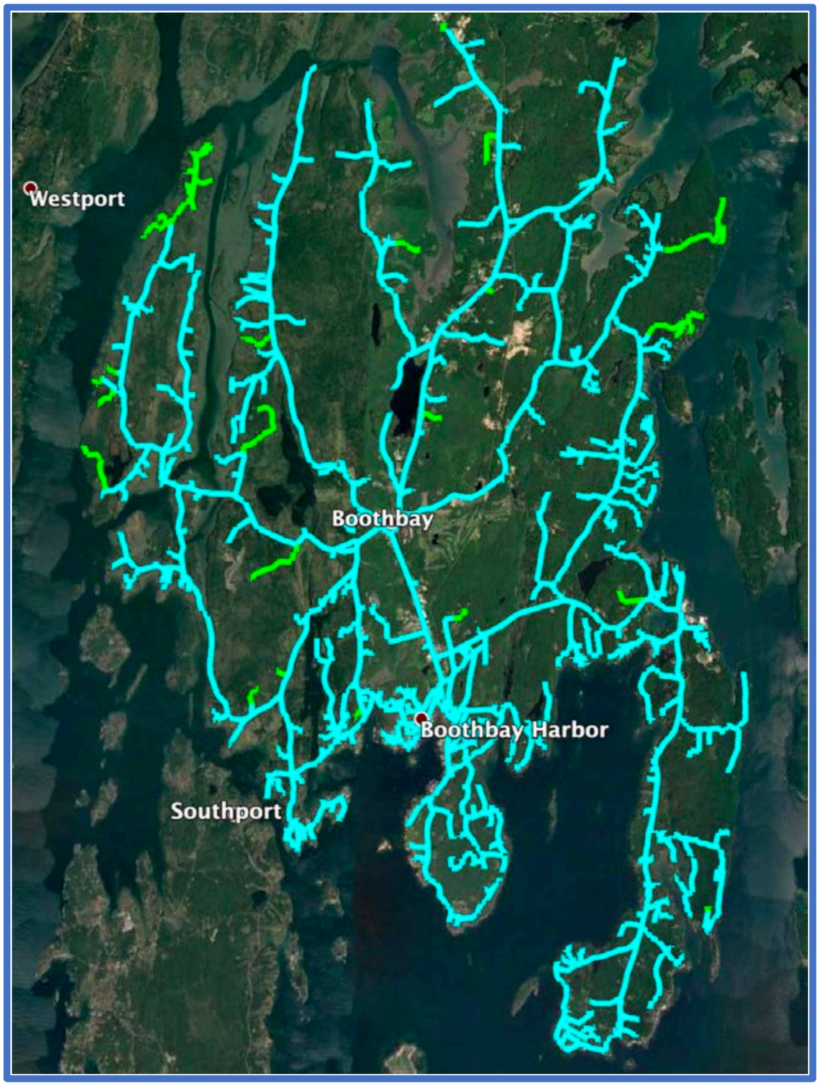
Casco Bay Advisors, LLC
Broadband/Telecom Consulting

Towns of Boothbay and Boothbay Harbor Broadband Report



Prepared by

Casco Bay Advisors, LLC

March 31, 2020

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1 Executive Summary

Casco Bay Advisors, LLC (Casco Bay) is pleased to present this Broadband Report (Report) to the Towns of Boothbay and Boothbay Harbor (Towns), examining existing high-speed broadband assets within the Town limits, where gaps in coverage may exist, potential solutions and costs to fill those gaps and recommendations for next steps.

This Report begins with an overview of the various technologies capable of providing Internet access and the differences in the capability of each. We recommend reviewing this section first in order to easily interpret and digest the remainder of the Report.

The foundation of our research efforts included contacts with each of the land-line based service providers currently serving the Towns and reviewing and incorporating any mapping data provided by the service providers. We then conducted a field audit of every public and private roadway, including long driveways to verify the accuracy of the data provided and to acquire data where sufficiently detailed mapping was not provided. This information was then incorporated into a Geospatial Information System (GIS), along with 911 addressing data, parcel data and aerial imagery, to facilitate analysis and presentation of the data collected.

Our research has determined that 94% of potential subscribers in Boothbay and 99% of potential subscribers in Boothbay Harbor have access to cable modem service provided by Charter (Spectrum) with minimum advertised download speeds of 100Mbps and minimum advertised upload speeds of 10Mbps. Both communities are widely served by lower speed DSL Internet from Consolidated Communications and approximately 300 potential subscribers have access to Fiber-to-the-Home (FTTH) service from LCI. Most businesses in the Towns, with the exception of many home-based businesses have access to business-grade fiber-based service from all three current providers.

The Report includes an estimation of the overall cost to extend the Charter (Spectrum) cable modem service to the remaining areas of both Towns not currently served. For Boothbay the cost is estimated at $365,400 and for Boothbay Harbor just $23,850. These figures do not include the cost of extending service from the street to subscribers at the end of driveways longer than approximately 250 feet from the roadway, which is typically borne by the subscriber.

As an alternative to the existing providers, we have estimated the costs for various options to overbuild both Towns with a new Fiber-to-the-Home (FTTH) network under municipal ownership or in partnership with a service provider. At the high end, the capital cost for Boothbay is estimated at $6,050,700 and the capital cost for Boothbay Harbor is estimated at $3,376,662. We believe these costs could potentially be reduced by up to 50% in a partnership arrangement with a willing service provider.

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With this Report in hand and the data now transparently available, we recommend the Towns develop a vision and set of goals to guide their efforts going forward and to engage both the incumbent service providers and other potential alternative service providers to expand the availability, capacity and competitive options for the provision of affordable, reliable high-speed Internet.

As has been demonstrated this spring of 2020, unrestricted access to robust, universally available, affordable and reliable Internet is a critical infrastructure required to participate in the increasingly global economy, especially in the areas of healthcare, education, entertainment, financial services, consumer goods and services, and global commerce.

We applaud the Towns for taking this initiative to better understand their current resources and to set the stage for ensuring the entire community is well positioned to take advantage of the introduction of new Internet enabled services.

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2 Internet Access and Broadband Definition

The terms "Internet access" and "broadband" are often used interchangeably. There is frequently confusion between the two, especially as the definitions evolve with technology changes.

Internet access connects individual computer terminals, computers, mobile devices, and computer networks to the Internet, enabling users to access Internet services such as email, applications and information delivered via the World Wide Web. Internet service providers (ISPs) offer Internet access through various technologies that offer a wide range of data signaling rates (speeds).

Consumer use of the Internet first became popular through dial-up Internet access in the 1990s. By the first decade of the 21st century, many consumers in developed nations used faster, broadband Internet access technologies.

Broadband is a generic term representing any wide-bandwidth data transmission method with the ability to transport multiple signals and traffic types simultaneously. This data can be transmitted using coaxial cable, optical fiber, radio or twisted pair copper. In the context of Internet access, broadband is used much more loosely to mean any high-speed Internet access that is always on and faster than traditional dial-up access. Different governing authorities have developed inconsistent definitions of what constitutes broadband service based on access speed.

In January 2015, the Federal Communications Commission (FCC) voted to define broadband as Internet service with at least 25 Mbps (megabits per second) download and 3 Mbps upload. Their definition affects policy decisions and the FCC's annual assessment of whether broadband is being deployed to all Americans quickly enough. In Maine, the ConnectMaine Authority Board[1] currently defines effective broadband network capacity as speeds equal to or greater than 25Mbps/3Mbps, and anything less as "unserved."

For those rural and high-cost areas served by Consolidated Communications, Inc. (CCI) where CCI has accepted subsidies through the Connect America Fund – Phase II (CAF-II), the FCC has adopted a minimum speed standard of 10Mbps/1Mbps.

[1] In recognition of the critical importance of modern technology for education, health care, and business success in Maine, the Legislature created the ConnectME Authority (Authority) in 2006 as an independent state agency to develop and implement broadband strategy for Maine. The Authority is governed by a board which is comprised of members appointed by the Governor or specifically identified and designated by statute.

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3 Internet Access Technology Overview

In this section, we present an overview of different Internet access technology, including digital subscriber line, cable modem, fixed wireless, 4G/LTE Advanced, 5G, satellite, and Fiber-to-the-Premise.

3.1 DSL

Digital subscriber line (DSL) is a technology most frequently used by traditional telephone system operators such as Consolidated Communications, Inc. (CCI) and to deliver advanced services *(high-speed data and potentially video)* over twisted pair copper telephone wires. This technology has lower data carrying capacity than the hybrid fiber coaxial network deployed by cable system operators like Charter Communications (Spectrum). Data speeds are range-limited by the length of the copper cable serving the premise, the wire gauge of the copper conductors and the condition of the copper.

DSL service can be delivered simultaneously with wired telephone service on the same telephone line. This is possible because DSL uses higher frequency bands for data transmission than are required for the voice service transmission. At the customer premises, a DSL filter on each non-DSL outlet blocks any high-frequency interference to enable simultaneous use of the voice and DSL services.

The bit rate of consumer DSL services can range from 256 Kbps *(kilobits per second)* to over 100 Mbps in the direction of the service provider to the customer (downstream), depending on the DSL technology, line conditions, and the length of the copper loop. Until recently, the most commonly installed DSL technology for Internet access has been asymmetric digital subscriber line (ADSL). With ADSL, the data throughput in the upstream direction *(the direction from the consumer to the service provider)* is lower, hence the designation of asymmetric service.

At the central office, a digital subscriber line access multiplexer (DSLAM) terminates the DSL circuits and aggregates them, where they are handed off to other networking transport equipment. The DSLAM terminates all connections and recovers the original digital information. For locations beyond the maximum distance from the central office for the particular type of DSL technology deployed (7,000 – 12,000 feet), DSLAMs can be deployed in the field in outside plant cabinets *(remote terminals)* and connected to the central office by fiber optic cables. A shorter distance from the subscriber premise to the DSLAM results in greater bandwidth *(speed and/or capacity)* for the connected users.

The customer end of the connection consists of a terminal adaptor or "DSL modem." This converts data between the digital signals used by computers and the voltage signal of a suitable frequency range which is then applied to the phone line.

There are additional formats of DSL technologies that can enhance the capacity of the network. ADSL2+ extends the capability of basic ADSL by doubling the number of downstream channels, increasing the frequency from 1.1 Mhz to 2.2 Mhz. The data rates can be as high as 24 Mbps

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downstream and up to 1.4 Mbps upstream, depending on the distance from the DSLAM to the subscriber's premises. Like the previous standards, ADSL2+ will degrade from its peak bit rate after a certain distance.

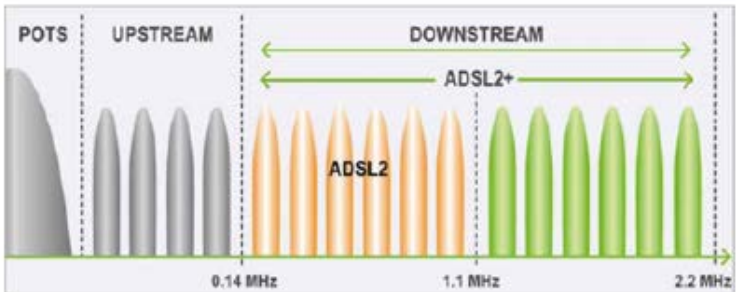

Figure 1: ADSL2+ Frequency Utilization

ADSL2+ allows port bonding, where multiple ports are physically provisioned to the end user and the total bandwidth is equal to the sum of all provisioned ports. When two lines capable of 24 Mbps are bonded, the end result is a connection capable of 48 Mbps download and twice the original upload speed.

Very-high-bit-rate digital subscriber line 2 (VDSL2+) permits the transmission of asymmetric and symmetric aggregate data rates up to 200 Mbps downstream and upstream on twisted pairs using a bandwidth up to 30 Mhz. It deteriorates quickly from a theoretical maximum of 250 Mbps at the source to 100 Mbps at 1,600 feet and 50 Mbps at 3,300 feet but degrades at a much slower rate from there. Starting from one mile, its performance is similar to ADSL2+. Bonding may be used to combine multiple wire pairs to increase available capacity or extend the copper network's reach. All new DSL deployments for CCI utilize VDSL2+ equipment.

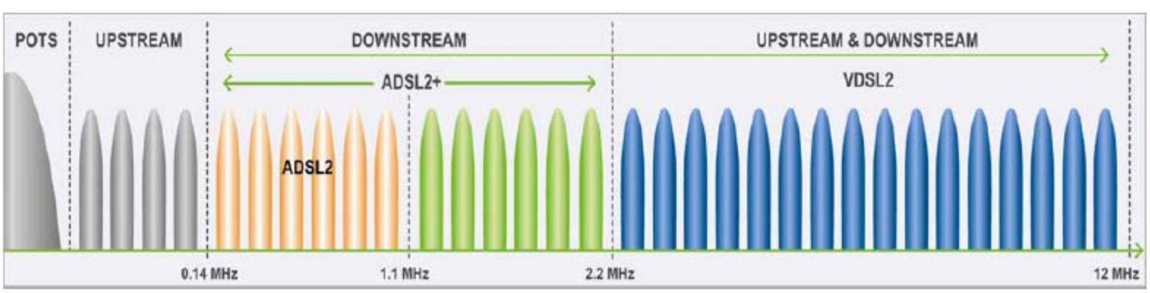

Figure 2: VDSL2+ Frequency Utilization

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3.2 Cable Modem

Cable modem Internet access is provided over a hybrid fiber coaxial (HFC) broadband network. It has been employed globally by cable television operators since the early 1990s and is the network architecture utilized by Spectrum. In an HFC cable system, the television channels are sent from the cable system's distribution facility, the headend, to local communities through optical fiber trunk lines. The fiber-optic trunk lines provide adequate bandwidth to allow future expansion for bandwidth-intensive services. At the local community, an optical node translates the signal from a light beam to an electrical signal and sends it over coaxial cable lines for distribution to potential subscribers.

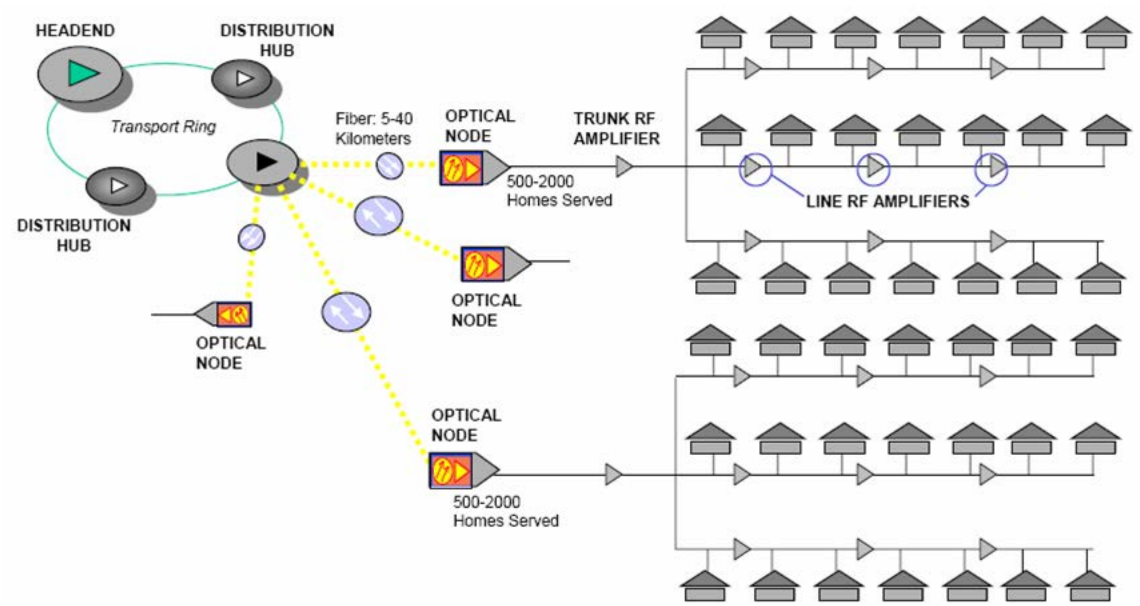

Figure 3: Hybrid Fiber/Coax Network Architecture Diagram

The coaxial portion of the network connects 25–2,000 homes in a tree-and-branch configuration off the node. RF amplifiers are used at intervals to overcome cable attenuation and passive losses of the electrical signals caused by splitting or "tapping" the coaxial cable.

The HFC broadband network is typically operated bi-directionally, meaning that signals are carried in both directions on the same network from the headend/hub office to the home, and from the home to the headend/hub office. The forward-path or downstream signals carry information such as video content, voice and data. The return-path or upstream signals carry information such as video control signals to order a movie or Internet data to send an email. The forward-path and the return-path are carried over the same coaxial cable in both directions between the optical node and the home.

Data Over Cable Service Interface Specification (DOCSIS) is an international telecommunications standard that permits the addition of high-bandwidth data transfer to an existing cable TV (CATV) system. DOCSIS 3.1 has been deployed by Spectrum to provide Internet access over their existing HFC infrastructure. The DOCSIS 3.1 standard is capable of supporting Internet speeds of up to 10 Gbps

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(gigabits per second), but most providers are currently offering speeds of 1 Gbps or less service for residential users.

3.3 Fixed Wireless

Fixed wireless broadband is the operation of wireless devices or systems used to connect two fixed locations *(e.g., building to building or tower to building*) with a radio or other wireless link. Fixed wireless data (FWD) links are often a cost-effective alternative to leasing fiber or installing cables between the buildings. The point-to-point signal transmissions occur through the air over a terrestrial microwave platform. The advantages of fixed wireless include the ability to connect with users in remote areas without the need for laying new cables and the capacity for broad bandwidth that is not impeded by fiber or cable capacities. Fixed wireless services typically use a directional radio antenna on each end of the signal. These antennas are generally larger than those seen in Wi-Fi setups and are designed for outdoor use. They are typically designed to be used in the unlicensed Industrial, Scientific, and Medical (ISM) radio frequency bands (900 MHz, 1.8 GHz, 2.4 GHz and 5 GHz). However, in many commercial installations licensed frequencies may be used to ensure quality of service (QoS) or to provide higher connection speeds.

To receive this type of Internet connection, consumers mount a small dish to the roof of their home or office and point it to the transmitter. Line-of-sight is usually necessary for Wireless Internet Service Providers (WISPs) operating in the 2.4 and 5 GHz bands. The 900 MHz band offers better non-line-of-sight (NLOS) performance. Providers of unlicensed fixed wireless broadband services typically provide equipment to customers and install a small antenna or dish somewhere on the roof. This equipment is usually deployed and maintained by the company providing that service.

3.4 4G/LTE Advanced Broadband

4G/LTE Advanced is wireless technology being deployed by cellular telephone providers such as AT&T, Verizon Wireless, US Cellular, Sprint and T-Mobile for traditional mobile phone and data services. The latest standard incorporates two new technologies - Carrier Aggregation, and Multiple Input Multiple Output (MIMO), in order to provide speeds in excess of 100 Mbps, and eventually up to 1 Gbps and beyond. While standard data connections use one antenna and one signal at any given time, 4G LTE Advanced has the capability of utilizing multiple signals and multiple antennas.

Mobile LTE wireless service uses MIMO technology to combine multiple antennas on both the transmitter and the receiver. A 2×2 MIMO configuration has two antennas on the transmitter and two on the receiver, but the technology is not limited to 2x2. More antennas could theoretically operate at faster speeds as the data streams can travel more efficiently. The signal is then combined with “carrier aggregation,” which allows a device to receive multiple 4G signals at once. The received signals don’t have to be on the same frequency; one could receive an 1800 MHz and an 800 MHz signal at the same

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time, which is not possible with standard 4G. Up to five different 20 MHz signals can be combined to create a data pipe of up to 100 MHz of bandwidth.

3.5 5G Wireless[2]

Fifth-generation wireless (5G) is the latest iteration of cellular technology, engineered to greatly increase the speed and responsiveness of wireless networks. With 5G, data transmitted over wireless broadband connections could travel at rates as high as 20 Gbps by some estimates -- exceeding wireline network speeds -- as well as offer latency of 1 millisecond or lower for uses that require real-time feedback. 5G will also enable a sharp increase in the amount of data transmitted over wireless systems due to more available bandwidth and advanced antenna technology.

In addition to improvements in speed, capacity and latency, 5G offers network management features, among them network slicing, which allows mobile operators to create multiple virtual networks within a single physical 5G network. This capability will enable wireless network connections to support specific uses or business cases and could be sold on an as-a-service basis. A self-driving car, for example, would require a network slice that offers extremely fast, low-latency connections so a vehicle could navigate in real time. A home appliance, however, could be connected via a lower-power, slower connection because high performance isn't crucial.

5G networks and services will be deployed in stages over the next several years to accommodate the increasing reliance on mobile and internet-enabled devices. Overall, 5G is expected to generate a variety of new applications, uses and business cases as the technology is rolled out.

How 5G works - Wireless networks are composed of cell sites divided into sectors that send data through radio waves. Fourth generation (4G) Long-Term Evolution (LTE) wireless technology provides the foundation for 5G. Unlike 4G, which requires large, high-power cell towers to radiate signals over longer distances, 5G wireless signals will be transmitted via large numbers of small cell stations located in places like light poles or building roofs. The use of multiple small cells is necessary because the millimeter wave spectrum -- the band of spectrum between 30 GHz and 300 GHz that most 5G implementations rely on to generate high speeds -- can only travel over short distances and is subject to interference from weather and physical obstacles, like buildings.

Previous generations of wireless technology have used lower-frequency bands of spectrum. To offset millimeter wave challenges relating to distance and interference, the wireless industry is also considering the use of lower-frequency spectrum for 5G networks so network operators could use spectrum they already own to build out their new networks. Lower-frequency spectrum reaches greater distances but has lower speed and capacity than millimeter wave.

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[2] https://searchnetworking.techtarget.com/definition/5G

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3.6 Satellite

Satellite Internet is available to virtually the entire lower 48 states, with some coverage in Alaska, Hawaii and Puerto Rico. The satellites are positioned more than 22,000 miles above the equator. These satellites are geostationary, which means they are always above a specific point on the earth as it rotates. The first Internet satellites successfully brought the Internet to a larger audience, but the rates were incredibly slow. Modern satellites use more advanced technology to transmit information which provides faster Internet access, but this is still much slower than landline-based Internet and terrestrial wireless Internet services.

When a consumer subscribes to satellite Internet, the company installs household equipment, which consists of an antenna dish and a modem. The antenna is located outside of the house and is generally two or three feet in diameter. The antenna must have an unobstructed view of the sky, called the line-of-sight, in order to communicate with the satellite. The antenna is connected to a modem, which connects to a computer with an Ethernet cable.

To manage bandwidth quality for all users, each plan comes with a cap on the data you can transmit or consume per month. The amount of data allotted depends on the subscriber’s plan. Plans typically range from 5 GB to 50 GB of data transmission per month with use limits prescribed. If you exceed the allotted data amount, Internet speeds will be throttled back until the next month. However, some companies allow subscribers to pay for more data capacity once the threshold is met, resetting normal operation levels.

Looking forward, at least a dozen companies, including Boeing, Amazon, SpaceX, OneWEb and Telesat are deploying, or planning to deploy thousands of Low Earth Orbit (LEO) satellites in massive constellations to provide Internet service to unserved and underserved regions of the world. The benefit of LEO satellites includes greater bandwidth and less latency, with the reported potential of displacing traditional land-line based Internet service. SpaceX and others have begun deploying LEO satellites and are in the process of testing the service to demonstrate their viability.

Satellite industry proponents say that now, unlike decades ago when Teledesic and the earlier iteration of Iridium failed to develop successful businesses, technology advancements are enabling satellite service to be offered more affordably and efficiently.

3.7 Fiber-to-the-Home (FTTH)

Fiber-to-the-Home (FTTH) or Fiber-to-the-Premise (FTTP) is a network utilizing fiber optic cables directly to the home or business and is capable of offering virtually unlimited symmetrical bandwidth. Most FTTP networks can offer 1 Gbps of bandwidth in both download and upload directions, with some providers offering 2 Gbps and even 10 Gbps service capacity. The majority of new networks being deployed utilize this type of technology.

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FTTH networks can be configured and operated in a number of different ways. These include:

- As a single service provider in a closed network environment;
- As an open access dark fiber configuration where, competing providers can lease the fiber and place their own optical/electronics to complete the service;
- As an open access dark fiber configuration where the network owner provides the optical/electronics and leases the service to competing providers; and,
- As a Software Defined Network, where competing providers interconnect with the network and users select their provider in a virtual manner.

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4 Mapping of Existing Infrastructure and Capabilities

4.1 Data Collection Efforts

To kick off our mapping initiative, we solicited industry standard GIS-based maps from all known service providers with assets deployed in the Towns. Three service providers provide land-line based service to both communities. Consolidated Communications (CCI) is the incumbent telephone service provider in both Towns. Spectrum is the sole cable TV and cable modem Internet provider. LCI provides service to selected business and institutional customers but is considering an expansion to serve residential subscribers.

- CCI provided PDF maps of their DSL speed capability and requested we not publish the data. As a consequence, this mapping data is not included in this Report, but we do refer to the data in later sections. *CCI has indicated a willingness to provide these maps directly to Town officials under a non-disclosure agreement.* CCI has declined to provide GIS-based maps of their assets.

- Charter (Spectrum) provided a PDF map (8.5" x 11") of their infrastructure for each Town and has declined to provide GIS-based maps of their assets. The scale of these maps renders them unusable for the purposes of this Report.

- LCI has provided GIS-based maps of their existing fiber optic infrastructure as well as GIS-based maps of the potential expansion of their fiber optic network in both Towns.

In order to incorporate the assets of those who declined or were unresponsive to our request, we performed a field audit[3] to identify fiber optic cabling owned by CCI, determine the extent of the Spectrum network and to identify any other fiber optic cabling not previously identified by those who were responsive to our request. As a result, we are highly confident we have identified all of the high-speed broadband assets deployed within the Town limits.

Following are maps for the assets of each provider and a discussion regarding the capability of those assets.

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[3] Our field audit included driving along every public and private road and most all long driveways in both Towns to identify infrastructure attached to the utility poles or buried underground. A few long driveways blocked by gates were not audited.

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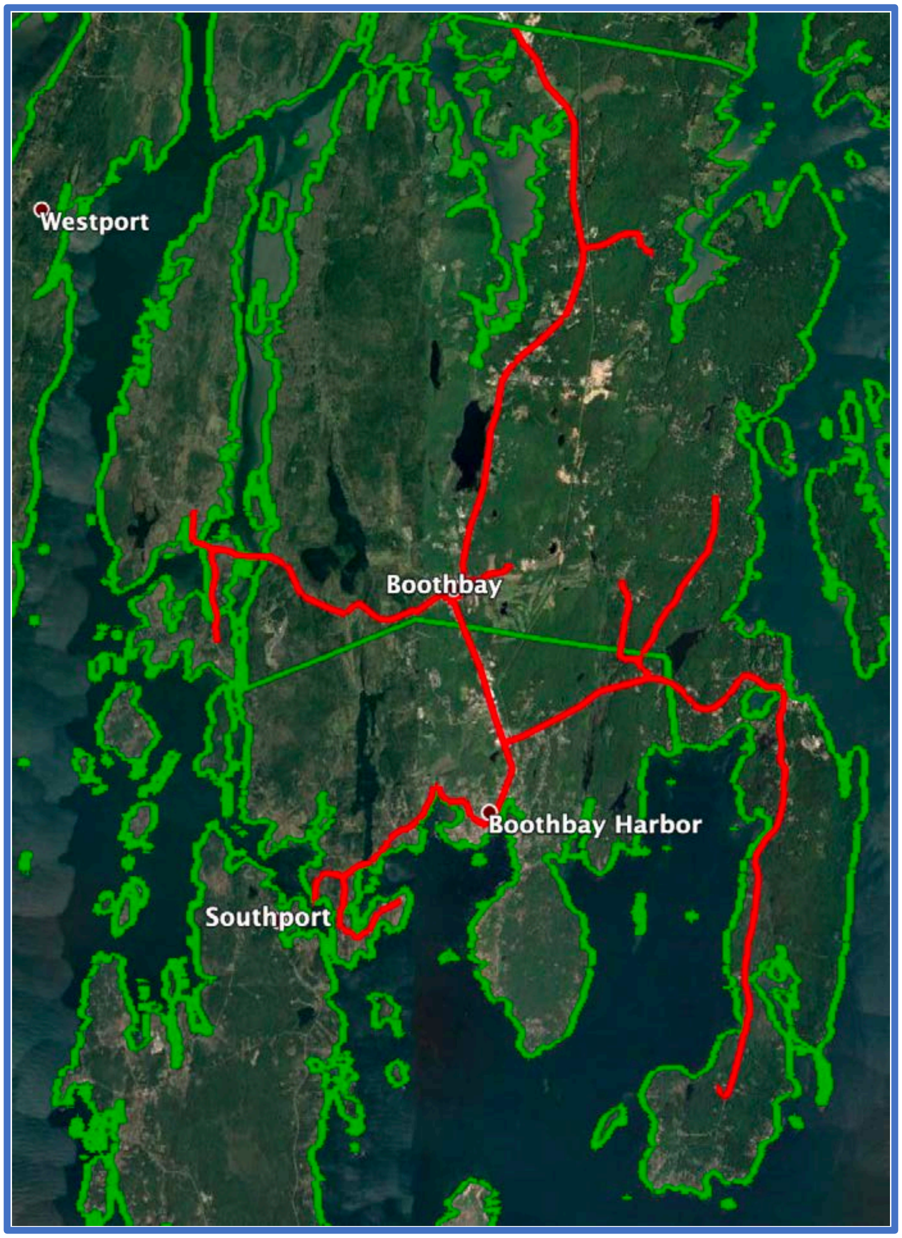
4.2 Consolidated Communications (CCI)



As the incumbent local telephone company, Consolidated Communications (CCI) has a twisted-pair copper network connecting virtually every potential residential and business subscriber within the Towns. We did not attempt to map these copper assets, which are utilized for voice and lower speed DSL-based broadband services. The map above illustrates the location of CCI's fiber optic network based upon our field survey. CCI is capable of providing any type of service along their fiber optic network up to 10Gbps or greater, but the infrastructure was not designed or engineered to provide Fiber-to-the-Home broadband service.

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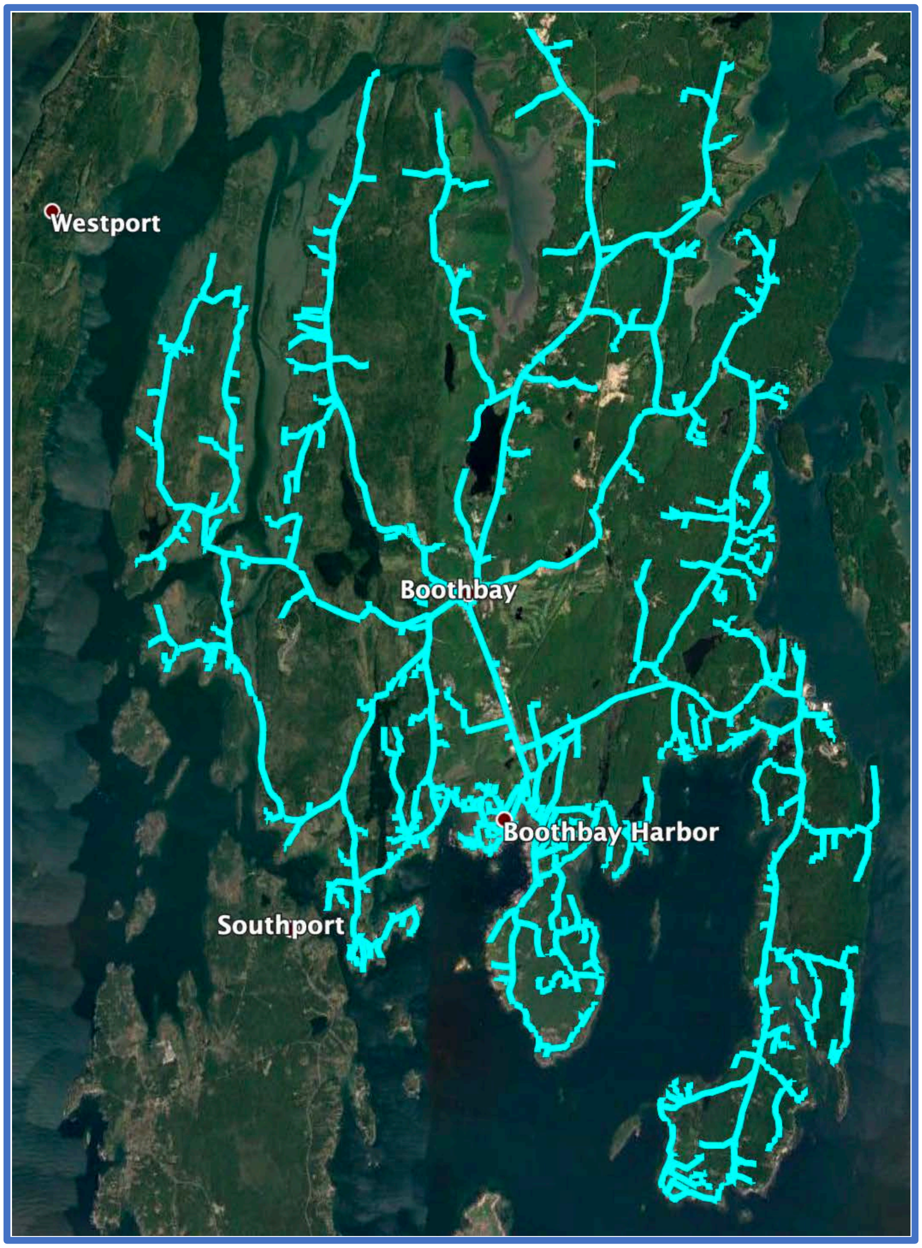
4.3 Charter (Spectrum)



Charter (Spectrum) has deployed their hybrid fiber coaxial network along the cyan colored roads highlighted in the map above. Spectrums entry-level broadband service is a minimum 100Mbps/10Mbps, with the capability of increasing the speed to 1Gbps. By our count, Spectrum is currently capable of serving 2,343 of the potential 2,484, or 94% of the potential subscriber locations in Boothbay and 2,116 of the potential 2,127, or 99% of the potential subscriber locations in Boothbay Harbor.

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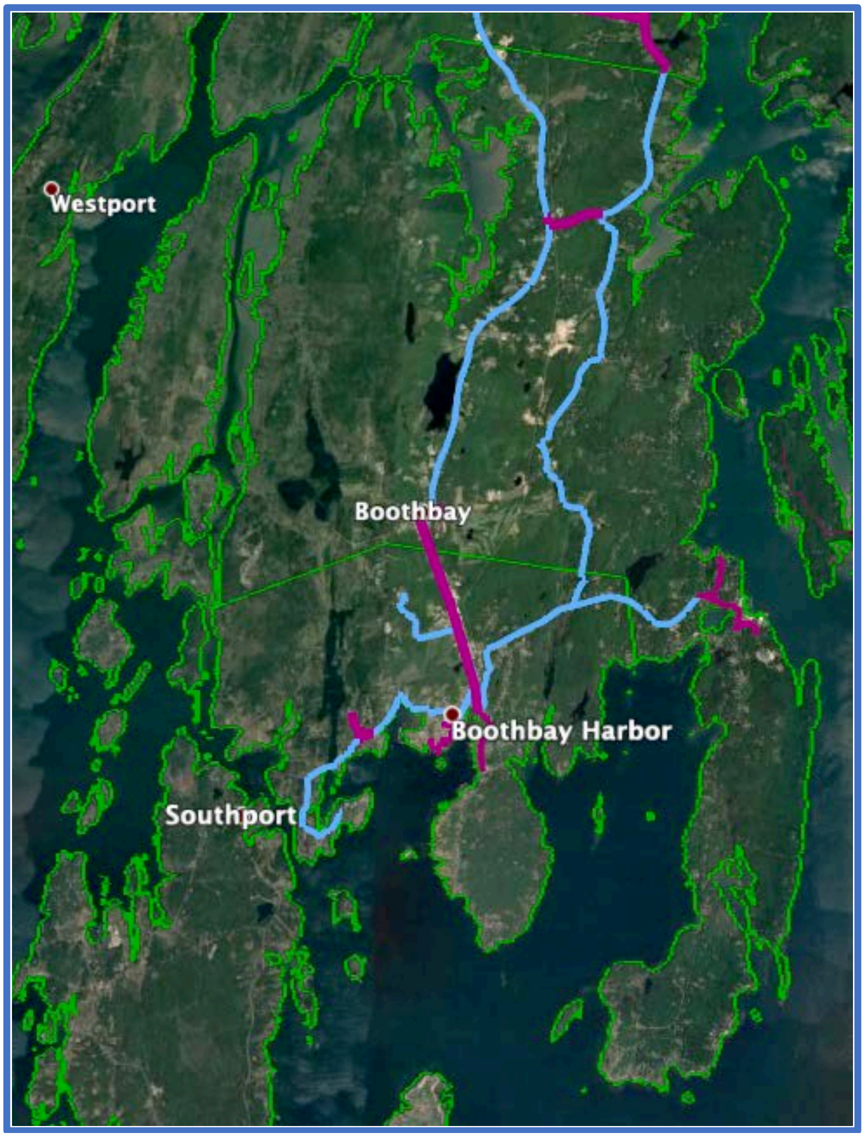
4.4 LCI



The map above illustrates the location of LCI's fiber optic network. LCI is capable of providing any type of service along their fiber optic network up to 10Gbps or greater and is primarily utilized by business and institutional clients. While the majority of their network is not designed or engineered to provide Fiber-to-the-Home broadband service, the purple road segments in the map above illustrates those areas where LCI FTTH service is currently available to approximately 300 potential subscribers.

In addition, the existing LCI network is well positioned to be leveraged and to form the foundation for a FTTH overbuild. Of particular interest and value is the dual and diverse fiber routes connecting back to the Maine Fiber Company 3-Ring-Binder (3RB) network along route 1 in the Town of Edgecomb and extending to Canada to the north and Boston to the south.

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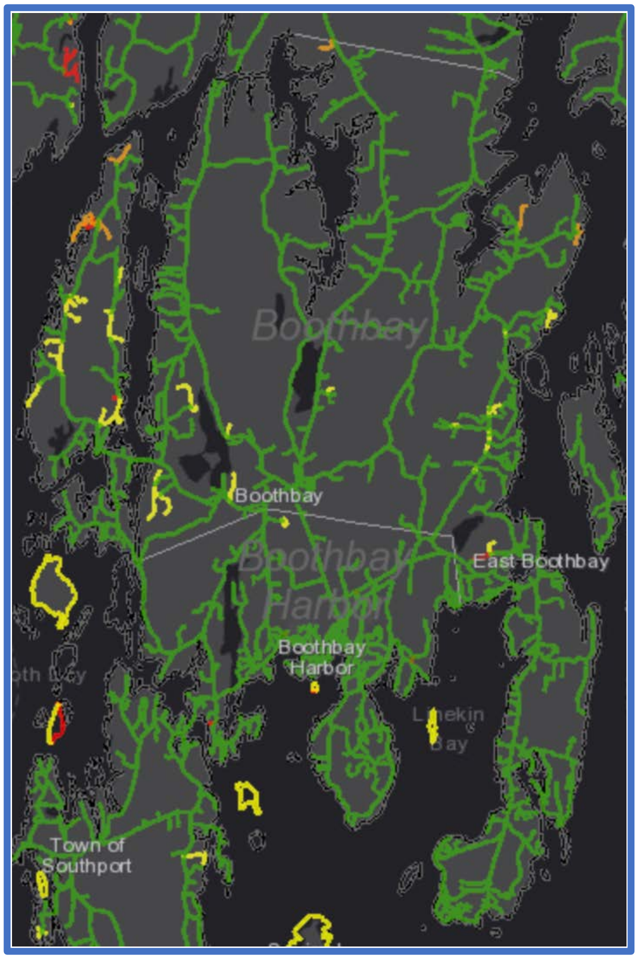
5 Infrastructure Gap Analysis

5.1 DSL - Minimum 25Mbps/3Mbps

The ConnectMaine Authority considers subscribers unable to receive a minimum 25Mbps/3Mbps service as "unserved" and eligible for grant programs. The map below illustrates those areas with no Internet connectivity (Red), service below 10Mbps/1Mbps (orange) and areas with service less than 25Mbps/3Mbps (yellow).



This data is the consolidated data reported by all service providers based on the same data as submitted to the FCC and does not identify a specific service provider capability. In addition, this data is 12 – 18 months old and is known to be of questionable value.

Prior to the close of the State of Maine legislative session earlier this month, LD1563 was passed and signed into law requiring all providers to submit actual speed availability by specific addresses to the ConnectMaine Authority for updated mapping, although as of this writing, many providers have yet to comply.

The State of Maine Broadband Action Plan, updated and published in January of this year, declares that providers who do not provide address specific actual speed availability data will not be eligible for subsidies.

It is important to note that the ConnectMaine Authority mapping is based upon census block data as submitted by the service providers using a process defined by the FCC. That process considers any census block containing just a single subscriber capable of receiving a minimum 25mbps/3Mbps as fully served. As such, the mapping provided by the ConnectMaine Authority may dramatically overstate availability and understate those areas considered unserved. Without access to the service providers operation systems, cable plant records and deployed equipment types, it is impossible to determine the actual extent of areas unserved by a minimum 25Mbps/3Mbps service.

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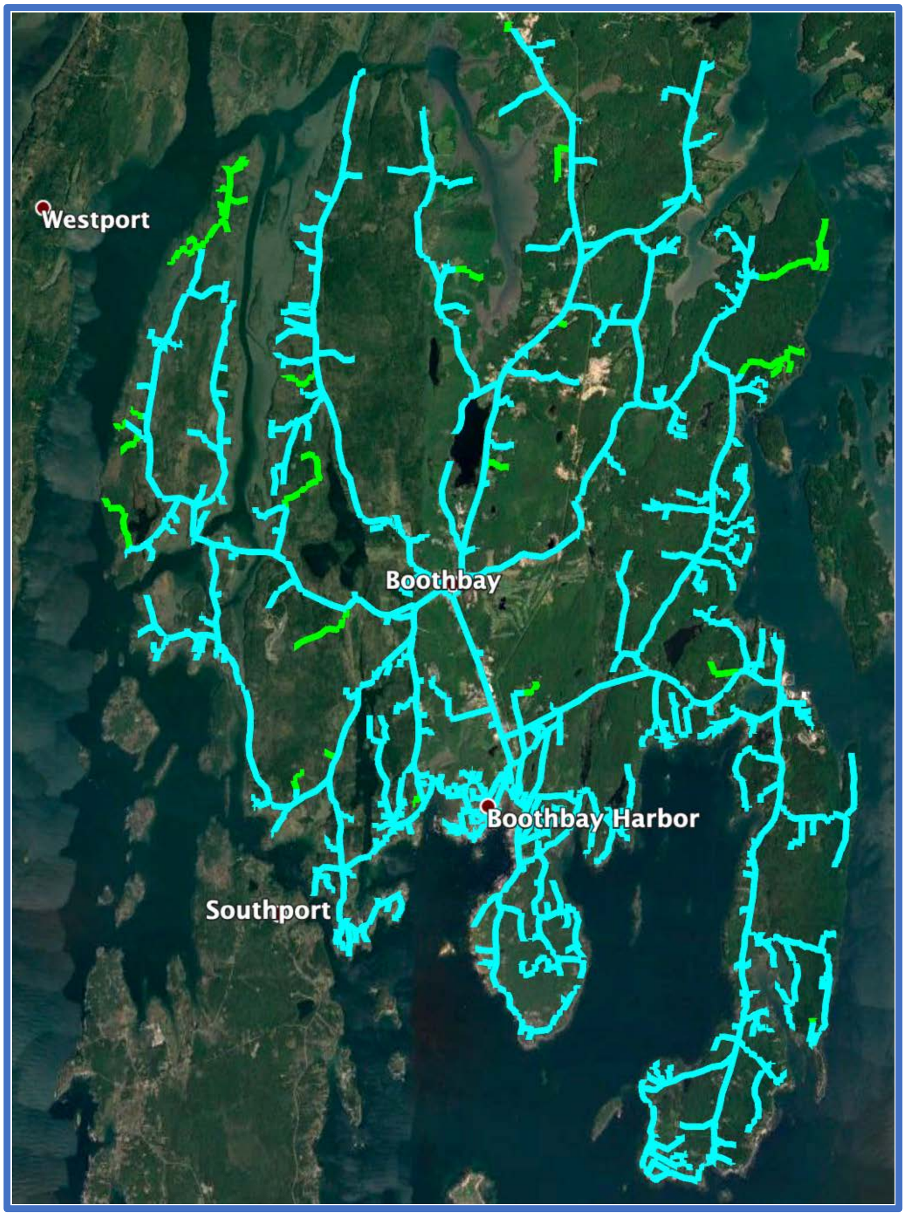
5.2 Cable Modem Internet - Minimum 100Mbps/10Mbps



This map illustrates the areas served by Spectrum with a minimum 100Mbps/10Mbps service in the color cyan and the roads unserved by Spectrum in the color green.

In the course of our field audit and development of these maps, our methodology mirrors the design methodology utilized for both hybrid fiber/coax networks (Spectrum) and FTTH networks. That methodology includes:

- Locations with long driveways are considered to be served, even if the location is not connected to the network.
- The core network, both existing and designs to be extended, stop at the next to the last potential subscriber with the last subscriber assumed to be served via a drop cable that is not illustrated on these maps.

The table below itemizes the un-cabled road segments and measures the mileage and quantity of potential subscribers along each road segment.[4]

[4] We have calculated the quantity of potential subscribers along each road segment by overlaying the Towns 911 data and parcel data with multiple aerial photographic vintages to manually count potential subscriber locations. This method is not an exact science and we recognize there may be slight errors in our count as a result, but we believe this to be the most accurate method available.

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5.2.1 Boothbay Uncabled Road Segments

Uncabled Road Segments - Boothbay			
Road Segment	Mileage	Quantity	Per Mile
Barters Island			
West Side Rd	0.69	7	10.1
Delany Rd	0.10	3	30.0
Stone Point Ln	0.15	2	13.3
Higbee Ln	0.16	3	18.8
West Side Rd (lateral 1)	0.11	3	27.3
Partridge Rd	0.16	3	18.8
West Side Rd (lateral 2)	0.10	2	20.0
West Side Rd (lateral 3)	0.10	2	20.0
Porcupine Point Rd	0.10	2	20.0
Delano Rd	0.36	10	27.8
Winding Ln	0.16	6	37.5
Chadbourne Rd	0.22	3	13.6
Sheepscot Shores	0.12	6	50.0
Woodshed Ln	0.11	3	27.3
Kimballtown Rd	0.51	3	5.9
Barters Island subtotal	**3.15**	**58**	**18.4**
Boothbay Proper			
Gaecklin Rd	0.54	3	5.6
Knickerbocker Landing Rd	0.68	7	10.3
Stone Wharf Rd	0.34	6	17.6
Forest Haven	0.24	3	12.5
Deer Run Rd	0.38	5	13.2
Sherman Cove Rd	0.10	2	20.0
Wiscasset Rd (lateral)	0.10	2	20.0
Blueberry Ledge Ln	0.21	7	33.3
Steves Rd	0.94	14	14.9
Browns Ln	0.05	0	0.0
Sea Mist Dr	0.17	7	41.2
Anabel Rd	0.42	7	16.7
Deer Trail Dr	0.15	5	33.3
Wharf Rd	0.12	3	25.0
Riverbend Dr	0.20	4	20.0
Boothbay Proper subtotal	**4.64**	**75**	**16.2**
East Boothbay			
Village View Wa	0.28	6	21.4
Wigwam Tr	0.05	2	40.0
East Boothbay subtotal	**0.33**	**8**	**24.2**
Boothbay Total			
Grand Total	**8.12**	**141**	**17.4**

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5.2.2 Boothbay Harbor Uncabled Road Segments

Uncabled Road Segments - Boothbay Harbor			
Road Segment	**Mileage**	**Quantity**	**Per Mile**
Old Quarry Ln	0.11	2	18.2
Turkey Hill Dr	0.15	3	20.0
Wilder Ln	0.10	2	20.0
Moffat Ln	0.17	4	23.5
Total	**0.53**	**11**	**20.8**

5.2.3 Comparison to other communities

The table below provides a listing of communities where Casco Bay Advisors has performed similar studies to determine the quantity of potential subscribers per mile served by Charter (Spectrum).

Spectrum - Potential Subscribers per mile served	
Carrabasset Valley	41.3
Eustis / Stratton	23.0
Fayette	31.4
Fort Fairfield	37.9
Jay	27.5
Kingfield	23.9
Leeds	20.7
Livermore Falls	40.5
Minot	19.4
Mount Vernon	16.7
Phillips	24.7
Readfield	19.3
Strong	28.6
Wayne	19.0

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5.2.4 Boothbay Cabled Road Segments

Existing Charter (Spectrum) - Boothbay											
Road Segment	Mileage	Quantity	Per Mile	Road Segment	Mileage	Quantity	Per Mile	Road Segment	Mileage	Quantity	Per Mile
1st St Ext	0.18	9	50.0	Golden Rod Ln	0.10	2	20.0	Peaceful Acres	0.32	4	12.5
2nd St	0.05	3	60.0	Gray Rd	0.19	1	5.3	Pension Ridge Rd	2.15	53	24.7
A St	0.05	2	40.0	Green Landing	0.28	5	17.9	Perkins Rd	0.18	6	33.3
Adams Pond Rd (north)	0.57	8	14.0	Greenleaf Rd	0.19	4	21.1	Pine Island Rd	0.29	2	6.9
Adams Pond Rd (south)	0.74	20	27.0	Grimes Ave	0.16	14	87.5	Pine Woods Rd	0.12	3	25.0
Adams Rd	0.12	3	25.0	Grove St	0.10	4	40.0	Pineview Ridge Rd	0.37	9	24.3
Albion Point Rd	0.15	45	300.0	Hackett Rd	0.24	5	20.8	Pinkham Ln	0.14	2	14.3
Alley Rd	0.05	1	20.0	Haney Rd	0.30	0	0.0	Pleasant Cove Rd	1.00	25	25.0
Amero Rd	0.10	5	50.0	Hardwick Rd	0.59	21	35.6	Pleasant Point Dr	0.17	2	11.8
Anchor Ln	0.20	3	15.0	Hatch Farm Rd	0.05	2	40.0	Pleasant View Ln	0.10	3	30.0
Anderson Rd	0.10	3	30.0	Hiawatha Rd	0.21	9	42.9	Pocohontas Trail	0.14	5	35.7
Annabel Rd	0.10	2	20.0	Hidden Ridge Ln	0.22	6	27.3	Point Rd	0.10	6	60.0
Appel Ln	0.10	2	20.0	High Fields Rd	0.48	13	27.1	Poore Rd	0.15	3	20.0
Apple Hill Ln	0.10	2	20.0	High St	0.11	11	100.0	Pot Hole Rd	0.14	3	21.4
Arrowhead Rd	0.14	3	21.4	Highland Ridge Rd	0.20	4	20.0	Presley Dr	0.66	20	30.3
Arsen Ault Ave	0.11	3	27.3	Hillside Pl	0.20	5	25.0	Railroad Ave	0.10	2	20.0
Back Eighty Rd	0.17	7	41.2	Hodgdon Ln	0.10	4	40.0	Rays Ln	0.10	3	30.0
Back Narrows Rd	2.66	81	30.5	Humdinger Rd	0.16	5	31.3	Rice Rd	0.27	5	18.5
Back River Rd	4.58	115	25.1	Indian Hill Rd	0.12	2	16.7	Ridge Rd	0.22	9	40.9
Balsam Dr	0.11	8	72.7	Industrial Park Dr	0.61	12	19.7	River Rd	2.10	32	15.2
Barlow Hill Rd	0.15	8	53.3	Island View Rd	0.10	3	30.0	Royall Rd	0.44	5	11.4
Barn Rd	0.11	2	18.2	Isle of Sprirngs Rd	0.59	18	30.5	Ryder Trail	0.54	13	24.1
Barters Island Rd	2.19	41	18.7	Jabberwok Ln	0.10	2	20.0	Rye Field Rd	0.10	2	20.0
Bay St	0.10	5	50.0	Jacobs Landing	0.33	3	9.1	S Ledge Rd	0.10	2	20.0
Beath Rd	0.59	31	52.5	Kelly Brook Rd	0.15	5	33.3	Samoset Trail	0.72	30	41.7
Beaver Run Way	0.11	2	18.2	Kimball Ln	0.10	3	30.0	Sand Dollar Ln	0.05	2	40.0
Bellhaven Way	0.05	2	40.0	Kimballtown Rd	0.64	12	18.8	Sandy Cove Rd	0.36	9	25.0
Ben's Landing Rd	0.16	1	6.3	King Phillips Trail	1.35	50	37.0	Sawyer's Island Rd	1.12	28	25.0
Boothbay Shores / Wigwam Trail	0.17	1	5.9	Knickerbocker Rd (north)	0.81	12	14.8	School St	0.20	15	75.0
Boothbay Woods Rd	0.10	1	10.0	Knickerbocker Rd (south)	0.38	3	7.9	Sea Ledge Rd	0.33	3	9.1
Botantical Gardens Dr	0.31	1	3.2	Knickerkane Rd	0.10	2	20.0	Sea Surf Rd	0.39	15	38.5
Breakneck Ridge Rd	0.17	5	29.4	Leavitt Rd	0.14	4	28.6	Seascape Pl	0.15	3	20.0
Brookwood Dr	0.24	3	12.5	Ledges Ln	0.05	3	60.0	Shackleton's Way	0.32	9	28.1
Bryers Cir	0.41	7	17.1	Ledges Rd	0.20	3	15.0	Sheepscot Shores	0.24	3	12.5
Bufflehead Cove Rd	0.10	4	40.0	Leighton Ln	0.10	2	20.0	Short St	0.05	2	40.0
Burleigh Hill Rd	0.44	2	4.5	Lincoln Rd	0.34	16	47.1	Sisters Ln	0.10	1	10.0
Burnham Cove Rd	0.25	7	28.0	Linden Ln	0.13	4	30.8	Smugglers Cove	0.10	2	20.0
Butler Rd	1.23	19	15.4	Linkin Landing	0.10	2	20.0	Spar Shed Ln	0.05	2	40.0
Campers Cove Rd	0.17	3	17.6	Little River Ln	0.10	6	60.0	Spofford Rd	0.22	11	50.0
Carlisle Rd	0.10	2	20.0	Long Ledge Rd	0.10	2	20.0	Spring St	0.13	9	69.2
Carter Town Dr	0.10	3	30.0	Lookout Dr	0.05	4	80.0	Spruce Dr	0.18	9	50.0
Chandler Rd	0.10	8	80.0	Lukes Gulch	0.10	2	20.0	Spruce Shores Rd	0.14	4	28.6
Church St	0.05	2	40.0	Madison Rd	0.10	2	20.0	Steves Rd	0.10	1	10.0
Cindy Cir	0.11	5	45.5	Marble Ledge Dr	0.28	5	17.9	Stone Cove Rd	0.23	7	30.4
Clam Ave	0.31	3	9.7	Marston Rd	0.10	2	20.0	Sunny Acres Ln	0.26	7	26.9
Colburn Ln	0.10	2	20.0	Mary Anne Rd	0.15	3	20.0	Sunrise Rd	0.10	1	10.0
Corey Ln	0.58	13	22.4	Mass Ave	0.13	7	53.8	Tamarac Trail	0.31	12	38.7
Cottage Ln	0.10	1	10.0	Matthews St	0.21	10	47.6	Tavenner Rd	0.37	15	40.5
Country Club Rd	0.99	23	23.2	McCobb Rd	0.10	5	50.0	Tecumseh Trail	0.18	11	61.1
Courjon Rd	0.17	2	11.8	McKown Rd	0.10	2	20.0	Tharpe Ln	0.10	2	20.0
Crooker Rd	0.15	2	13.3	ME-27	5.13	148	28.8	The Ledges	0.10	2	20.0
Crow Point Ln	0.12	2	16.7	Meadow Cove Landing	0.16	5	31.3	Thistle Ln	0.16	9	56.3
Cunner Rock Rd	0.18	2	11.1	Meadow Cove Rd	0.70	25	35.7	Tibbets Rd	0.10	5	50.0
Dallas Dr	0.10	3	30.0	Merry Ln	0.18	3	16.7	Tidewater Dr	0.33	5	15.2
Day Rd	0.10	4	40.0	Merryweather Ln	0.11	2	18.2	Tool Rd	0.10	2	20.0
Decker Reef Rd	0.51	12	23.5	Middle Rd	0.28	9	32.1	Townline Rd	0.24	8	33.3
Dodge Rd	0.10	5	50.0	Montgomery Rd	0.31	9	29.0	Towson Ln	0.26	9	34.6
Dover Cross Rd	0.17	2	11.8	Moose Ridge Crossing	0.27	3	11.1	Trevett Rd	0.10	3	30.0
Dover Cross Rd (east)	0.35	4	11.4	Mudflat Ave	0.14	10	71.4	Tri Cove Ln	0.10	2	20.0
Dover Rd	2.49	29	11.6	Murphy Rd	0.30	9	30.0	Tripple Leaf Ln	0.16	7	43.8
E Brook Rd	0.12	3	25.0	Murray Hill Rd	0.69	49	71.0	Twin Cove Rd	0.35	8	22.9
E St	0.05	2	40.0	My Way	0.24	6	25.0	Valley Rd	0.10	4	40.0
Eagle Ridge Rd	0.10	1	10.0	Narrows Ridge Rd	0.30	8	26.7	Van Horn Rd	0.75	22	29.3
East Side Rd (north)	0.40	2	5.0	Northern Dr	0.22	4	18.2	Walker Rd	0.17	2	11.8
East Side Rd (south)	1.55	40	25.8	Oak Hill Rd	0.32	8	25.0	Wall St	0.14	7	50.0
Easy St	0.10	2	20.0	Ocean Point Rd	4.62	206	44.6	Wendell's Way	0.16	1	6.3
Elbow Rd	0.11	8	72.7	Ocean Point Rd	1.30	80	61.5	West Side Rd	2.34	56	23.9
Emily Ln	0.12	3	25.0	Ocean Ridge Rd	0.27	13	48.1	West St Ext	0.10	4	40.0
Evergreen Dr	0.26	7	26.9	Ocean View Pl	0.11	8	72.7	Western Ledge Rd	0.37	5	13.5
Farnham Point Rd	1.10	25	22.7	Ojibwa Trail	0.21	5	23.8	Whynots Watch Rd	0.21	12	57.1
Firth Dr	0.64	19	29.7	Old Pier Rd	0.10	3	30.0	Wilde Pl	0.05	2	40.0
Fish Hawk Hill Rd	0.13	4	30.8	Old Wharf Ln	0.15	1	6.7	Wilderness Trail	0.11	2	18.2
Flint Ln	0.14	5	35.7	Osprey Ln	0.05	2	40.0	Windrush Ln	0.05	2	40.0
Flo's Ln	0.10	4	40.0	Ovens Mouth Rd	0.10	3	30.0	Windward Ln	0.05	2	40.0
Forest Haven	0.10	1	10.0	Page Ln	0.27	4	14.8	Wipporwill Dr	0.16	2	12.5
Fort Island Rd	0.41	3	7.3	Paradise Point Rd	0.81	20	24.7	Wolf Rd	0.10	4	40.0
Giles Rd	0.18	3	16.7	Park St	0.25	15	60.0	Woodshed Ln	0.05	1	20.0
Goddard Point Rd	0.10	2	20.0	Pasture Ln	0.18	4	22.2	Yankee Way	0.10	2	20.0
								Total	**83.24**	**2,343**	**28.1**

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5.2.5 Boothbay Harbor Cabled Road Segments

Existing Charter (Spectrum) - Boothbay Harbor							
Road Segment	Mileage	Quantity	Per Mile	Road Segment	Mileage	Quantity	Per Mile
Abenaki Rd	0.05	2	40.0	Maddocks Rd	0.10	4	40.0
Andre Ln	0.10	36	360.0	Massachusetts Rd	0.30	16	53.3
Appalachee Rd	0.54	31	57.4	Massachusetts Rd (lateral)	0.10	4	40.0
Appalachee Rd (east)	0.10	1	10.0	McClintock St	0.05	5	100.0
Appalachee Rd (west)	0.05	2	40.0	McCobb Rd	0.10	2	20.0
Apple Tree Way	0.10	2	20.0	McFarland Point Dr	0.17	49	288.2
Arthur Dr	0.11	3	27.3	McKown Point Rd	0.96	39	40.6
Atlantic Ave	1.29	109	84.5	McKown Point Rd (lateral)	0.12	3	25.0
Atlantic Ave (lateral)	0.10	2	20.0	McKown St	0.16	16	100.0
Back Narrows Rd	0.25	6	24.0	ME-27	3.46	227	65.6
Baileyville Rd	0.57	21	36.8	Middle Rd	1.20	41	34.2
Barter Rd	0.10	6	60.0	Mill Cove Crest Rd	0.10	7	70.0
Bay Landing Ln	0.11	42	381.8	Moffat Ln	0.10	2	20.0
Bay St	0.50	43	86.0	Montgomery Rd	0.54	16	29.6
Bayberr Rd	0.11	11	100.0	Mountain View Rd	0.18	6	33.3
Beach Rd	0.48	29	60.4	Nahanada Rd	0.27	5	18.5
Bear End Rd	0.10	3	30.0	Oak Point Rd	0.26	6	23.1
Beath Rd	0.10	2	20.0	Oak St	0.42	39	92.9
Blackstone Rd	0.10	7	70.0	Ocean Point Rd	1.32	20	15.2
Blowhorn Rd	0.31	8	25.8	Old Ice House Rd	0.10	4	40.0
Boothbay House Hill Rd	0.05	3	60.0	Old Stonwall Rd	0.46	14	30.4
Bradley Rd	0.18	13	72.2	Paine Rd	0.10	7	70.0
Breakwater Rd	0.13	3	23.1	Park St	0.35	19	54.3
Bridge St	0.05	9	180.0	Park St (lateral)	0.10	4	40.0
Briggs Ln	0.05	3	60.0	Patton Ln	0.10	5	50.0
Browns Rd	0.31	14	45.2	Pearl St	0.11	7	63.6
Campbell St	0.35	31	88.6	Pennington Ln	0.16	5	31.3
Cedar Ln	0.10	4	40.0	Penoyer Dr	0.05	1	20.0
Central Ave	0.10	5	50.0	Perkins Rd	0.05	3	60.0
Chimes Dr	0.25	6	24.0	Pine St	0.10	4	40.0
Commercial St	0.46	78	169.6	Pinkham Cove Rd	0.05	5	100.0
Cranberry Rd	0.15	3	20.0	Pooler Rd	0.13	7	53.8
Crest Ave	0.97	51	52.6	Power Hill Farm Rd	0.13	5	38.5
Crooked Pine Rd	0.25	33	132.0	Racoon Dr	0.10	6	60.0
Eames St	0.05	5	100.0	Reed Rd	0.46	11	23.9
Eastern Ave	0.57	35	61.4	Roads End Rd	0.31	23	74.2
Eaton Rd	0.18	5	27.8	Roberts Cir	0.10	8	80.0
Eaton Rd (lateral)	0.05	3	60.0	Rock Rd	0.22	8	36.4
Elvira Dr	0.10	3	30.0	Samoset Rd	1.44	32	22.2
Emery Ln	0.70	28	40.0	School St	0.30	31	103.3
Factory Cove Rd	**0.15**	11	73.3	Sea St	0.20	22	110.0
Fullerton Ct	0.05	5	100.0	Seaview Pl	0.05	3	60.0
Fullerton St	0.31	22	71.0	Secret Cove Ln	0.10	2	20.0
Gilead St	0.10	5	50.0	Sherman St	0.10	9	90.0
Giles Pl	0.05	4	80.0	Simons Dr	0.23	24	104.3
Glenside Rd	0.10	7	70.0	Snow Hill Rd	0.10	2	20.0
Granary Way	0.10	10	100.0	Snow Rd	0.10	9	90.0
Grandview Ave	0.51	20	39.2	Southern Rd	0.05	2	40.0
Greenleaf Ln	0.10	6	60.0	Spruce Point Heights	0.10	1	10.0
Hackmatack Rd	0.10	3	30.0	Sprucepoint Hill Rd	0.10	1	10.0
Hammond Way	0.10	4	40.0	St Andrews Ln	0.10	6	60.0
Harbor Heights Rd	0.14	12	85.7	Summit Rd	0.23	14	60.9
Harris Point Rd	0.17	10	58.8	Sun Set Rd	0.38	15	39.5
Heron Cove Rd	0.24	8	33.3	Townsend Ave	0.10	2	20.0
High St	0.05	2	40.0	Tupper Rd	0.10	5	50.0
Highland Park Rd	0.18	15	83.3	Union Ct	0.10	6	60.0
Hillside Rd	0.10	2	20.0	Union St	0.25	30	120.0
Hodgdon Cove Rd	0.17	6	35.3	Village Ct	0.11	14	127.3
Howard St	0.10	3	30.0	Virginia St	0.27	11	40.7
Hutchinson Dr	0.20	10	50.0	W Harbor Pond Rd	0.18	10	55.6
Juniper Point Rd	0.23	19	82.6	W Rd	0.10	5	50.0
Kenney Field Dr	0.61	47	77.0	Wall Point Rd	0.47	16	34.0
Lakeside Dr	2.12	60	28.3	Warren Ln	0.12	6	50.0
Lakeview Rd	0.67	38	56.7	Waters Edge Tr	0.10	**3**	30.0
Ledge Rd	0.10	5	50.0	Watutka Way	0.05	2	40.0
Linekin Rd	0.59	21	35.6	Wawenock Trail	0.26	10	38.5
Lobster Cove Rd	1.00	54	54.0	Weeks Rd	0.10	4	40.0
Logan Rd	0.10	5	50.0	West St	0.13	19	146.2
Lupin Ln	0.05	2	40.0	Wharf St	0.05	16	320.0
				Williams St	0.21	14	66.7
				Total	**38.08**	**2,116**	**55.6**

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5.3 Fiber-to-the-Home - Minimum 100Mbps/100Mbps

Based upon our analysis and investigation, with the exception of those road segments where LCI has made FTTH service available (see map in Section 4.5) there are no other households in the Towns currently able to receive a consumer-grade FTTH service.

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6 Network Designs

6.1 Minimum 25Mbps/3Mbps - DSL

With the few areas of CCI service territory not currently served by a minimum 100Mbps/10Mbps cable modem service, it does not appear to be a viable option to upgrade DSL service capability and reach. Further, CCI has indicated they have no plans to upgrade their DSL service in the Town. A more viable approach would be to extend cable modem service to those currently un-cabled roads. As a result, we are not including a network design for upgraded DSL service.

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6.2 Minimum 100Mbps/10Mbps - Cable Modem

With 94% of potential subscribers in Boothbay and 99% of potential subscribers in Boothbay Harbor already served by a minimum 100Mbps/10Mbps cable modem service, extension of that capability to the remaining un-cabled roads as illustrated in the map in Section 5.2 would be a viable initiative.

The franchise agreement for both Towns includes an obligation for Spectrum to extend service to uncabled roadways that,

> *". . . have the greater of the equivalent of twenty (20) year-round customers to Family Cable service per aerial mile of contiguous cable including the cable required to reach such homes, or the equivalent of twenty-five (25) homes (occupied on a year-round basis) per contiguous aerial mile including the cable required to reach such homes."*

For areas with a lower density, the franchise agreements include an obligation for Spectrum to,

> *". . . extend the system to even lesser population densities if the subscribers will agree to pay installation and monthly service charges equal to the revenues of twenty (20) paying Family Cable service subscribers per aerial mile of cable for a three (3) year period."*

While the potential subscribers per mile for the uncabled areas of the Towns do not meet these density requirements, based upon our experience in other municipalities, Spectrum would be likely to fund at least 50% of the cost to serve all of the remaining potential subscribers in the community.

Town Metrics				
		Boothbay	**Boothbay Harbor**	**Total**
Uncabled Mileage		8.1	0.5	8.7
Potential Subscribers		141	11	152
Average subscribers per mile		**17.4**	**20.8**	**17.6**
Cable TV Extension				
Cost per mile	**$45,000**	$365,400	$23,850	**$389,250**

The table above estimates the total cost per Town to extend the Cable TV infrastructure. This cost is based on recent experience with a similar Cable TV extension project in another Maine municipality where Spectrum quoted $45,000 per mile as the cost to be split between Spectrum and the municipality.

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6.3 Minimum 1Gbps/1Gbps - FTTH

By virtue of the fact that there is limited FTTH service within the Towns, the combination of the cabled and uncabled roadways as illustrated in Section 5.2 above represents the design for a FTTH solution. There are a number of different design/operating options for a FTTH solution that should be considered.

Single Provider FTTH network - This is a network built and operated with a single provider only. The single provider could be the Towns themselves, or another service provider who partners with the Town. Service provider partners could potentially be any service provider, including the incumbent telephone company currently operating within the Towns.

Non-Discriminatory Open-Access FTTH network - A non-discriminatory open-access fiber network is an all-fiber network constructed and operated in a manner that allows multiple service providers to utilize the network under the same pricing, terms and conditions as any other service provider. In other words, it provides a level playing field and encourages and facilitates competition between an unlimited number of competitors. There are two types of open-access networks:

> **An Open-Access *Lit* Fiber network** - is a network where an Internet Service Provider (ISP) would interconnect their network to the common equipment in the centrally located Central Office (CO) and lease the fiber and the optical/electronics at the subscriber premise to deliver the service.
>
> **An Open-Access *Dark* Fiber network** - is a network where the ISP leases a fiber from the POP to the subscriber and places their own equipment in the POP and their own optical/electronics interface at the subscriber premise to deliver the service.

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7 FTTH Cost Estimates and Public-Private Partnership Strategies

There are a number of variables that impact the construction cost and operation of a fiber network that can only be determined with confidence by producing a detailed engineering plan and financial proforma, which is outside the scope of this Study. However, using various industry metrics and leveraging our experience building and operating fiber networks and negotiating with service providers, we can provide a high-level estimate of such costs. The table below summarizes the high-level estimated costs for the various options, with each option discussed below the table.

Fiber-to-the-Home High-level Estimate								
		Boothbay	**Boothbay Harbor**	**Both Towns Combined**	**Both Towns Combined**	**Both Towns Combined**	**Both Towns Combined**	**Both Towns Combined**
Network Type		Single Provider	Single Provider	Single Provider	Single Provider	Single Provider	Open Access Lit	Open Access Dark
Ownership		Municipal	Municipal	Municipal	Incumbent Phone	3rd Party	Municipal	Municipal
Poles per mile	**33**	3,015	1,274	4,289	4,289	4,289	4,289	4,289
Make-ready per pole	**$400**	$1,205,952	$509,652	$1,715,604	n/a	$1,715,604	$1,715,604	$1,715,604
Annual License per pole	**$20**	$60,298	$25,483	$85,780	n/a	$85,780	$85,780	$85,780
Backbone Construction	**$25,000**	$2,284,000	$965,250	$3,249,250	$3,249,250	$3,249,250	$3,249,250	$3,249,250
Central Office Construction	**$500,000**	$250,000	$250,000	$500,000	$250,000	$500,000	$500,000	$250,000
Take rate	**50%**							
Drop per subscriber	**$1,000**	$1,242,000	$1,063,500	$2,305,500	$2,305,500	$2,305,500	$2,305,500	$2,305,500
Subtotal		**$5,042,250**	**$2,813,885**	**$7,856,134**	**$5,804,750**	**$7,856,134**	**$7,856,134**	**$7,606,134**
Project Management	**10%**	$504,225	$281,388	$785,613	$580,475	$785,613	$785,613	$760,613
Contingency	**10%**	$504,225	$281,388	$785,613	$580,475	$785,613	$785,613	$760,613
Total Estimated Capital Cost		**$6,050,700**	**$3,376,662**	**$9,427,361**	**$6,965,700**	**$9,427,361**	**$9,427,361**	**$9,127,361**
Estimated Municipal Subsidy Percent		100%	100%	100%	50%	50%	100%	100%
Amount		**$6,050,700**	**$3,376,662**	**$9,427,361**	**$3,482,850**	**$4,713,681**	**$9,427,361**	**$9,127,361**

7.1 Single Provider FTTH with Municipal Ownership and Operation

This solution is the most expensive, carries the most risk for the Town and is very similar to the FTTH network for the Town of Islesboro, where we acted as the Owners Project Manager on behalf of the town. This scenario is similar to partnering with a 3rd Party service provider in terms of the estimated costs per mile and take-rate. The difference would be the network would be entirely owned by the Town and the Town would be fully responsible for the maintenance and operation of the network. In the case of Islesboro, the Town contracts with GWI for the operation and routine maintenance and contracts with the contractor who built the network for major maintenance and restoration activities.

While this solution carries the greatest burden in terms of costs and risks, it provides the Town with complete control for the quality and performance of the service provided, and the Town would no longer be subject to large companies from away who do not share the same interests.

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Given the fact that the 97% of the area of both Towns already have high-speed Internet through Spectrum, we do not believe the ConnectMaine Authority, or any federal programs will provide any subsidy amounts. As a result, municipal funding or other sources will need to be considered.

7.2 Single Provider FTTH with Incumbent Phone Companie

With this option, CCI would over-build its networks with FTTH. The estimated cost per mile will be lower than the municipal option since CCI is a joint owner of the utility poles and already has cabling attached enabling CCI to simply over-lash the new fiber optic cable over the existing copper infrastructure. As a result, CCI would not have the considerable expense associated with the utility pole make-ready process. Further, they already have an established Central Office.

7.3 Single Provider FTTH with 3rd Party Service Provider

If the Towns decides to pursue a FTTH solution and the incumbent provider is not interested in partnering, or the Towns are not interested in partnering with the incumbent provider, there are a number of 3rd Party service providers who may have an interest. Those providers would include: GWI, Pioneer Broadband, Premium Choice Broadband, Axiom Technologies, OTELCO, LCI and Matrix Communications.

In this scenario, the estimated construction costs are significantly higher as these service providers *(with the exception of LCI)* currently have little to no infrastructure in the area from which to extend or leverage. The estimated subsidy percentage is lower than with the incumbent telephone company primarily due to the fact that all revenue generated would be new revenue for these service providers compared to the replacement revenue for CCI.

7.4 Open-Access Lit FTTH with Municipal Ownership and Operation

As discussed previously, an **Open-Access FTTH network** is a non-discriminatory open-access fiber network constructed and operated in a manner that allows multiple service providers to utilize the network under the same pricing, terms and conditions as any other service provider. In other words, it provides a level playing field and encourages and facilitates competition between an unlimited number of competitors. This solution envisions an **Open-Access *Lit* Fiber network** where the Internet Service Providers (ISPs) would interconnect their network to the common equipment in the centrally located Central Office (CO) and lease the fiber and the optical/electronics at the subscriber premise to deliver the service.

The estimated cost per mile would be slightly less than the single provider FTTH solution where a 3rd Party or the Town would own the network because the cost to connect back to the Internet would be the responsibility of each service provider who leases capacity on the network. This is the only

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difference in terms of costs. Like the Single Provider FTTH with Municipal Ownership option, the Town would be fully responsible for the maintenance and operation of the network.

While not mentioned previously, the Towns should be aware that CCI and Spectrum currently have a policy of not utilizing open-access networks and will likely continue to maintain their separate networks.

7.5 Open-Access Dark FTTH with Municipal Ownership and Operation

This option is an **Open-Access *Dark* Fiber network** where the ISPs lease a fiber from the POP to the subscriber and place their own equipment in the CO and their own optical/electronics interface at the subscriber premise to deliver the service.

The overall estimated cost for this solution is lower than an open-access lit fiber network because no optical electronics are required to be provided in the CO or at the customer premise, which is the responsibility of the ISP. Like the Single Provider FTTH with Municipal Ownership option, the Town would be fully responsible for the maintenance and operation of the network.

7.6 Cost Options and Public-Private Partnership Strategy Summary

There is no right or wrong choice as to which solution the Town chooses to pursue, rather each solution should be contrasted with the vision and goals of the Town, the available funding sources, and the capacity and commitment of the Town to provide management and oversight.

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8 Recommendations for Next Steps

Casco Bay recommends the Town aggressively and timely pursue the following initiatives as many service providers are looking for expansion areas and communities willing to partner. Our recommendations are itemized below.

- The Towns should quickly develop their broadband infrastructure vision and goals to guide their efforts.

- Since the Spectrum Cable Modem Extension solution is the lowest cost, least risk, quickest to deploy to fill the current gaps in coverage, we recommend engaging Spectrum at the earliest opportunity to explore their interest.

- Simultaneously, we recommend sharing the report with CCI and all of the potential 3rd Party service providers to gauge their interest in serving the Town with a FTTH solution. For those interested, negotiations should be pursued on a timely basis.

- While Casco Bay Advisors is an independent consultancy that is not aligned with any service providers, construction contractors or equipment vendors; we are aware that LCI has an interest in expanding their presence in the Boothbay region and has preliminary designs and cost estimates to deploy a FTTH network in phases throughout the region. Given their existing and diverse infrastructure serving the Towns, their long history as a family-owned service provider serving many nearby communities and their reputation for quality and service; the Towns will be well served by exploring a relationship with LCI as it considers all of its options.

Casco Bay Advisors maintains collaborative and independent working relationships with all of the service providers, network construction contractors and with the state-based institutions that can assist with funding models including the ConnectMaine Authority and the Finance Authority of Maine. We would be happy to assist the Towns to execute upon their broadband vision and leverage our 36 years' experience and success with other Maine municipalities.

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