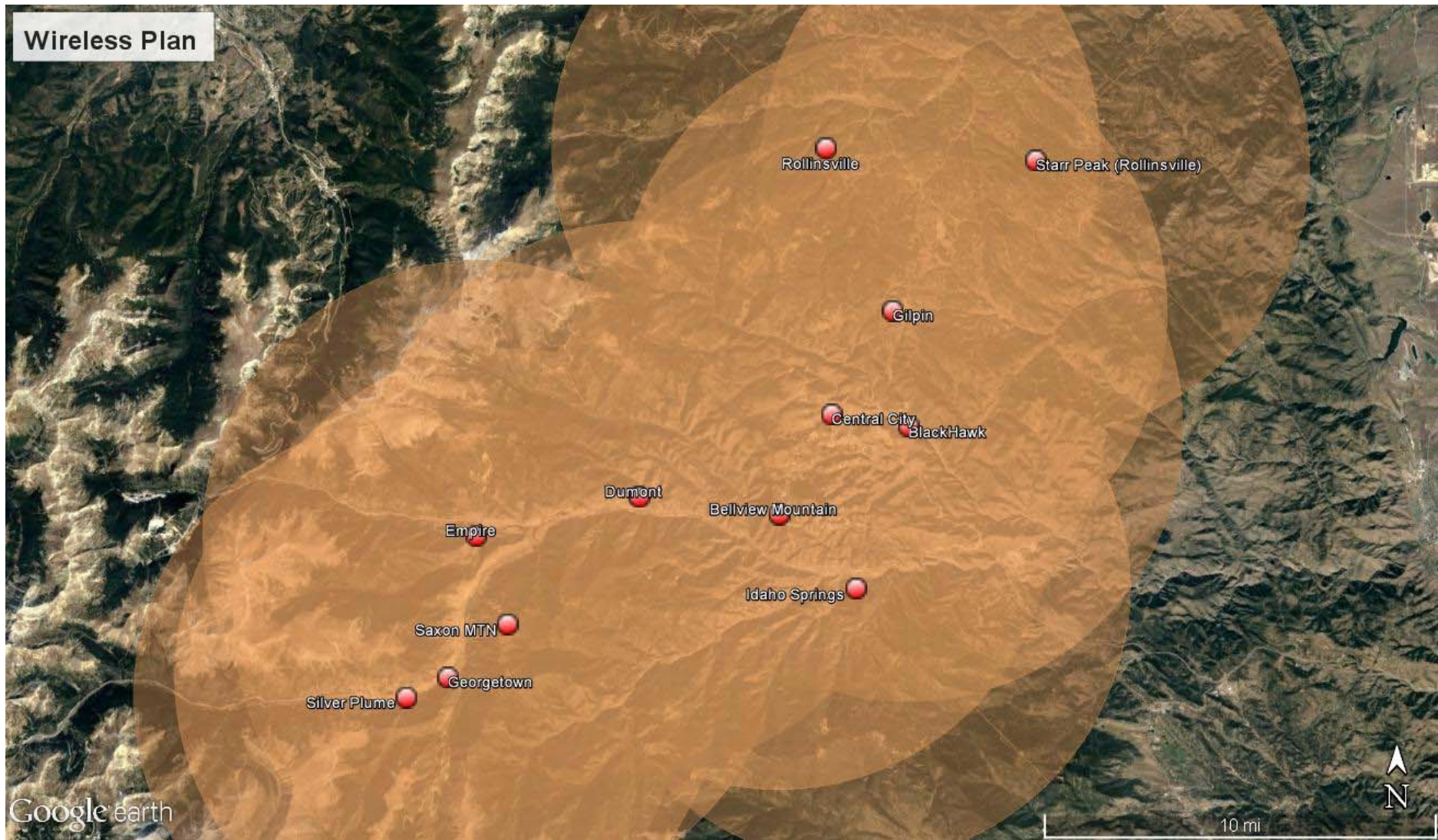
### ◆ Gilpin

- Central City
- Black Hawk
- Gilpin
- Rollinsville
- Starr Peak



Below is a map of the tower locations identified in Clear Creek and Gilpin Counties. The tan color on the map shows the wireless coverage that has been included in the design.

Wireless Plan



Most network service providers do not own the antenna mounting structure on which they attach their equipment. Separate companies typically construct and own the monopole, lattice or guyed tower and market that tower for lease space to the service providers. A service provider may also contract with a tower owner to obtain approval to construct a tower in a particular location and once the facility is constructed the service provider will then lease space from the tower owner on the newly constructed tower.

## Wireless Industry Stakeholders

Prior to the granting of the cellular licenses in 1980 for the first phase of deployment, the United States was divided into 51 regions by Rand McNally and Company. These regions are described as Metropolitan Trading Areas (MTA). The spectrum auction conducted by the Federal Government for the 1900 MHz bands for 2G (PCS), further divided the United States into 493 geographic areas called Basic Trading Areas (BTA). Gilpin and Clear Creek Counties located in the “Denver” MTA 22 (a.k.a. MTA 22) and the “Grand Junction, CO” BTA (a.k.a. BTA 168).

The following personal wireless service providers have purchased licenses to offer broadband, fixed wireless, mobile radio, phone and or television in the lower frequencies (600-800 MHz): AT&T; Access 700, LLC; DISH; T-Mobile; Union Telephone (Union Cellular); and Verizon Wireless.

Personal Communications Services (PCS) licensees and service providers for wireless phone and broadband operating in the high operating frequencies 1700-2600 MHz include: AT&T Wireless; Atlantic Wireless, Clearwire Spectrum Holdings III, LLC, Cleartalk; Commnet Wireless, LLC; Leaco Rural Telephone Cooperative, Inc; Sprint; T-Mobile; UBET; Union Telephone (Union Cellular); and Verizon Wireless.

Per Section 704 of the Telecommunications Act of 1996, all service providers require uninterrupted and continuous handoff service throughout the County. Each of these wireless voice and data providers will need towers and/or above ground antenna mounting locations to improve network coverage and capacity equating to an ongoing need to deploy more infrastructure, especially in areas of greater residential density.

## Theoretical Composite Frequency Maps

Modern and advancing technologies continue to transform how the wireless industry is electronically providing their services. Presently in the evolution of wireless communications, Smartphones use the newer technologies known as fourth generation (4G) Long Term Evolution (LTE). This platform uses broadband and the applications require more information

to be sent and received within the same radio envelope that was used in the previous deployment stages of personal wireless services. The more data contained within the radio frequency envelope makes it more important than ever to have as much signal density as possible. Increasing signal density requires more wireless facilities. Proximity of the infrastructure to the subscribers is becoming ever more important for optimizing network services.

While cities are being tested with fifth generation (5G) technologies, the wide-area launch date is still undetermined although slated for 2018-2020 in some urban areas. Fifth generation will implement true high-speed data with download speeds well in excess of today's standard 25 Mbps speeds.

The highlighted tan areas on the map represent where a generally reliable signal level should be available for indoor use for both low and high bands of service. Indoor usage is the service threshold utilized for composite modeling because it represents the lowest signal strength generally acceptable after considering the signal loss that occurs due to building penetration. Outdoor signal strength in the same area will usually be higher than indoor signal strength. Generally, the closer the subscriber is to the facility, the more reliable the service. A subscriber further from the facility will have less reliable service. As the subscriber gets closer to the edge of the yellow or blue area, the signal strength becomes more prone to degradation, particularly as usage in the area increases or environmental conditions worsen. The gray areas on the map indicate where the subscriber will experience weak, unpredictable levels of signal strength, or no service at all. Filling in these coverage gaps would require the installation of additional antenna and corresponding infrastructure.

## Wireless Broadband Equipment Considered

NEO's team included two network designs for the wireless plan. The two networks are described below.

### 450 5.8 GHz Access Point

- Capable of throughput of **over 550 Mbps** in a 20 MHz channel, and **more than 1 Gigabit per second** per sector (shared amongst all users) when using a 40 MHz channel
- Supports up to 238 subscribers per sector (3-4 Access Points per tower facility)
- Up to 40 Miles reach

#### 450 900 MHz Access Point

- Provides a reliable link for near and non-line-of-site deployments (**canyons and hard to reach areas**)
- 100+ Mbps subscriber capacity in a 20 MHz channel

We included pricing for three options (Good, Better and Best). The difference between the three options is the number of Access Points per Tower, the amount of coverage and the number of subscribers that each tower can support. The pricing below does not include installation and mobilization costs. We also assumed that backhaul for Internet access would be provided by connecting to anchor institutions.

Each tower location would have both the 450 5.8 GHz Access Point equipment and the 450 900 MHz Access Point equipment.

Clear Creek County

Part Number	Description	MSRP Price (Each)	System Quantity	Ext MSRP	# of Sites,	Extended Cost	Notes
<b>450M + 450I 900 MHz (Best Coverage) (Average Equipment per primary tower site)</b>							
450M	Cambium 450M	\$ 6,995.00	4	\$ 27,980.00			450M AP
450I 900MHz	Cambium 450i 900 MHz	\$ 2,895.00	4	\$ 11,580.00			450I 900 MHz AP
900MHZ-60-SEC	900MHz 60 Degree Sector Antenna	\$ 395.00	3	\$ 1,185.00			450I 900MHz 60 Degree Sector
450PS	450 Power Supply	\$ 380.00	6	\$ 2,280.00			Power Supply for 450 AP
EX2300	Juniper EX2300 Switch	\$ 1,067.00	1	\$ 1,067.00			24 Port Switch
820C-PTP-Link	820C Backhaul Link	\$ 22,450.00	1	\$ 22,450.00			820C Backhaul Link
FCC FEE	FCC Filing Fee	\$ 1,200.00	1	\$ 1,200.00			FCC Coordination Fee
			Total	\$ 67,742.00	7	\$474,194.00	
<b>450I 5.8 GHz + 450I 900 MHz (Mid Coverage) (Average Equipment per primary tower site)</b>							
450I 5.8 GHz	Cambium 450I	\$ 3,195.00	3	\$ 9,585.00			450I AP
450I 900MHz	Cambium 450i 900 MHz	\$ 2,895.00	3	\$ 8,685.00			450I 900 MHz AP
900MHZ-60-SEC	900MHz 60 Degree Sector Antenna	\$ 395.00	3	\$ 1,185.00			450I 900MHz 60 Degree Sector
450PS	450 Power Supply	\$ 380.00	5	\$ 1,900.00			Power Supply for 450 AP
EX2300	Juniper EX2300 Switch	\$ 1,067.00	1	\$ 1,067.00			24 Port Switch
820S-PTP-Link	820S Backhaul Link	\$ 13,450.00	1	\$ 13,450.00			820S Backhaul Link
FCC FEE	FCC Filing Fee	\$ 1,200.00	1	\$ 1,200.00			FCC Coordination Fee
			Total	\$ 37,072.00	7	\$259,504.00	
<b>450I 5.8 GHz + 450I 900 MHz (Bare Bones Coverage) (Average Equipment per primary tower site)</b>							
450I 5.8 GHz	Cambium 450I	\$ 3,195.00	2	\$ 6,390.00			450I AP
450I 900MHz	Cambium 450i 900 MHz	\$ 2,895.00	1	\$ 2,895.00			450I 900 MHz AP
900MHZ-60-SEC	900MHz 60 Degree Sector Antenna	\$ 395.00	3	\$ 1,185.00			450I 900MHz 60 Degree Sector
450PS	450 Power Supply	\$ 380.00	3	\$ 1,140.00			Power Supply for 450 AP
EX2300	Juniper EX2300 Switch	\$ 1,067.00	1	\$ 1,067.00			24 Port Switch
820S-PTP-Link	820S Backhaul Link	\$ 13,450.00	1	\$ 13,450.00			820S Backhaul Link
FCC FEE	FCC Filing Fee	\$ 1,200.00	1	\$ 1,200.00			FCC Coordination Fee
			Total	\$ 27,327.00	7	\$191,289.00	

Gilpin County							
Part Number	Description	MSRP Price (Each)	System Quantity	Ext MSRP	# of Sites, Gilpin	Extended Cost	Notes
<b>450M + 450I 900 MHz (Best Coverage) (Average Equipment per primary tower site)</b>							
450M	Cambium 450M	\$ 6,995.00	4	\$ 27,980.00			450M AP
450I 900MHz	Cambium 450i 900 MHz	\$ 2,895.00	4	\$ 11,580.00			450I 900 MHz AP
900MHZ-60-SEC	900MHz 60 Degree Sector Antenna	\$ 395.00	3	\$ 1,185.00			450I 900MHz 60 Degree Sector
450PS	450 Power Supply	\$ 380.00	6	\$ 2,280.00			Power Supply for 450 AP
EX2300	Juniper EX2300 Switch	\$ 1,067.00	1	\$ 1,067.00			24 Port Switch
820C-PTP-Link	820C Backhaul Link	\$ 22,450.00	1	\$ 22,450.00			820C Backhaul Link
FCC FEE	FCC Filing Fee	\$ 1,200.00	1	\$ 1,200.00			FCC Coordination Fee
			Total	\$ 67,742.00	5	\$338,710.00	
<b>450I 5.8 GHz + 450I 900 MHz (Mid Coverage) (Average Equipment per primary tower site)</b>							
450I 5.8 GHz	Cambium 450I	\$ 3,195.00	3	\$ 9,585.00			450I AP
450I 900MHz	Cambium 450i 900 MHz	\$ 2,895.00	3	\$ 8,685.00			450I 900 MHz AP
900MHZ-60-SEC	900MHz 60 Degree Sector Antenna	\$ 395.00	3	\$ 1,185.00			450I 900MHz 60 Degree Sector
450PS	450 Power Supply	\$ 380.00	5	\$ 1,900.00			Power Supply for 450 AP
EX2300	Juniper EX2300 Switch	\$ 1,067.00	1	\$ 1,067.00			24 Port Switch
820S-PTP-Link	820S Backhaul Link	\$ 13,450.00	1	\$ 13,450.00			820S Backhaul Link
FCC FEE	FCC Filing Fee	\$ 1,200.00	1	\$ 1,200.00			FCC Coordination Fee
			Total	\$ 37,072.00	5	\$185,360.00	
<b>450I 5.8 GHz + 450I 900 MHz (Bare Bones Coverage) (Average Equipment per primary tower site)</b>							
450I 5.8 GHz	Cambium 450I	\$ 3,195.00	2	\$ 6,390.00			450I AP
450I 900MHz	Cambium 450i 900 MHz	\$ 2,895.00	1	\$ 2,895.00			450I 900 MHz AP
900MHZ-60-SEC	900MHz 60 Degree Sector Antenna	\$ 395.00	3	\$ 1,185.00			450I 900MHz 60 Degree Sector
450PS	450 Power Supply	\$ 380.00	3	\$ 1,140.00			Power Supply for 450 AP
EX2300	Juniper EX2300 Switch	\$ 1,067.00	1	\$ 1,067.00			24 Port Switch
820S-PTP-Link	820S Backhaul Link	\$ 13,450.00	1	\$ 13,450.00			820S Backhaul Link
FCC FEE	FCC Filing Fee	\$ 1,200.00	1	\$ 1,200.00			FCC Coordination Fee
			Total	\$ 27,327.00	5	\$136,635.00	



### Consumer Premise Equipment

Consumer Premise Equipment (CPE) is not included in the cost projections above. CPE is a receiver dish, cable and grounding materials that will bring the WLAN broadband signal from the circuit into the consumers' residents, school building or office. Use of this type of CPE is strongly recommended over Wi-Fi receiver type antenna because the throughput will be much higher and allow the goal of providing broadband at an achievable rate of 20 - 100 Mbps. The cost for this equipment and installation will be around \$300 per installation.

# Section 8 – Last Mile Strategies, Potential Public-Private Partnerships

## Last Mile Options

“Last mile” refers to the broadband connection at homes and businesses. Although the local service providers have invested in limited fiber optic infrastructure to key businesses and anchor tenants, the existing providers’ networks are primarily based upon cable modem, Digital Subscriber Line (DSL), satellite and wireless technologies for the last mile.

The most ambitious strategy to consider is the opportunity to connect all homes and businesses with fiber. More challenging geographies are sometimes forced to utilize wireless technologies to deliver service with a hybrid fiber/wireless network. Cities and/or electric cooperatives are building or facilitating Fiber to the Premise networks or “Gigabit-enabled” networks, allowing for Internet speeds of 1,000 Mbps or 1 Gbps in both upload and download speeds for all homes and businesses within a city’s boundary.

There are a number of models to finance, design, construct and operate a Fiber to the Premise network. One of the models in the industry is when the municipality or electric cooperative designs, builds, owns and operates a network and becomes the Internet Service Provider to homes and businesses. This model is often referred to as a Retail Model and is discussed in detail below. Another model is one in which the entity builds and owns the fiber network and Internet services are provided directly by the private sector. This has often been referred to as a Wholesale Model, and again, is discussed in detail below.

Before we dive into the Retail and Wholesale Models, we will first discuss the capital costs for building a Fiber to the Premise network for each of the communities.

Capital Costs vary widely based upon the take rate percentage. Take rate percentage essentially means market share, or the percentage of homes and businesses that sign up for services. There are a number of strategies to mitigate take rate percentage. One strategy is to build into a neighborhood when a minimum number of homeowners and businesses have signed up for the service prior to construction of the network within that neighborhood. Google Fiber and Longmont have used this strategy with great success.

The capital costs do not include potential costs to house a Carrier Neutral Location or a data center to house the optical equipment needed to light the fiber to the premise networks.

FTTP Estimates, Assumptions for Gilpin County, Phasing based upon Town Boundaries

<b>Estimate Dashboard</b>	<b>Black Hawk</b>	<b>Central City</b>	<b>Totals</b>	<b>Gilpin County, Uninc.</b>	<b>Gilpin County, All</b>
<b>Major Assumptions</b>	<b>Values</b>	<b>Values</b>			<b>Values</b>
<b># Parcels/Passings</b>	54	373	427	2201	2628
<b>Total Plant Miles</b>	4.72	6.13	11	204	214.73
<b># Poles</b>	117	152	270	4732	5002
<b>Est. Aerial Miles</b>	3.78	4.90	9	152	161.05
<b>Est. UG Miles</b>	0.94	1.23	2	52	53.68
<b>Aerial %</b>	80%	80%		80%	75%
<b>UG %</b>	20%	20%		20%	25%
<b>Density HH/Mile</b>	11.44	60.85		10.80	12.24
<b>Take Rate</b>	40%	40%		40%	40%

<b>Projected Capital Costs</b>	<b>Black Hawk</b>	<b>Central City</b>	<b>Totals</b>	<b>Gilpin County, Uninc.</b>	<b>Gilpin County, All</b>
<b>Overall</b>	\$424,221	\$693,924	\$1,118,145	\$15,790,460	\$16,908,606
	\$7,856	\$1,860		\$10,947	\$6,434
	\$19,640	\$4,651		\$17,936	\$16,085
	\$89,877	\$113,201		\$69,043	\$78,744
<b>Engr. Labor</b>	\$13,039	\$32,489	\$45,528	\$541,925	\$587,453
<b>Aerial Labor</b>	\$91,589	\$118,906	\$210,495	\$3,335,765	\$3,546,260
<b>Underground Labor</b>	\$125,606	\$165,762	\$291,368	\$7,873,623	\$8,164,991
<b>Tech Services Labor</b>	\$62,043	\$91,701	\$153,744	\$95,754	\$249,498
<b>Customer Premise Labor and Install Materials including Splitters</b>	\$19,175	\$123,260	\$142,435	\$744,403	\$886,838
<b>OSP Materials</b>	\$77,557	\$122,781	\$200,338	\$3,188,858	\$3,389,196
<b>Electronics</b>	\$35,212	\$39,025	\$74,237	\$10,132	\$84,370

Additionally, NEO’s team identified capital costs not using the town boundaries, but instead looked at including homes and businesses that were in close proximity to the towns. The following is an estimate based upon a logical implementation.

### FTTP Estimates, Assumptions for Gilpin County, Phasing based upon Logical Implementation

<b>Estimate Dashboard</b>	<b>Black Hawk</b>	<b>Central City</b>	<b>Rollinsville</b>	<b>Totals</b>	<b>Gilpin County, Uninc.</b>	<b>Gilpin County, All</b>
<b>Major Assumptions</b>	<b>Values</b>	<b>Values</b>	<b>Values</b>			<b>Values</b>
# Parcels/Passings	1590	391	142	2123	1256	3379
Total Plant Miles	35.30	5.12	3.74	44	199	243.31
# Poles	877	127	93	1097	4948	6046
Est. Aerial Miles	28.24	4.10	2.99	35	159	194.65
Est. UG Miles	7.06	1.02	0.75	9	40	48.66
Aerial %	80%	80%	80%		80%	80%
UG %	20%	20%	20%		20%	20%
Density HH/Mile	45.04	76.37	37.97		6.31	13.89
Take Rate	40%	40%	40%		40%	40%

We included the costs to build Fiber to the Premise (FTTP) to each of the three incorporated communities and provided a total for all three. As much of population in Gilpin County (37% of the population) live in unincorporated communities, we provided an estimate to serve the 1256 homes that are located outside of city limits. We then provided a projected cost to build to all homes and businesses in Gilpin County

<b>Projected Capital Costs</b>	<b>Black Hawk</b>	<b>Central City</b>	<b>Rollinsville</b>	<b>Totals</b>	<b>Gilpin County, Uninc.</b>	<b>Gilpin County, All</b>
<b>Overall</b>	\$3,215,480	\$643,485	\$411,824	\$4,270,788	\$13,749,840	\$18,020,628
	\$2,022	\$1,646	\$2,900		\$10,947	\$5,333
	\$5,056	\$4,114	\$7,250		\$27,368	\$13,333
	\$91,090	\$125,681	\$110,113		\$69,043	\$74,064
<b>Engr. Labor</b>	\$158,436	\$31,217	\$15,427	\$205,080	\$497,636	\$702,715
<b>Aerial Labor</b>	\$684,072	\$99,342	\$72,568	\$855,983	\$3,858,270	\$4,714,253
<b>Underground Labor</b>	\$948,688	\$139,485	\$100,445	\$1,188,619	\$6,216,331	\$7,404,950
<b>Tech Services Labor</b>	\$207,146	\$93,390	\$69,815	\$370,351	\$5,771	\$376,123
<b>Customer Premise Labor and Install Materials including Splitters</b>	\$520,125	\$130,300	\$48,711	\$699,136	\$406,357	\$1,105,493
<b>OSP Materials</b>	\$631,089	\$110,724	\$68,691	\$810,505	\$2,808,048	\$3,618,553
<b>Electronics</b>	\$65,923	\$39,025	\$36,166	\$141,114	\$0	\$98,541

## FTTP Estimates, Assumptions for Clear Creek County

Estimate Dashboard	Empire	George-town	Idaho Springs	Silver-plume	Totals	Clear Creek County Uninc.	Clear Creek County, All
Major Assumptions	Values	Values	Values	Values			Values
# Parcels/Passings	283	1038	1710	172	3203	3561	6764
Total Plant Miles	2.46	8.16	11.46	1.82	24	204	227.89
# Poles	61	203	285	45	594	5069	5662
Est. Aerial Miles	1.97	6.53	9.17	1.46	19	163	182.31
Est. UG Miles	0.49	1.63	2.29	0.36	5	41	45.58
Aerial %	80%	80%	80%	80%		80%	80%
UG %	20%	20%	20%	20%		20%	20%
Density HH/Mile	115.04	127.21	149.21	94.51		17.46	29.68
Take Rate	40%	40%	40%	40%		40%	40%

We provided design and estimated capital costs for the cities and towns in Clear Creek County and provided total projected costs to build to the four towns. As much of the residents in Clear Creek County live outside of city limits, we projected estimated costs for the unincorporated areas and then an estimate for the entire County.



Projected Capital Costs	Empire	George-town	Idaho Springs	Silver-plume	Totals	Clear Creek County Uninc.	Totals
Overall	\$429,916	\$1,252,837	\$1,859,942	\$317,497	\$3,860,193	\$15,190,881	\$19,051,074
	\$1,519	\$1,207	\$1,088	\$1,846		\$4,265.90	\$2,817
	\$3,798	\$3,017	\$2,719	\$4,615		\$10,665	\$7,041
	\$174,763	\$153,534	\$162,299	\$174,449		\$74,468.75	\$83,598
Engr. Labor	\$19,885	\$71,059	\$112,750	\$12,792	\$216,486	\$626,547	\$843,032
Aerial Labor	\$47,863	\$158,213	\$222,045	\$35,510	\$463,631	\$3,951,770	\$4,415,401
Underground Labor	\$77,107	\$256,808	\$362,455	\$56,852	\$753,222	\$6,213,384	\$6,966,606
Tech Services Labor	\$83,780	\$155,277	\$217,649	\$72,397	\$529,103	\$166,438	\$695,542
Customer Premise Labor and Install Materials including Splitters	\$94,209	\$342,157	\$562,462	\$58,223	\$1,057,052	\$1,162,651	\$2,219,702
OSP Materials	\$68,641	\$216,354	\$315,073	\$44,254	\$644,321	\$3,095,269	\$3,739,590
Electronics	\$38,431	\$52,970	\$67,508	\$37,469	\$196,378	\$0	\$171,201

## Fiber to the Premise, Retail Model

In this model, the municipality and/or municipal utility designs, builds, owns and operates the network, and essentially becomes the Internet Service Provider. An increasingly prevalent case for investing in building municipal broadband is being made by advocates defining the Internet as a “utility” and thus a necessity for the public sector to provide when otherwise unavailable. Most municipalities that have deployed a retail, Fiber to the Premise strategy have been providing electric services to their constituents. Municipal electric utilities have an easier implementation path because they already have the access to utility poles and other infrastructure, billing processes in place, customer service centers operational, and business relationships with each and every homeowner and business.

The City of Longmont has deployed this approach and is nationally known as a model of success. Dubbed “NextLight,” this Gigabit fiber network is owned and operated by the City and its power utility, Longmont Power & Communications (LPC). Longmont opted out of Colorado’s SB 152 law in November of 2011 with 60% of the vote. Two years later, Longmont voters approved a \$40.3 million bond issuance to cover the startup costs and network build. Longmont followed Google Fiber’s marketing strategy by launching a pre-build sign-up campaign. The neighborhood with the most market share or “take rate” would be the first area where Longmont would build. The first neighborhood received a 72% take rate prior to construction. Longmont’s 38,000 homes and businesses now have symmetrical Gigabit service for \$50 per month for those who signed up early. The \$50 per month is guaranteed for the lifetime of the home as well as the owner/tenant of the home if he/she moves within the City limits. Longmont’s business service includes symmetrical 100 Mbps for \$230 per month and symmetrical 250 Mbps service for \$500 per month.

Longmont is experiencing an average take rate percentage of 56%. The initial feasibility study conducted in 2013 predicted a 27% take rate. Late in 2016, the City voted to increase LPC’s budget by \$7 million, sourced from the Electric and Broadband Utility Fund balance, to hire staff needed to support take rates twice as high as initially predicted.

Meanwhile NextLight is helping businesses and fostering growth by providing connectivity that’s enabling the community to successfully compete with its neighbor to the south, Boulder. Local businesses that were looking to expand outside the city elected to stay and grow in Longmont thanks to the Gigabit network. The network is also attracting regional work-from-home Coloradans looking for an ideal place to work and raise their family.

## Fiber to the Premise – Wholesale Model

Municipalities or Counties, or in this case, the local governments can take one of two approaches with the wholesale model, owning the fiber only or owning the fiber and the equipment it takes for it to run or be “lit.” For ease, we are going to use “county” to describe this model; although, it is understood that the county, or the municipality or any other entity has not yet stepped up to owning infrastructure. Fiber optic cable that does not have equipment on the ends of it is referred to as “dark” fiber. Fiber optic cable that has equipment in place is referred to as “lit” fiber.

Whether the county provides dark or lit fiber, the wholesale model assumes at least one and possibly multiple service providers are available to provide Internet services. The county owns the network, and in some cases, the equipment to light the network, and the service provider(s) pay a lease fee to the county in the form of a monthly payment or in the form of a revenue share, a percentage of the gross revenues generated by service fees on the network.

This ownership by a local government, run by a private entity approach is nothing new; it has been prevalent for decades with toll roads that are managed privately. What is a new and emerging trend, is communities funding a network and turning it over to a traditional carrier to manage and operate the network, such as in Rio Blanco County.

In addition to the retail and wholesale Fiber to the Premise models, there are a number of emerging public-private partnership models that are just being introduced in the industry. A description of typical funding mechanisms for municipalities or counties will be discussed below as well as a description of the emerging public-private partnership models.

## Public-Private Partnerships

The following models are provided to the Local governments to help understand other possible approaches. These various approaches may or may not work in Clear Creek and Gilpin Counties.

When evaluating public-private partnerships, local governments need to balance the tension between control, risk and reward against the goals for the project. Control, in this context, refers to ownership of the network or how much capital the municipality is willing to invest. A local government must consider how much control or capital is needed to be invested to minimize risks and maximize rewards. Risks are associated primarily with financial risks such as debt and debt coverage, as well as implementation, execution and operational risks. Reward is often associated with where and how fast a network is constructed, coupled with what type of services will be offered and at what price. There may be other benefits that are classified

under “reward” such as fiber built for the city’s benefit at no cost or construction and operational efficiencies gained from the potential partnership.



Partners can include private for-profit companies, local non-profits, other anchor institutions and even local residents. In some instances, the local government may have a very limited role in a partnership and may only provide access to rights of way or other city infrastructure such as conduit, excess fiber, water or public safety towers, licensed spectrum, light poles or local government buildings. In other cases, a local government may agree to become an anchor tenant and pay for service on the network for a contracted term, providing a guaranteed revenue source for the network project partner to justify the business plan to build out further in the community. In more extensive partnerships, the local government can play a larger role, such as providing capital for part or all of the network construction. In some public partnership models, the private sector provides financing, while the local government shares in some of the risk. In other models, the local government pays for a substantial portion or all of the network build and contracts the operation of the network to the project partner. Sharing in the financial and operational risks and in the associated benefits of a project can allow communities to pursue broadband endeavors that may otherwise be unattainable.

Below are examples of three public partnership models that have been implemented by communities in the recent years.



## Google

- Google builds, owns operates
- City has little control over buildout, pricing, Service Level Agreements
- No capital risk



## Westminster, MD

- City owns infrastructure
- Ting is the service provider
- “Built by Westminster, Powered by Ting”
- Revenue share
- Ting covers any shortfall in debt coverage
- Support ancillary services (cell, e-government)



## 20 year Lease

- Company finances build
- Lease payments are driven by minimum take rate percentage
- Payments from the service providers cover the lease payment
- No capital
- City owns network after 20-30 years

Google Fiber, No Capital Outlay from the Municipality (and no Control)

Perhaps the most coveted example of a public-private partnership is the Google Fiber project in the Kansas City area. Google chose Kansas City, KS and Kansas City, MO as the community to embark upon its first foray into building fiber infrastructure. Kansas City, KS committed to facilitate access to local infrastructure and conduit that it owned and provided access to its rights of way. Kansas City, MO committed to waive local permitting fees and provided Google with unfettered access to dedicated city staff to support the project.

In return, Google has agreed to build and operate a fiber to the premise network and provide Internet access service with 1 Gbps speeds to homes at \$70 per month and to businesses at \$300 per month. Google Fiber did not commit to ubiquitous coverage in Kansas City, but agreed to build out fiber in neighborhoods (called “fiberhoods”) that met a predetermined take rate percentage prior to construction.

Google Fiber used this same approach in Austin, TX and in Provo, Utah. Although in the past three years Google has announced plans to replicate this model in 35 other cities, Google has recently announced that it is pulling back its fiber to the premise strategy and is experimenting with Gigabit wireless technologies. Currently Gigabit wireless technology is limited to 500 feet; meaning, fiber optic cable still needs to be installed very close to homes and businesses for the wireless technology to deliver Gigabit bandwidth. Nevertheless, Google’s pull back has caused some trepidation in the industry. Google is evaluating other models for partnership with cities

and their pause in fiber to the premise implementation should not be taken as an indication of their appetite for collaboration with cities.

In the Google Fiber KS model, the local governments do not commit capital to build the network. This limits the cities' financial risk substantially, but it also curbs the control they have over how and where the network is built. The municipalities in the Google Fiber projects have no say over prices charged to the customers, how the network is built or how fast. Google makes all of the decisions regarding current and future operations, and whether or not they pull out of a market. Given their most recent announcements of pulling back their plans, this has proven to be a substantial risk to the communities. Critics of Google's fiberhood approach claim that Google has "cherry-picked" more affluent neighborhoods to build its fiber and has left economically challenged neighborhoods off its build list.

Ting, Municipality Builds the Fiber Network, Ting pays for Equipment and Operates the Network

Canada's Ting has recently made a name for itself as a private carrier that will deliver fiber to the premises services over a city-owned network. Already underway in Westminster, MD, Santa Cruz, CA, and Huntsville, AL, Ting is now partnering with Centennial, CO to bring Gigabit fiber Internet access to Centennial's 107,000 residents and its local businesses.

In this model, the municipality provides the capital to build, own and maintain the "dark" fiber throughout the community and to every home and business. Ting "lights" the fiber by providing capital for the equipment. Ting provides Gigabit services to homes for \$89 per month and to businesses for \$139 per month. In order for the city to pay down its debt associated with building the fiber network, Ting pays the city a fee for homes and businesses that are fiber-ready or have been passed with fiber and another fee when homes and businesses start subscribing to Internet services.

While the fiber network is the property of the city and eventually an "open network," meaning several service providers can use it to offer services to homes and businesses, Ting partnerships typically feature an "exclusive right to operate network" for a minimum amount of time. While the build is the responsibility of the respective cities, Ting will lease and light the fiber and provide all equipment and Internet access. Cities partnering with Ting are mitigating risk and staying out of the challenging ISP business, but have more control over where, how and how fast the network is built. The cities also have control over pricing and services offered and can require that the network is available for others to use after an initial period of time.

Other companies are now replicating this model. Companies in Colorado that have stated they would enter into public-private partnerships similar to Ting's model include Cedar Networks, Allo, FastTrack and Forethought. In Rio Blanco County, Cimarron Telecommunications and Local Access Internet are providing services in a similar model. Others may also offer a similar model if asked to respond to a formal Request for Information or Proposal.

#### Long-term Lease, Shared Take Rate Risks or Utility Fee

Private firms including SiFi and Symmetrical Networks will fund a network build, and will oversee design, engineering, construction and operation of the network with a 20-year exclusive lease agreement. These firms are forecasting that the subscription rates they receive will provide healthy returns on their investment. And for extra measure, they ensure a sufficient return by requiring cities to guarantee take rates, or pay the difference. The good news is that these potential city paybacks have a long ramp-up time before ever going into effect.

Additionally, the guaranteed take rate is typically more than achievable at somewhere between 30-38%, depending on the negotiated terms. At the end of the negotiated years, the city owns the network free and clear but can continue to lease the fiber to their established partner(s). Macquarie Capital will also work with communities to establish a fiber network using a similar model to that described above or with a utility fee structure model. This utility fee structure model was recently used to rescue Utah's Utopia network from its financial woes. In the Utopia project, Macquarie charges a flat utility fee for every home and business that the network passes, whether the home or business signs up for services or not. Terms of the deal were reported to be \$22.60 per month for five cities. In terms of revenue sharing, each city is able to keep 75% of wholesale revenue after the first \$2M per year. This arrangement is expected to wipe out Utopia's debt by 2021 if the network sees a 24% take rate for premium services

Macquarie Capital is also providing financing, design, engineering, construction and operations for an anchor institutions network for the State of Kentucky. This "concessionaire model" provides a long-term agreement of 30 years where Macquarie is the lead vendor coordinating all financing and implementation for the project and the State of Kentucky, in turn, shares in the risks and rewards of the project.

#### How is the Network Implemented and Operated?

As discussed, there are a myriad of ways that a public-private partnership can be funded. In the same vein, implementation and operation models vary. In many instances, the municipality has staff and resources that are already providing utilities to their constituents, or are already maintaining roads and right of ways. With this being said, designing, building and operating a fiber network is not always in a municipality's wheelhouse. Often a municipality will

outsource the design, engineering, permitting, construction of the network and physical turn-up of services. In some cases, the municipality may also contract for operations of the network and in other instances, the municipality may source these functions in-house.

Private entities Macquarie, SiFi, Symmetrical Networks and Fujitsu, that are providing financing for these networks to be built under a public-private partnership model, are also looking for opportunities to work with municipalities who wish to outsource either part or the entire above list. Other municipalities are choosing to partner with these firms for the financing and operations, by keep the design, engineering and construction services under their control, using standard procurement processes for these functions.

As discussed in the funding section of this paper, each entity has a different model to recoup its investment and meet their business case for success. Usually these arrangements, fees, and exclusive rights contracts are complex and should be reviewed by a firm with extensive experience in multiple cities with a wide variety of business models and contingencies.

Software Defined Network, with an “Opt-In” Twist  
Named the community broadband project of the year by the National Association of Telecommunications Officers and Advisors (NATOA), the City of Ammon, Idaho’s open access network is obviously making many communities take notice. Ammon’s fiber network is a “software defined network,” allowing “fiber apps” to be setup and hosted on the network. One such application, is an innovative public safety application that uses the fiber network to coordinate immediate, real-time responses to school shootings. This has led to the City partnering with the University of Utah in a \$600,000 initiative to research and develop a series of next-generation networking technologies supporting public safety, including broadband public emergency alerts.

Ammon has created Local Improvement Districts (LIDs) where residents can “opt in” or “opt out” of receiving service from the fiber to the premise network. For those who opt-in, they are charged a monthly fee, where those who are not interested are not charged. The city council’s logic is that those who opt-in are investing in an opportunity to increase their property value. Within a specific LID, improvement bonds are used to cover the expense. Bonds are paid off by an assessment of each participating property. It’s estimated that this will result in a \$15 to \$20 monthly charge for opting-in households.

The open-access network has an accessible online dashboard where Ammon’s residents can change providers if they’re not happy with their current provider. They can also set up private, high speed “rooms” online, with a few clicks. Virtual connections can be set up between all of



the schools, or with the school and the hospital – on the fly, again, with a few clicks. Ammon’s open access model offers very high speed Internet with a number options for providers, but more importantly, it also supports a number of growing data applications, allowing collaboration with anyone on the network at any time.

## Financial Models - Does the Financial Model Work to Build Fiber to the Premise?

NEO’s team ran several financial models for building a Fiber to the Premise network in each county of the study area. The financial model is tested for feasibility by running a number of litmus tests that forecast whether or not the network can be sustainable and essentially pay back its debt.

In general, the model for providing retail services in both counties, with a 40% take rate percentage within the first two years, provides enough operating cashflows to pay the debt obligations. NEO Connect modeled this approach for both Counties. It was assumed that each County would seek debt financing through revenue or general obligation bonds with interest rates of 4.33%.

NEO assumed that each County would initially build out FTTP in each of its respective municipalities where there is more density. Gilpin County would need \$4.27 Million and Clear Creek County would need \$3.8 Million in debt financing for their respective first phases. The second phases for each County would be to build out the unincorporated areas within each County. The second phase for Gilpin County would include \$13.8 Million in debt financing and Clear Creek would require \$15.2 Million in debt financing.

To mitigate financial risk and to have the most efficient use of capital, NEO recommends spending capital when neighborhoods have a predetermined take rate percentage of pre-sign ups. This ties capital outlay close to when the entity would receive revenue, mitigating debt coverage risk and creating an efficient use of capital.

Customer counts were based upon GIS data that was provided by the County staff in each County. We assumed a take rate percentage of 20% in the first year, an additional 20% in the second year and an additional 10% in the third year for each phase of construction.

We assumed the following mix of services and percentages of customers taking various services:

<b>Residential Services</b>	<b>Pricing</b>	<b>% of Customers Taking Service</b>
100 Mbps/100 Mbps	\$ 49.99	80%
1 Gbps/1 Gbps	\$ 79.99	20%
Residential Voice	\$ 30.00	10%
Managed WiFi	\$ 4.95	10%
Worry Free WiFi	\$ 9.95	5%
Static IP	\$ 9.95	1%
Wireless Booster/AP	\$ 9.95	5%
<b>Business Services</b>	<b>Pricing</b>	<b>% of Customers Taking Service</b>
100 Mbps/100 Mbps	\$ 79.99	80%
300 Mbps/300 Mbps	\$ 249.99	10%
1 Gbps/1 Gbps	\$ 499.99	10%
Voice Business (POTS line)	\$ 100.00	5%
Voice Business (SIP Trunk)	\$ 64.00	20%

The financial model improves greatly with eliminating the lower tiers of service and the lower price offerings. As each of the Counties have a population that is fairly affluent, this approach should be considered; however, additional market research may be conducted to verify customers would sign up for the services at higher price points. The results of this strategy are addressed below.

For the initial financial review, we used the service tiers and pricing shown above. Here are the results of these assumptions.

## Clear Creek County, FFTP Retail Model

Income Statement	Clear Creek County, FFTP - Retail				
	2018	2019	2020	2021	2022
	Forecast Project Period				
	Year 1	Year 2	Year 3	Year 4	Year 5
<b>Revenues</b>					
Service Revenues					
Empire	\$ 25,700	\$ 66,700	\$ 95,100	\$ 102,800	\$ 102,800
Georgetown	\$ 94,500	\$ 245,100	\$ 349,100	\$ 378,000	\$ 378,000
Idaho Springs	\$ 155,500	\$ 403,900	\$ 574,800	\$ 622,000	\$ 622,000
Businesses, all	\$ 50,000	\$ 130,500	\$ 160,800	\$ 160,800	\$ 160,800
<b>Total Revenues</b>	<b>\$ 409,520</b>	<b>\$ 1,350,340</b>	<b>\$ 2,181,850</b>	<b>\$ 2,558,510</b>	<b>\$ 2,620,000</b>
<b>Expenses</b>					
Internet Access	\$ 60,000	\$ 60,000	\$ 60,000	\$ 60,000	\$ 60,000
Annual Growth/Reduction of Internet Access	\$ -	\$ (8,494)	\$ (9,733)	\$ (10,161)	\$ (10,161)
Video Overhead, Programming Fees per Customer	\$ -	\$ -	\$ -	\$ -	\$ -
Software Maintenance	\$ 4,099	\$ 12,472	\$ 18,667	\$ 20,803	\$ 20,803
Maintenance materials	\$ -	\$ -	\$ -	\$ -	\$ -
Salaries	\$ 103,593	\$ 226,561	\$ 227,157	\$ 190,039	\$ 165,928
Payroll Taxes and Benefits	\$ 36,257	\$ 79,296	\$ 79,505	\$ 66,514	\$ 58,075
Sales Churn, percent of Total Revenue	\$ 8,190	\$ 27,007	\$ 43,637	\$ 51,170	\$ 52,400
Marketing and Sales, percent of Total Revenue	\$ 20,476	\$ 67,517	\$ 109,093	\$ 127,926	\$ 131,000
Residential Customer Care, Operations	\$ 476	\$ 951	\$ 1,168	\$ 1,168	\$ 1,168
Business Customer Care, Operations	\$ 208	\$ 1,127	\$ 1,943	\$ 2,300	\$ 2,300
<b>Total Expenses</b>	<b>\$ 247,497</b>	<b>\$ 497,380</b>	<b>\$ 574,768</b>	<b>\$ 557,364</b>	<b>\$ 529,119</b>
<b>EBITDA</b>	<b>\$ 162,023</b>	<b>\$ 852,960</b>	<b>\$ 1,607,082</b>	<b>\$ 2,001,146</b>	<b>\$ 2,090,881</b>
	<b>2018</b>	<b>2019</b>	<b>2020</b>	<b>2021</b>	<b>2022</b>
	Forecast Project Period				
	<b>Year 1</b>	<b>Year 2</b>	<b>Year 3</b>	<b>Year 4</b>	<b>Year 5</b>
Interest Expense	\$ 163,296	\$ 813,691	\$ 799,616	\$ 784,921	\$ 769,576
Principal Payments	\$ 63,169	\$ 318,636	\$ 332,710	\$ 347,406	\$ 332,710
<b>Net Income</b>	<b>\$ (64,443)</b>	<b>\$ (279,367)</b>	<b>\$ 474,755</b>	<b>\$ 868,819</b>	<b>\$ 988,595</b>

### Looking at Financial Feasibility Objectives

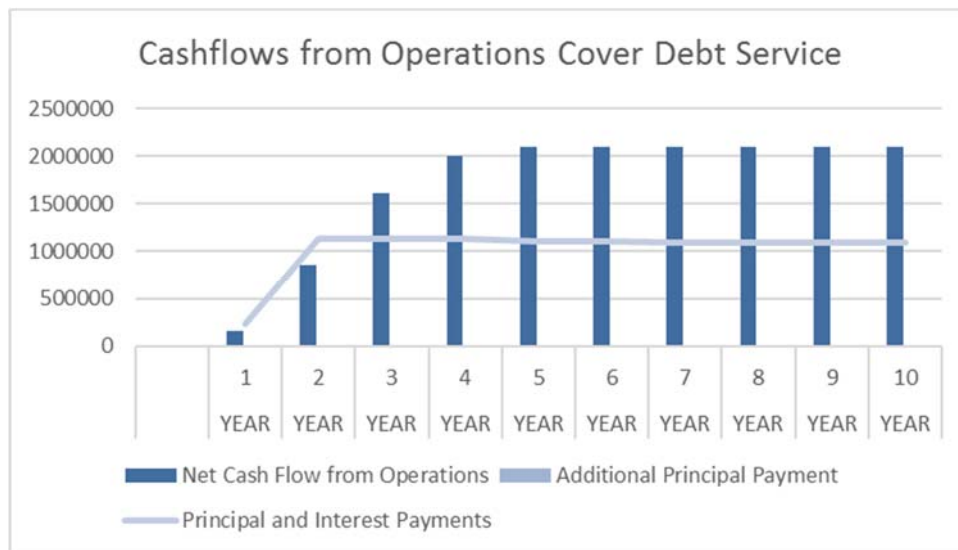
Covering debt is one of the most important financial risks that needs to be examined in detail before embarking upon a fiber-to-the-premise strategy. NEO recommends examination of several financial feasibility objectives to mitigate debt coverage risks.

The first feasibility objective is the debt coverage ratio on each tranche of funding. This ratio provides an indication of whether or not the project can be financed.

Coverage Ratio of each Tranch									
	2018	2019	2020	2021	2022	2023	2024	2025	
	YEAR	YEAR	YEAR	YEAR	YEAR	YEAR	YEAR	YEAR	YEAR
	1	2	3	4	5	6	7	8	
<b>OPERATIONS</b>									
Net Cash Flow from Operations	\$ 162,023	\$ 852,960	\$ 1,607,082	\$ 2,001,146	\$ 2,090,881	\$ 2,089,672	\$ 2,089,672	\$ 2,089,672	\$ 2,089,672
<b>Debt Service</b>	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -
Interest, Phase 1	\$ 163,296	\$ 160,506	\$ 157,593	\$ 154,550	\$ 151,374	\$ 148,057	\$ 144,594	\$ 140,978	\$ 140,978
Principal, Phase 1	\$ 63,169	\$ 65,959	\$ 68,873	\$ 71,915	\$ 75,091	\$ 78,408	\$ 81,871	\$ 85,488	\$ 85,488
Total Principal and Interest for Phase 1	\$ 226,465	\$ 226,465	\$ 226,465	\$ 226,465	\$ 226,465	\$ 226,465	\$ 226,465	\$ 226,465	\$ 226,465
<b>Coverage Ratio</b>	<b>72%</b>	<b>377%</b>	<b>710%</b>	<b>884%</b>	<b>923%</b>	<b>923%</b>	<b>923%</b>	<b>923%</b>	
Interest, Phase 2	\$ -	\$ 653,185	\$ 642,024	\$ 630,370	\$ 618,202	\$ 605,496	\$ 592,229	\$ 578,376	\$ 578,376
Principal, Phase 2	\$ -	\$ 252,677	\$ 263,838	\$ 275,491	\$ 287,660	\$ 300,366	\$ 313,633	\$ 327,486	\$ 327,486
Total Principal and Interest for Phase 2	\$ -	\$ 905,862	\$ 905,862	\$ 905,862	\$ 905,862	\$ 905,862	\$ 905,862	\$ 905,862	\$ 905,862
<b>Coverage Ratio</b>		<b>75%</b>	<b>142%</b>	<b>177%</b>	<b>185%</b>	<b>185%</b>	<b>185%</b>	<b>185%</b>	<b>185%</b>

NEO has met with several financial firms that provide debt financing for municipal and county fiber projects. Generally, additional tranches of funding may be obtained when the debt coverage ratio of 125% is achieved. As the above chart indicates, if the targeted coverage ratio needed is 125%, the project can be funded within two years.

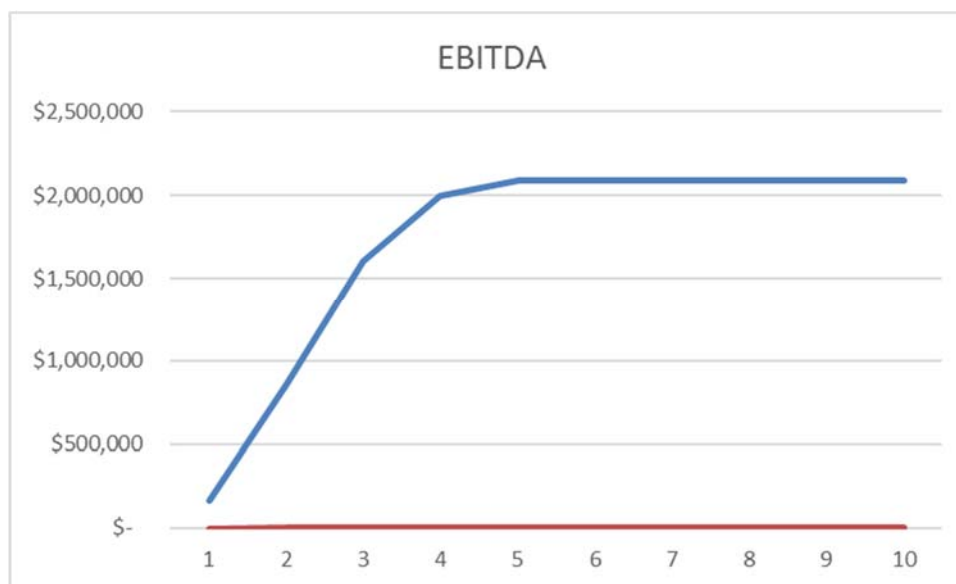
Another good indication that this approach would be financially feasible is examining whether or not the cumulative cashflows from operations over ten years is greater than the outstanding debt in year ten.



After ten years, the cumulative cash flows are forecasted at over \$17.162 Million; while the outstanding debt in year ten is \$16.134 Million. It should be noted that the first years of operations requires additional debt to cover principal and interest payments.

<b>Cumulative cash flows over 10 years greater than the debt service</b>											
		<b>2018</b>	<b>2019</b>	<b>2020</b>	<b>2021</b>	<b>2022</b>	<b>2023</b>	<b>2024</b>	<b>2025</b>	<b>2026</b>	<b>2027</b>
		<b>YEAR</b>	<b>YEAR</b>	<b>YEAR</b>	<b>YEAR</b>	<b>YEAR</b>	<b>YEAR</b>	<b>YEAR</b>	<b>YEAR</b>	<b>YEAR</b>	<b>YEAR</b>
		<b>1</b>	<b>2</b>	<b>3</b>	<b>4</b>	<b>5</b>	<b>6</b>	<b>7</b>	<b>8</b>	<b>9</b>	<b>10</b>
<b>OPERATIONS</b>											
Net Cash Flow from Operations		\$ 162,023	\$ 852,960	\$ 1,607,082	\$ 2,001,146	\$ 2,090,881	\$ 2,089,672	\$ 2,089,672	\$ 2,089,672	\$ 2,089,672	\$ 2,089,672
Cumulative Cash Flow from Operations		\$ 162,023	\$ 1,014,983	\$ 2,622,064	\$ 4,623,210	\$ 6,714,092	\$ 8,803,764	\$ 10,893,437	\$ 12,983,109	\$ 15,072,782	\$ 17,162,454
<b>CAPITAL EXPENDITURES</b>											
Capital Expenditures		\$ 3,860,192	\$ 15,190,881	\$ 125,000	\$ 125,000	\$ 125,000	\$ 125,000	\$ 125,000	\$ 125,000	\$ 125,000	\$ 125,000
EQUITY	0%	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -
<b>Debt Service</b>											
Required Draws		\$ 3,860,192	\$ 15,190,881	\$ 125,000	\$ 125,000	\$ 125,000	\$ -	\$ -	\$ -	\$ -	\$ -
Principal Payments		\$ 63,169	\$ 318,636	\$ 332,710	\$ 347,406	\$ 332,710	\$ 347,406	\$ 362,751	\$ 378,774	\$ 395,504	\$ 412,973
Total Outstanding Debt		\$ 3,797,023	\$ 18,669,267	\$ 18,461,557	\$ 18,239,151	\$ 18,031,440	\$ 17,684,034	\$ 17,321,283	\$ 16,942,509	\$ 16,547,005	\$ 16,134,032
Interest		\$ 163,296	\$ 813,691	\$ 799,616	\$ 784,921	\$ 769,576	\$ 753,553	\$ 736,823	\$ 719,354	\$ 701,113	\$ 682,066

EBITDA (Earnings before Interest, Taxes, Depreciation and Amortization) is forecasted to be over \$2 Million after the network is built.



There is sufficient cashflow to cover principal and interest payments, starting in year 3.

Positive EBITDA?											
	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	
	YEAR	YEAR	YEAR	YEAR	YEAR	YEAR	YEAR	YEAR	YEAR	YEAR	YEAR
	1	2	3	4	5	6	7	8	9	10	
<b>EBITDA</b>	\$ 162,023	\$ 852,960	\$ 1,607,082	\$ 2,001,146	\$ 2,090,881	\$ 2,089,672	\$ 2,089,672	\$ 2,089,672	\$ 2,089,672	\$ 2,089,672	\$ 2,089,672
Less Interest Expense	\$ 163,296	\$ 813,691	\$ 799,616	\$ 784,921	\$ 769,576	\$ 753,553	\$ 736,823	\$ 719,354	\$ 701,113	\$ 682,066	
Less Principal Payment	\$ 63,169	\$ 318,636	\$ 332,710	\$ 347,406	\$ 332,710	\$ 347,406	\$ 362,751	\$ 378,774	\$ 395,504	\$ 412,973	
Earnings after Interest and Principal Payments	\$ (64,443)	\$ (279,367)	\$ 474,755	\$ 868,819	\$ 988,595	\$ 988,713	\$ 990,099	\$ 991,545	\$ 993,056	\$ 994,633	

Understanding the financial model is important for the County, not only from the viewpoint of whether the County pursued a strategy to own and operate the network, but also, to understand what the implications may be for a potential public-private partnership.

As discussed above, the financial model improves greatly with eliminating the lower service and pricing tiers. This may be one strategy to mitigate the take rate percentage risk. For the following model, we lowered the take rate percentage to 15% in the first year, 15% in the second year and 5% in the third year. We used the following service tier percentages.

<b>Residential Services</b>	<b>Pricing</b>	<b>% of Customers Taking Service</b>
100 Mbps/100 Mbps	\$ 49.99	0%
1 Gbps/1 Gbps	\$ 79.99	100%
Residential Voice	\$ 30.00	10%
Managed WiFi	\$ 4.95	10%
Worry Free WiFi	\$ 9.95	5%
Static IP	\$ 9.95	1%
Wireless Booster/AP	\$ 9.95	5%
<b>Business Services</b>	<b>Pricing</b>	<b>% of Customers Taking Service</b>
100 Mbps/100 Mbps	\$ 79.99	0%
300 Mbps/300 Mbps	\$ 249.99	30%
1 Gbps/1 Gbps	\$ 499.99	70%
Voice Business (POTS line)	\$ 100.00	5%
Voice Business (SIP Trunk)	\$ 64.00	20%

These changes yielded the following results.

Income Statement	Clear Creek County, FFTP - Retail				
	2018	2019	2020	2021	2022
	Forecast Project Period				
	Year 1	Year 2	Year 3	Year 4	Year 5
<b>Revenues</b>					
Service Revenues					
Empire	\$ 26,700	\$ 70,000	\$ 94,600	\$ 100,000	\$ 100,000
Georgetown	\$ 98,800	\$ 256,900	\$ 348,900	\$ 368,400	\$ 368,400
Idaho Springs	\$ 163,000	\$ 423,300	\$ 575,100	\$ 607,600	\$ 607,600
Businesses, all	\$ 106,100	\$ 275,800	\$ 340,000	\$ 340,000	\$ 340,000
<b>Total Revenues</b>	<b>\$ 461,840</b>	<b>\$ 1,512,055</b>	<b>\$ 2,366,830</b>	<b>\$ 2,691,905</b>	<b>\$ 2,742,400</b>
<b>Expenses</b>					
Internet Access	\$ 60,000	\$ 60,000	\$ 60,000	\$ 60,000	\$ 60,000
Annual Growth/Reduction of Internet Access	\$ -	\$ (7,871)	\$ (8,704)	\$ (8,918)	\$ (8,918)
Video Overhead, Programming Fees per Customer	\$ -	\$ -	\$ -	\$ -	\$ -
Software Maintenance	\$ 3,074	\$ 9,354	\$ 13,520	\$ 14,588	\$ 14,588
Maintenance materials	\$ -	\$ -	\$ -	\$ -	\$ -
Salaries	\$ 87,865	\$ 190,274	\$ 183,348	\$ 152,733	\$ 140,678
Payroll Taxes and Benefits	\$ 30,753	\$ 66,596	\$ 64,172	\$ 53,457	\$ 49,237
Sales Churn, percent of Total Revenue	\$ 9,237	\$ 30,241	\$ 47,337	\$ 53,838	\$ 54,848
Marketing and Sales, percent of Total Revenue	\$ 23,092	\$ 75,603	\$ 118,342	\$ 134,595	\$ 137,120
Residential Customer Care, Operations	\$ 357	\$ 713	\$ 822	\$ 822	\$ 822
Business Customer Care, Operations	\$ 156	\$ 846	\$ 1,432	\$ 1,610	\$ 1,610
<b>Total Expenses</b>	<b>\$ 226,682</b>	<b>\$ 450,463</b>	<b>\$ 513,305</b>	<b>\$ 497,900</b>	<b>\$ 485,160</b>
<b>EBITDA</b>	<b>\$ 235,158</b>	<b>\$ 1,061,592</b>	<b>\$ 1,853,525</b>	<b>\$ 2,194,005</b>	<b>\$ 2,257,240</b>
	<b>2018</b>	<b>2019</b>	<b>2020</b>	<b>2021</b>	<b>2022</b>
	Forecast Project Period				
	<b>Year 1</b>	<b>Year 2</b>	<b>Year 3</b>	<b>Year 4</b>	<b>Year 5</b>
Interest Expense	\$ 163,296	\$ 813,691	\$ 799,616	\$ 784,921	\$ 769,576
Principal Payments	\$ 63,169	\$ 318,636	\$ 332,710	\$ 347,406	\$ 332,710
<b>Net Income</b>	<b>\$ 8,693</b>	<b>\$ (70,735)</b>	<b>\$ 721,198</b>	<b>\$ 1,061,678</b>	<b>\$ 1,154,954</b>

Even with lower take rate percentages (15%, 15% and 5%), the projections show a sustainable model.

### Gilpin County, FFTP Retail Model

The same financial considerations were applied to Gilpin County. NEO first ran the financial model with the lower service tiers and pricing.



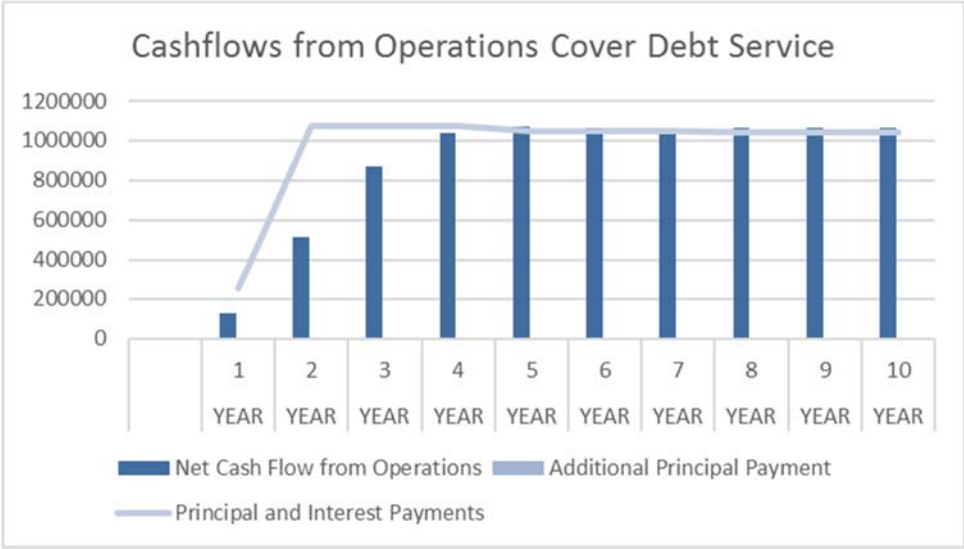
Income Statement	Gilpin County FTTP, Retail Model				
	2018	2019	2020	2021	2022
	Forecast Project Period				
	Year 1	Year 2	Year 3	Year 4	Year 5
<b>Revenues</b>					
Service Revenues					
Black Hawk	\$ 144,400	\$ 375,400	\$ 534,500	\$ 578,400	\$ 578,400
Central City	\$ 35,500	\$ 92,100	\$ 131,700	\$ 142,800	\$ 142,800
Rollinsville	\$ 12,700	\$ 33,800	\$ 47,600	\$ 51,200	\$ 51,200
Businesses, all	\$ 100,400	\$ 185,500	\$ 200,400	\$ 200,400	\$ 200,400
<b>Total Revenues</b>	<b>\$ 343,980</b>	<b>\$ 870,810</b>	<b>\$ 1,257,450</b>	<b>\$ 1,407,460</b>	<b>\$ 1,428,800</b>
<b>Expenses</b>					
Internet Access	\$ 60,000	\$ 60,000	\$ 60,000	\$ 60,000	\$ 60,000
Annual Growth/Reduction of Internet Access	\$ -	\$ (7,448)	\$ (8,004)	\$ (8,155)	\$ (8,155)
Video Overhead, Programming Fees per Customer	\$ -	\$ -	\$ -	\$ -	\$ -
Software Maintenance	\$ 3,059	\$ 7,241	\$ 10,022	\$ 10,776	\$ 10,776
Maintenance materials	\$ -	\$ -	\$ -	\$ -	\$ -
Salaries	\$ 87,625	\$ 158,032	\$ 153,513	\$ 133,696	\$ 125,192
Payroll Taxes and Benefits	\$ 30,669	\$ 55,311	\$ 53,730	\$ 46,794	\$ 43,817
Sales Churn, percent of Total Revenue	\$ 6,880	\$ 17,416	\$ 25,149	\$ 28,149	\$ 28,576
Marketing and Sales, percent of Total Revenue	\$ 17,199	\$ 43,541	\$ 62,873	\$ 70,373	\$ 71,440
Residential Customer Care, Operations	\$ 432	\$ 1,051	\$ 1,475	\$ 1,601	\$ 1,601
Business Customer Care, Operations	\$ 78	\$ 156	\$ 196	\$ 196	\$ 196
<b>Total Expenses</b>	<b>\$ 218,059</b>	<b>\$ 355,783</b>	<b>\$ 384,998</b>	<b>\$ 370,981</b>	<b>\$ 360,994</b>
<b>EBITDA</b>	<b>\$ 125,921</b>	<b>\$ 515,027</b>	<b>\$ 872,452</b>	<b>\$ 1,036,479</b>	<b>\$ 1,067,806</b>
	<b>2018</b>	<b>2019</b>	<b>2020</b>	<b>2021</b>	<b>2022</b>
	<b>Forecast Project Period</b>				
	<b>Year 1</b>	<b>Year 2</b>	<b>Year 3</b>	<b>Year 4</b>	<b>Year 5</b>
Interest Expense	\$ 183,493	\$ 773,381	\$ 759,974	\$ 745,976	\$ 731,359
Principal Payments	\$ 70,982	\$ 303,522	\$ 316,928	\$ 330,927	\$ 316,928
<b>Net Income</b>	<b>\$ (128,555)</b>	<b>\$ (561,876)</b>	<b>\$ (204,450)</b>	<b>\$ (40,424)</b>	<b>\$ 19,519</b>

**Looking at Financial Feasibility Objectives**

Gilpin County will not have enough operating cashflows in the first four years to cover principal and interest payments. Although additional debt can be taken down after the first phase in building to the municipalities, building out to the rest of the County will prove more difficult. Again, with a pre-sign up approach, the risks of building out to the unincorporated areas may be mitigated by other building out when a certain percentage of the homes have signed up for service.

Coverage Ratio of each Tranch									
	2018	2019	2020	2021	2022	2023	2024	2025	
	YEAR	YEAR	YEAR	YEAR	YEAR	YEAR	YEAR	YEAR	YEAR
	1	2	3	4	5	6	7	8	
<b>OPERATIONS</b>									
Net Cash Flow from Operations	\$ 125,921	\$ 515,027	\$ 872,452	\$ 1,036,479	\$ 1,067,806	\$ 1,067,248	\$ 1,067,248	\$ 1,067,248	\$ 1,067,248
<b>Debt Service</b>	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -
Interest, Phase 1	\$ 183,493	\$ 180,358	\$ 177,084	\$ 173,666	\$ 170,097	\$ 166,370	\$ 162,478	\$ 158,414	\$ 158,414
Principal, Phase 1	\$ 70,982	\$ 74,118	\$ 77,391	\$ 80,810	\$ 84,379	\$ 88,106	\$ 91,998	\$ 96,061	\$ 96,061
Total Principal and Interest for Phase 1	\$ 254,476	\$ 254,476	\$ 254,476	\$ 254,476	\$ 254,476	\$ 254,476	\$ 254,476	\$ 254,476	\$ 254,476
<b>Coverage Ratio</b>	<b>49%</b>	<b>202%</b>	<b>343%</b>	<b>407%</b>	<b>420%</b>	<b>419%</b>	<b>419%</b>	<b>419%</b>	
Interest, Phase 2	\$ -	\$ 593,023	\$ 582,890	\$ 572,310	\$ 561,262	\$ 549,727	\$ 537,682	\$ 525,104	\$ 525,104
Principal, Phase 2	\$ -	\$ 229,404	\$ 239,537	\$ 250,117	\$ 261,165	\$ 272,700	\$ 284,745	\$ 297,322	\$ 297,322
Total Principal and Interest for Phase 2	\$ -	\$ 822,427	\$ 822,427	\$ 822,427	\$ 822,427	\$ 822,427	\$ 822,427	\$ 822,427	\$ 822,427
<b>Coverage Ratio</b>		<b>48%</b>	<b>81%</b>	<b>96%</b>	<b>99%</b>	<b>99%</b>	<b>99%</b>	<b>99%</b>	<b>99%</b>

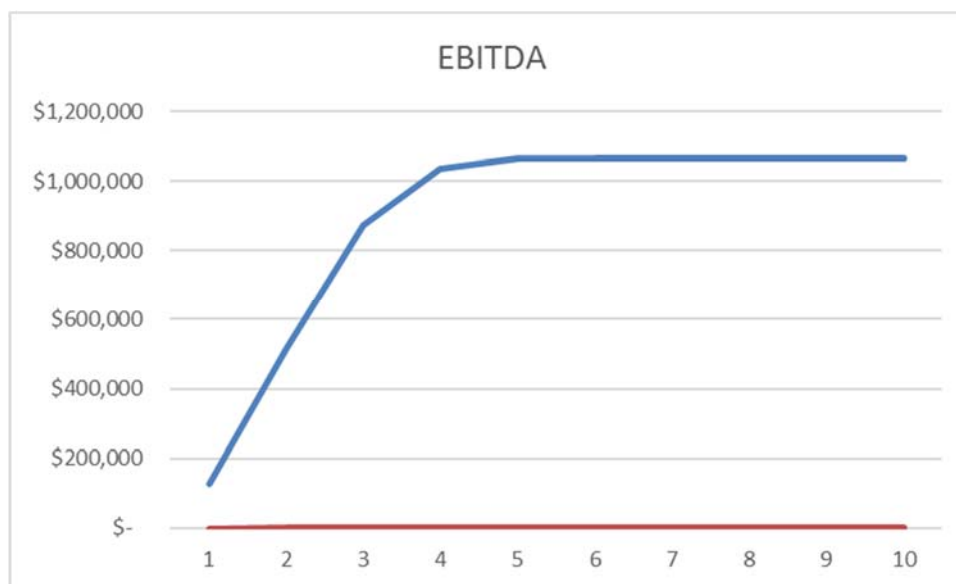
Cashflows from operations cover debt service starting in year 5. There is very little free cashflow after principal and interest payments.



It would take longer for Gilpin County to pay back its debt service from operating cashflows. After ten years, the cumulative cash flows are forecasted at over \$8.95 Million; while the outstanding debt in year ten is \$15.248 Million.

<b>Cumulative cash flows over 10 years greater than the debt service</b>											
		<b>2018</b>	<b>2019</b>	<b>2020</b>	<b>2021</b>	<b>2022</b>	<b>2023</b>	<b>2024</b>	<b>2025</b>	<b>2026</b>	<b>2027</b>
		<b>YEAR</b>	<b>YEAR</b>	<b>YEAR</b>	<b>YEAR</b>	<b>YEAR</b>	<b>YEAR</b>	<b>YEAR</b>	<b>YEAR</b>	<b>YEAR</b>	<b>YEAR</b>
		<b>1</b>	<b>2</b>	<b>3</b>	<b>4</b>	<b>5</b>	<b>6</b>	<b>7</b>	<b>8</b>	<b>9</b>	<b>10</b>
<b>OPERATIONS</b>											
Net Cash Flow from Operations		\$ 125,921	\$ 515,027	\$ 872,452	\$ 1,036,479	\$ 1,067,806	\$ 1,067,248	\$ 1,067,248	\$ 1,067,248	\$ 1,067,248	\$ 1,067,248
Cumulative Cash Flow from Operations		\$ 125,921	\$ 640,948	\$ 1,513,400	\$ 2,549,879	\$ 3,617,685	\$ 4,684,932	\$ 5,752,180	\$ 6,819,428	\$ 7,886,676	\$ 8,953,924
<b>CAPITAL EXPENDITURES</b>											
Capital Expenditures		\$ 4,270,789	\$ 13,749,840	\$ 125,000	\$ 125,000	\$ 125,000	\$ 125,000	\$ 125,000	\$ 125,000	\$ 125,000	\$ 125,000
EQUITY	0%	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -
<b>Debt Service</b>											
Required Draws		\$ 4,270,789	\$ 13,749,840	\$ 125,000	\$ 125,000	\$ 125,000	\$ -	\$ -	\$ -	\$ -	\$ -
Principal Payments		\$ 70,982	\$ 303,522	\$ 316,928	\$ 330,927	\$ 316,928	\$ 330,927	\$ 345,544	\$ 360,806	\$ 376,743	\$ 393,384
Total Outstanding Debt		\$ 4,199,807	\$ 17,646,125	\$ 17,454,197	\$ 17,248,270	\$ 17,056,342	\$ 16,725,415	\$ 16,379,872	\$ 16,019,065	\$ 15,642,322	\$ 15,248,939
Interest		\$ 183,493	\$ 773,381	\$ 759,974	\$ 745,976	\$ 731,359	\$ 716,096	\$ 700,159	\$ 683,519	\$ 666,143	\$ 648,000

EBITDA (Earnings before Interest, Taxes, Depreciation and Amortization) is forecasted to be over \$1 Million after the network is built.



There is barely enough cashflow to cover principal and interest payments, starting in year 5.

Positive EBITDA?											
	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	
	YEAR	YEAR	YEAR	YEAR	YEAR	YEAR	YEAR	YEAR	YEAR	YEAR	YEAR
	1	2	3	4	5	6	7	8	9	10	
<b>EBITDA</b>	\$ 125,921	\$ 515,027	\$ 872,452	\$ 1,036,479	\$ 1,067,806	\$ 1,067,248	\$ 1,067,248	\$ 1,067,248	\$ 1,067,248	\$ 1,067,248	\$ 1,067,248
Less Interest Expense	\$ 183,493	\$ 773,381	\$ 759,974	\$ 745,976	\$ 731,359	\$ 716,096	\$ 700,159	\$ 683,519	\$ 666,143	\$ 648,000	
Less Principal Payment	\$ 70,982	\$ 303,522	\$ 316,928	\$ 330,927	\$ 316,928	\$ 330,927	\$ 345,544	\$ 360,806	\$ 376,743	\$ 393,384	
Earnings after Interest and Principal Payments	\$ (128,555)	\$ (561,876)	\$ (204,450)	\$ (40,424)	\$ 19,519	\$ 20,225	\$ 21,545	\$ 22,923	\$ 24,362	\$ 25,864	

The above illustrates that the financial model is not feasible and proves to be risky. Perhaps the only way this would work in Gilpin County is if the County received grant money to pay for most of the build.

As with Clear Creek County above, the financial model improves greatly with eliminating the lower service and pricing tiers. This may be one strategy to mitigate the take rate percentage risk. For the following model, we lowered the take rate percentage to 15% in the first year, 15% in the second year and 5% in the third year. We used the following service tier percentages.

<b>Residential Services</b>	<b>Pricing</b>	<b>% of Customers Taking Service</b>
100 Mbps/100 Mbps	\$ 49.99	0%
1 Gbps/1 Gbps	\$ 79.99	100%
Residential Voice	\$ 30.00	10%
Managed WiFi	\$ 4.95	10%
Worry Free WiFi	\$ 9.95	5%
Static IP	\$ 9.95	1%
Wireless Booster/AP	\$ 9.95	5%
<b>Business Services</b>	<b>Pricing</b>	<b>% of Customers Taking Service</b>
100 Mbps/100 Mbps	\$ 79.99	0%
300 Mbps/300 Mbps	\$ 249.99	30%
1 Gbps/1 Gbps	\$ 499.99	70%
Voice Business (POTS line)	\$ 100.00	5%
Voice Business (SIP Trunk)	\$ 64.00	20%

These changes yielded the following results.

Income Statement	Gilpin County FTTP, Retail Model				
	2018	2019	2020	2021	2022
	Forecast Project Period				
	Year 1	Year 2	Year 3	Year 4	Year 5
<b>Revenues</b>					
Service Revenues					
Black Hawk	\$ 151,500	\$ 393,000	\$ 534,500	\$ 564,400	\$ 564,400
Central City	\$ 37,100	\$ 96,700	\$ 131,300	\$ 138,400	\$ 138,400
Rollinsville	\$ 13,200	\$ 35,000	\$ 47,900	\$ 50,400	\$ 50,400
Businesses, all	\$ 283,100	\$ 523,500	\$ 566,000	\$ 566,000	\$ 566,000
<b>Total Revenues</b>	<b>\$ 525,265</b>	<b>\$ 1,220,415</b>	<b>\$ 1,619,955</b>	<b>\$ 1,747,780</b>	<b>\$ 1,766,000</b>
<b>Expenses</b>					
Internet Access	\$ 60,000	\$ 60,000	\$ 60,000	\$ 60,000	\$ 60,000
Annual Growth/Reduction of Internet Access	\$ -	\$ (7,118)	\$ (7,472)	\$ (7,547)	\$ (7,547)
Video Overhead, Programming Fees per Customer	\$ -	\$ -	\$ -	\$ -	\$ -
Software Maintenance	\$ 2,422	\$ 5,591	\$ 7,358	\$ 7,735	\$ 7,735
Maintenance materials	\$ -	\$ -	\$ -	\$ -	\$ -
Salaries	\$ 77,851	\$ 139,887	\$ 131,250	\$ 117,090	\$ 112,838
Payroll Taxes and Benefits	\$ 27,248	\$ 48,961	\$ 45,938	\$ 40,981	\$ 39,493
Sales Churn, percent of Total Revenue	\$ 10,505	\$ 24,408	\$ 32,399	\$ 34,956	\$ 35,320
Marketing and Sales, percent of Total Revenue	\$ 26,263	\$ 61,021	\$ 80,998	\$ 87,389	\$ 88,300
Residential Customer Care, Operations	\$ 345	\$ 815	\$ 1,090	\$ 1,152	\$ 1,152
Business Customer Care, Operations	\$ 59	\$ 117	\$ 137	\$ 137	\$ 137
<b>Total Expenses</b>	<b>\$ 215,536</b>	<b>\$ 350,863</b>	<b>\$ 372,414</b>	<b>\$ 363,363</b>	<b>\$ 358,898</b>
<b>EBITDA</b>	<b>\$ 309,729</b>	<b>\$ 869,552</b>	<b>\$ 1,247,541</b>	<b>\$ 1,384,417</b>	<b>\$ 1,407,102</b>
	<b>2018</b>	<b>2019</b>	<b>2020</b>	<b>2021</b>	<b>2022</b>
	Forecast Project Period				
	<b>Year 1</b>	<b>Year 2</b>	<b>Year 3</b>	<b>Year 4</b>	<b>Year 5</b>
Interest Expense	\$ 183,493	\$ 773,381	\$ 759,974	\$ 745,976	\$ 731,359
Principal Payments	\$ 70,982	\$ 303,522	\$ 316,928	\$ 330,927	\$ 316,928
<b>Net Income</b>	<b>\$ 55,253</b>	<b>\$ (207,351)</b>	<b>\$ 170,639</b>	<b>\$ 307,515</b>	<b>\$ 358,815</b>

This gives the model more operating cashflows to cover debt service.

### Financial Model, Wholesale Services

If either of the Counties wanted to pursue a wholesale model, there may be less capital costs and debt service needed, depending upon who pays for what infrastructure. Typically, in a wholesale model, the service providers would share in the capital risk.

In addition to the shared capital risk, a revenue share would be negotiated with the service providers. Most likely, if either County pursued this type of strategy, the residential pricing

may need to be priced at a rate that is more than \$50 per month for residential services. In order for the financial model to work for a wholesale approach, for all parties, the pricing for residential services may need to be in the \$75 - \$90 per month range. Pricing for business services could be in the range of \$300 - \$500 per month.

This model could potentially work if a creating financing arrangement was put in place. Perhaps the capital costs are paid for through a grant, or through a utility fee or through raising property taxes. One advantage with the wholesale model over the retail model is that the County would not be responsible for customer care. These costs were taken out of the wholesale model as the service provider would be responsible for customer service, billing, and trouble resolution.

The financial results are not as lucrative as the retail model, but the wholesale model could potentially work with a 50% grant, the County paying all of the debt coverage and the County receives \$40 per customer as a revenue share. Perhaps a more attractive financial arrangement could be negotiated whereby the service provider assumes some of the debt. Here are the financial results.

Income Statement	Clear Creek County, FTTP - Wholesale, \$40/customer, 50% Equity/Grant				
	2018	2019	2020	2021	2022
	Forecast Project Period				
	Year 1	Year 2	Year 3	Year 4	Year 5
<b>Revenues</b>					
Service Revenues					
Empire	\$ 12,700	\$ 33,100	\$ 45,000	\$ 47,600	\$ 47,600
Georgetown	\$ 46,700	\$ 121,500	\$ 165,000	\$ 174,400	\$ 174,400
Idaho Springs	\$ 77,000	\$ 200,200	\$ 271,900	\$ 287,200	\$ 287,200
Businesses, all	\$ 9,600	\$ 25,000	\$ 30,800	\$ 30,800	\$ 30,800
<b>Total Revenues</b>	<b>\$ 204,940</b>	<b>\$ 664,755</b>	<b>\$ 1,026,130</b>	<b>\$ 1,152,805</b>	<b>\$ 1,167,200</b>
<b>Expenses</b>					
Internet Access	\$ -	\$ -	\$ -	\$ -	\$ -
Annual Growth/Reduction of Internet Access	\$ -	\$ -	\$ -	\$ -	\$ -
Video Overhead, Programming Fees per Customer	\$ -	\$ -	\$ -	\$ -	\$ -
Software Maintenance	\$ 3,074	\$ 9,354	\$ 13,520	\$ 14,588	\$ 14,588
Maintenance materials	\$ -	\$ -	\$ -	\$ -	\$ -
Salaries	\$ -	\$ -	\$ -	\$ -	\$ -
Payroll Taxes and Benefits	\$ -	\$ -	\$ -	\$ -	\$ -
Sales Churn, percent of Total Revenue	\$ 4,099	\$ 13,295	\$ 20,523	\$ 23,056	\$ 23,344
Marketing and Sales, percent of Total Revenue	\$ 10,247	\$ 33,238	\$ 51,307	\$ 57,640	\$ 58,360
Residential Customer Care, Operations	\$ -	\$ -	\$ -	\$ -	\$ -
Business Customer Care, Operations	\$ -	\$ -	\$ -	\$ -	\$ -
<b>Total Expenses</b>	<b>\$ 23,420</b>	<b>\$ 61,887</b>	<b>\$ 91,349</b>	<b>\$ 101,284</b>	<b>\$ 102,292</b>
<b>EBITDA</b>	<b>\$ 181,520</b>	<b>\$ 602,868</b>	<b>\$ 934,781</b>	<b>\$ 1,051,521</b>	<b>\$ 1,064,908</b>
	<b>2018</b>	<b>2019</b>	<b>2020</b>	<b>2021</b>	<b>2022</b>
	Forecast Project Period				
	<b>Year 1</b>	<b>Year 2</b>	<b>Year 3</b>	<b>Year 4</b>	<b>Year 5</b>
Interest Expense	\$ 81,648	\$ 406,845	\$ 399,808	\$ 392,460	\$ 384,788
Principal Payments	\$ 31,585	\$ 159,318	\$ 166,355	\$ 173,703	\$ 166,355
<b>Net Income</b>	<b>\$ 68,287</b>	<b>\$ 36,705</b>	<b>\$ 368,618</b>	<b>\$ 485,357</b>	<b>\$ 513,765</b>



Income Statement	Gilpin County FTTP, Wholesale Model, \$40/customer, 50% Equity/Grant				
	2018	2019	2020	2021	2022
	Forecast Project Period				
	Year 1	Year 2	Year 3	Year 4	Year 5
<b>Revenues</b>					
Service Revenues					
Black Hawk	\$ 71,600	\$ 186,000	\$ 252,800	\$ 267,200	\$ 267,200
Central City	\$ 17,600	\$ 45,800	\$ 62,100	\$ 65,600	\$ 65,600
Rollinsville	\$ 6,400	\$ 16,600	\$ 22,600	\$ 24,000	\$ 24,000
Businesses, all	\$ 25,600	\$ 47,300	\$ 51,200	\$ 51,200	\$ 51,200
<b>Total Revenues</b>	<b>\$ 161,565</b>	<b>\$ 405,115</b>	<b>\$ 565,155</b>	<b>\$ 614,080</b>	<b>\$ 619,200</b>
<b>Expenses</b>					
Internet Access	\$ -	\$ -	\$ -	\$ -	\$ -
Annual Growth/Reduction of Internet Access	\$ -	\$ -	\$ -	\$ -	\$ -
Video Overhead, Programming Fees per Customer	\$ -	\$ -	\$ -	\$ -	\$ -
Software Maintenance	\$ 2,422	\$ 5,591	\$ 7,358	\$ 7,735	\$ 7,735
Maintenance materials	\$ -	\$ -	\$ -	\$ -	\$ -
Salaries	\$ -	\$ -	\$ -	\$ -	\$ -
Payroll Taxes and Benefits	\$ -	\$ -	\$ -	\$ -	\$ -
Sales Churn, percent of Total Revenue	\$ 3,231	\$ 8,102	\$ 11,303	\$ 12,282	\$ 12,384
Marketing and Sales, percent of Total Revenue	\$ 8,078	\$ 20,256	\$ 28,258	\$ 30,704	\$ 30,960
Residential Customer Care, Operations	\$ -	\$ -	\$ -	\$ -	\$ -
Business Customer Care, Operations	\$ -	\$ -	\$ -	\$ -	\$ -
<b>Total Expenses</b>	<b>\$ 19,731</b>	<b>\$ 39,949</b>	<b>\$ 52,919</b>	<b>\$ 56,721</b>	<b>\$ 57,079</b>
<b>EBITDA</b>	<b>\$ 141,834</b>	<b>\$ 365,166</b>	<b>\$ 512,236</b>	<b>\$ 557,360</b>	<b>\$ 562,121</b>
	<b>2018</b>	<b>2019</b>	<b>2020</b>	<b>2021</b>	<b>2022</b>
	Forecast Project Period				
	<b>Year 1</b>	<b>Year 2</b>	<b>Year 3</b>	<b>Year 4</b>	<b>Year 5</b>
Interest Expense	\$ 101,415	\$ 396,194	\$ 389,318	\$ 382,139	\$ 374,642
Principal Payments	\$ 39,231	\$ 155,666	\$ 162,542	\$ 169,721	\$ 162,542
<b>Net Income</b>	<b>\$ 1,187</b>	<b>\$ (186,694)</b>	<b>\$ (39,624)</b>	<b>\$ 5,499</b>	<b>\$ 24,937</b>

The results in Gilpin County are not as favorable as in Clear Creek County. Perhaps doing a joint project between the Counties could mitigate the risks for Gilpin County. It could be concluded that there is a possibility to negotiate a public private partnership with a service provider to share in the capital cost and debt risk, and to operate the FTTP network, with a revenue share paid to the County. The County could work with the service provider to obtain a grant or to look at other creative financing through utility fees, increased property taxes or tax improvement financing.

In Minnesota, several of these types of partnerships have been put in place. The State of Minnesota has a 50% grant program called the MN Border to Border Grant Program. It is available to areas that are currently unserved or underserved. Their definition threshold of served is having the capability of 100 Mbps in download and upload speeds. Local governments have applied for grant funding, and have guaranteed the match through general obligation bonds and through raising property taxes. The service provider provides all services and assumes all operating costs. The service provider enters into a loan agreement with the local government and makes principal and interest payments over a specific period of time. After this period of time, the service provider owns a portion of the network and the local government continues to own a portion of the network as a safety net.

This type of approach could potentially be used in Gilpin and/or Clear Creek County.