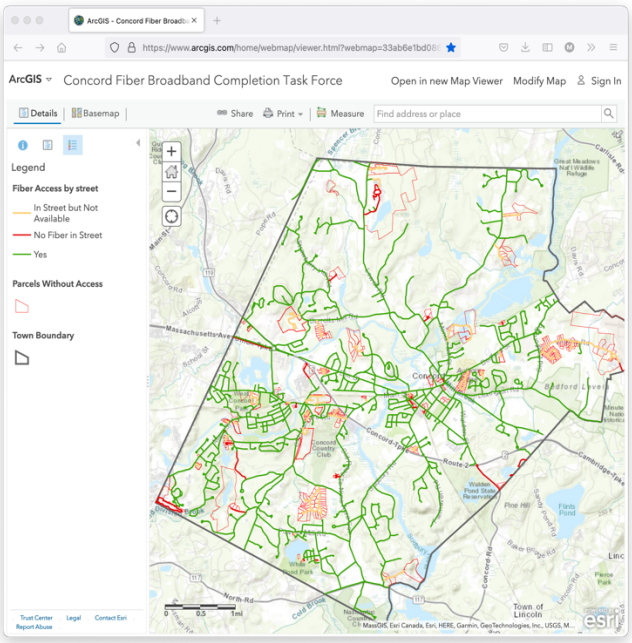

DRAFT FIBER BROADBAND COMPLETION REPORT

April 10, 2022

ABSTRACT

This report outlines the state of completion of Concord's fiber optic network. It recommends how to proceed with investments to accomplish universal access. It outlines the value doing so. The April 10, 2022 version is an initial public draft offered to the community for comment and feedback to the Task Force.

Fiber Broadband Completion Task Force:

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1. Abstract: FBCTF Report Public Draft

This Document is the initial public draft of the Fiber Broadband Completion Task Force report. It is offered to the community for comments and feedback. It will be summarized at a public meeting scheduled for April 14, 2022 at 7:00 PM in the Concord Townhouse Hearing Room and virtually on zoom.

Citizens are encouraged to submit comments in writing using the Task Force web page. https://concordma.gov/2958/Fiber-Broadband-Completion-Task-Force

A copy of this report can be downloaded from there as well.

It is the intention of the Task Force to create a final version of this report by early May 2022 in accordance with the Charge to the Task Force and the requirement of Article 41 of the 2021 Concord Town Meeting which created this effort.

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2. Preface

The Fiber Broadband Completion Task Force (FBCTF) was created by Concord's Annual Town Meeting in June, 2021. Article 41, which passed by a nearly unanimous vote, urged the Town Manager to increase the availability of municipal fiber optic telecommunications service, and asked the Select Board to appoint a committee. The committee was charged with studying and recommending appropriate solutions, including possible funding, for:

(a) expediting the installation of fiber-optic telecommunications utility service on the remaining 5% of Town streets that lacks such service;
(b) exploring barriers to Concord Light Broadband subscription growth; and
(c) investigating opportunities for expanding fiber-to-the-home and to fiber-to-the-business.

As the Fiber Broadband Completion Task Force began working on these issues in September 2021, it also developed a number of additional recommendations, all of which this Report is intended to address. Article 41 directed that the Report would be submitted to the Select Board and the Town Manager.

The Fiber Optic network is an extraordinarily valuable asset to the Town. It is capable of supporting economic vitality, sustainability and resilience goals. The Fiber Optic network began in 2014 with small steps, at the urging of then-Town Manager Chris Whelan. Goals were purposefully conservative, such as needing to be competitive and earn a return. The slow approach ensured that taxpayers and rate payers would not be harmed. Concord Light Broadband, a division of the Concord Municipal Light Plant, grew to serve over 1500 customers, and became operationally self-sustaining. After the COVID-19 pandemic, it became apparent that new subscriptions to, and extensions of, the Fiber Optic network have slowed. While fiber is installed in more than 120 miles of the 138 miles of Concord's streets, only 78% of the Town's addresses are able to access the fiber. The FBCTF was created to put new energy into possible solutions to the issues and questions that go along with creating a citizen-owned and citizen-serving asset.

3. Definition of Focus Areas:

The Task Force identified four focus areas based on the Article 41 requirements and the charge from the Select Board. What follows is a brief introduction to each of these which was established in early meetings of the Task Force to be explored in more detail. This report is organized into sections that are intended to provide background for the public and policy makers in each area.

A. "The last 5 – 7% of Streets"
    a. Broadly speaking the objective of this area is to define which premises in the CMLP service area are "not served". Determine why they are "not served" and recommend policies that establish if, when and how fiber will be extended to serve them.
    b. It is an established fact that CMLP did not install fiber in the right-of-way of all streets and roads in Concord.
    c. This area of study will define examine and establish which streets and roads remain without fiber and therefor is "not served".
    d. Each area that does not have fiber now will be assigned one of more reason codes for the lack of fiber.
    e. To the extent possible the Task Force will determine how many residential and business premises are not served due to lack of fiber in the right-of-way.
    f. The Task Force will explore programmatic solution for addressing the reasons associated with the lack of fiber.
    g. These solutions will be presented in the context of the policy decisions that would be associated with implementing them.
    h. Metrics in these areas will related to parcels and streets "served", percentage of the CMLP customers served, cost of fiber system extensions and funding available for system extensions within the right-of-way.

B. "Barriers to Subscription Growth"
    a. The area's objective is to focus on premises that currently are served by fiber to establish if there are policy or programmatic inhibitors to adoption.
    b. Generally, this area is a look at demand and decision making among potential subscribers.
    c. The task force will seek to establish an understanding of what may be inhibiting the adoption of the service by those potential customers. Some examples could include:
        i. Knowledge of the offerings
        ii. Cost or value of the offerings
        iii. Inhibitors to Installation (other than as covered in Section A).
        iv. Impact of underground bylaw

d. Metrics in this area will include take rates, subscriber levels, new installations performed, cycle times associated with installations, reason for cancellation or incomplete orders, percentage of successfully completed orders.

C. "Fiber to the Home and Fiber-to-the-business" aka the 'last mile'
   a. This subset of potential customers includes premises that are on parcels which are served by fiber from the right-of-way, but have additional obstacles to installation that are specific to either the type of premise, structure or subdivision.
   b. This area will focus on the issues that inhibit renters, co-op members, condominium and businesses from installing the service.
   c. Policies related to installation of fiber in common areas of private property in order to provide access to individual customers within those properties will be examined.
   d. Metrics in this area will include number of potential customer premises, number of newly enabled premises.

D. Additional issues related to the mission, business, and financial policies
   a. The task force will discuss recommendations for how the citizens of Concord should express their preferences for CMLP's Fiber Services.
   b. Currently Town Meeting, the Select Board, the Light Board, the Town Manager as CMLP General Manager and CMLP staff all potentially have roles in guiding the priorities of the Fiber Broadband service. This implies a complex governance structure that could be more clearly delineated. The Task Force will discuss recommendations in this area which could include specific Processes and Procedures to establish:
      i. Goals and priority of Universal Access
      ii. Choice of services provided by CMLP
      iii. Capital allocation priorities and use of capital for fiber
      iv. Operating return objectives for telecommunications services
      v. PILOT and Payment in Lieu of Franchise by the Broadband Business
      vi. Strategic Plans and goals for Concord's Broadband business

4. Executive Summary and Overview

The initiative to provide the Broadband service in Concord arose out of two specific drivers. First, in the early 2000s groups of citizens perceived that there was the lack of good service from existing providers. Second, the Concord Municipal Light Plant (CMLP) the town-owned electric utility needed to replace an obsolete communication system used for a load control program. Peeling back these two drivers to more basic elements, we can say, there was an unmet demand for quality services. And there was an operational need at the electric utility that could be addressed through a capital investment. CMLP found that it could cost effectively address both these opportunities by building a fiber optic network.

The history of the genesis and construction of the fiber optic network is described in the report from the Berkman Klein Center for Internet and Society at Harvard University, "Citizen Take Charge: Concord Builds a Fiber Network". Available here: https://cyber.harvard.edu/publications/2017/MF/Concord. This history is a useful and very informative background. Subsequently, what led to Article 41 and the Fiber Broadband Completion Task Force (hereafter the "Task Force" or FBCTF) is the fact that significant portions of the community where not enabled to connect to the fiber network in the initial construction phase. Details of the gaps are presented later in this report. The Task Force's mission is to research and make recommendations on questions related to if, when, and how, the community should approach completing the fiber network.

Fiber completion taskforce process and approach:

1. Characterize the un-served residents (independent of housing type) within Concord.
   This work would include characterizing the un-served areas that have common attributes from the perspective of how to reach the resident.

2. Consider the possible cost for meeting those un-served citizens?
   (e.g., what technical approach, assuming fiber, can be used to reach the resident?)
   This portion of the work was primarily focused on the how with consideration given to most cost-effective approach within the constraints of the situation (e.g., underground utility requirements, third party situations such as homeowner associations and landlords between Concord Broadband and end user).

3. Consider alternatives and approaches to meet these un-served citizens.
   From a financial perspective, how shall we pay for #2, or can we pay for #2.

After almost eight years of operation the CMLP Broadband service is generally considered to be successful. The following is provided to place this enterprise activity in a broader context which can be helpful to establish policy.

The Fiber network is distinct from the Broadband service

There is an important distinction between the definition of a Fiber network and a Broadband service. A Fiber network is a physical asset consisting of the fiber optic cables and communication equipment used to send signals across it. A Broadband service is just one of many possible uses for fiber network. A Broadband service can be implemented without the use of a Fiber Network. Also, multiple Broadband services or service providers can share a Fiber network. It can be useful to think of the Fiber network like a road system and a Broadband service as one of many different users of the road system.

This report is primarily addressing the state of completion of the Fiber network which is owned by the Town of Concord. Because the Town provides a Broadband service on that Fiber network a review of that effort is important to understand the finances associated with the Fiber network.

The benefits of the fiber network that was constructed are significant:

A municipality can realize significant operations benefits from owning and operating a fiber network. It is important to understand that a fiber network is not a broadband service. A fiber network is a general-purpose means of connecting endpoints for communicating in any number of ways. Broadband is just one of the possible uses. As mentioned above, CMLP's initial need was to communicate with devices, meters, and load control switches, on the premises of its electric customers. In Concord's case, public safety communications, school department operations, water and sewer operations, and municipal operations in every town department benefit directly from the fiber network. The fact that the Town is also able to be monetized the fiber network by also providing Broadband service is a bonus, because the fiber network already provides significant cost savings, compared to contracting for communications services from the private sector for town and school department operations. Taken together, these benefits clearly support the rationale for owning and operating the fiber network. It saves money, and in effect, it pays for itself.

Does the fiber network address the original citizen concern, lack of options for good internet service from the private sector?

Objectively, the answer is of course it can. Fiber optic networks represent the state of the art in high-speed communication and therefore can meet this need. However, a follow up question is: Does Concord's network fill this need? This is a more complex question. Competing with the private sector to provide Broadband service requires continuous improvement and investment to ensure that the offerings are competitive.

Additionally, there is a question of coverage. Which residents and businesses have access to the network should be addressed as a matter of policy. If the Broadband offering is competitive, but the fiber network does not serve a particular customer in Concord, then the Fiber network fails to address the original citizen concern about access to quality service. Clarifying the objectives and commitment in this area is one of the policies that should be put in place by the Town.

How does Broadband compare to other municipal enterprise services and utilities?

Municipal utility services are generally provided to meet a recognized need. They are also typically provided based on an exclusive geographic service area.

Examples of the utilities provided by the Town of Concord include the electric, water, sewer systems. In these cases, the services are essential, and the service territory is exclusive. In other words, residents are unable to contract with private parties to obtain power, water, or sewer treatment. (Note that individuals may serve themselves, with on-site generation and use, private wells, and septic systems.) These characteristics provide clarity of purpose to the utility provider. Imperatives such as reliability, health and safety, universal access, and environmental protection form the rationale and influence policy choices. Efficient, cost-effective solutions are the obvious and appropriate approach.

Broadband service falls into a different category. It is not technically a utility. It is more accurately defined as an infrastructure service. It is a service because, like recreation and solid waste disposal, the private sector offers alternatives to the Town's service. Housing, childcare, and other human service functions can also fall into this category. In these cases, it is appropriate to examine the rationale and the goals for a municipal offering. In effect, the question of why the Town should provide the service is important and leads to parameters that dictate how the Town approaches the service offering.

Common reasons for providing a given service include lack of competition, lack of providers or universal access, tradition, and perception of mission. For example, the Town may wish to serve segments of the population who otherwise might not find the

private sector offerings affordable. Infrastructure services differ from other services in that they commonly depend on access to public rights-of-way, and they require larger capital investments and scale to be competitive.

Broadband, and access to the Internet in particular, is an example of an infrastructure service that is available from the private sector in Concord. (To a much smaller extent, Fiber networks are also privately available and have been primarily built to serve local businesses.) So why should the Town of Concord, through CMLP, provide Broadband? What is the rationale specifically for a fiber network? What purposes does the Town seek to achieve by sponsoring and supporting such an enterprise? Creating consensus around these issues is an important step to ensuring that the enterprise is performing well. Equally important could be to define what are not the goals, to avoid efforts in those directions and conserve resources.

The community should understand and position the Broadband service in a competitive environment.

Several of Concord's other enterprise activities regularly compare themselves to the competition. The Beede Center, the recreation department, and the solid waste curbside collection program all review their offerings considering the privately-offered alternatives, and adjust the offerings accordingly. Concord Light Broadband can and should do the same. The High-Speed Internet offerings can be compared to unbundled offerings from the private sector and are generally competitive. It is widely understood in the broadband industry that effective competition within a given geographic service territory results in lower cost and better service to consumers.

In recent years, Concord Light Broadband has provided the only alternative to the cable franchise service for Concord which meets the FCC definition of High-speed internet or better. The value of ensuring that there are competitive alternatives is an important rationale for the service to be one of the users of the fiber system. However, the competitive environment can and will change over time. It should be noted that low-earth orbit satellite systems, such as SpaceX's Starlink, and 5G fixed wireless cellular offering are beginning to become available. Over time they may become competitive. Each different service has advantages and disadvantages based on the engineering and physics. From a consumer's perspective, a duopoly is less desirable than multiple competitors because constraints on a particular service may rule it out for a given customer.

The community needs to choose how to approach issues of digital equity.

It is common for municipally-sponsored programs to operate with limited or negative financial returns to accomplish specific social goals. Recycling programs, affordable housing and childcare are often structured in such a way. The COVID-19 pandemic put additional emphasis on digital equity, accelerating what was the already widely recognized need for households to have high-speed Internet access. In Concord, we have identified a particular issue with respect to the fiber network. The initial fiber construction and service deployment favored premises which could provide a faster return on investment. The unintended consequence has been that many multi-dwelling units, apartments and condominiums were bypassed. Unfortunately, these tend to be the more affordable housing alternatives in the community. The current policy that the property owner is responsible for the cost of connecting to the fiber network the responsibility of the property owner when underground conduit or inside wiring is needed also creates barriers for these and other residents.

This report will describe some of these situations in more detail and enumerate specific recommendations regarding policies that could be enacted to promote more equitable access to the fiber network in Concord. To be clear, these programs will often involve relaxing the expectations for financial return. However, there is no reason to expect that they would create significant burdens if such programs were prudently implemented. Moreover, numerous federal and state grant programs for Broadband infrastructure have become available since the pandemic. It is critical that spending and funding decisions be made that articulate the community expectations and goals. This will enable the staff charged with operating the network to efficiently achieve results. It is the responsibility of policy makers to set the framework and to make choices about trade-offs. Once those policies are in place, staff is enabled. If policies are vague or missing, the results are likely to appear arbitrary or, in some cases, unfair.

Subscriber Growth has been slowing - There is a need to understand why.

In 2013, when the Broadband service was initiated, the overarching goal was to prove that the service was viable and to gain the experience needed to scale up operations. In 2022, after multiple years of operation, it is clear that the service can provide a reasonable, stable, rate of return. Several years of positive operating returns and a stable customer base suggest that the initial deployment was successful. Yet, growth has slowed substantially, and whether this is due to the pandemic, competition, market saturation, lack of marketing or awareness, or other factors, is not clear. It is important to investigate further as part of the goal setting and strategic planning process. The Task Force is recommending that CMLP engage in some customer survey activities to clarify this situation. Understanding the target subscriber base is an important element

in planning for completion of the fiber optic network because it helps to clarify what financial resources may be available to accomplish the goals that are set.

The pandemic clearly did have at least a short-term impact on the trajectory of growth of the broadband subscriber base. It is the nature of a subscription business that a reduction in growth rate has a large impact over time. The Task Force recommends that a portion American Recovery Plan Act (ARPA) relief funds received by the town be used to offset the impact on Broadband revenue. The Task Force has calculated the impact of the slowdown on revenue for the two-year period of March 2020 to March 2022 to be approximately $240,000 based on historical growth in subscriptions. A formal request for reimbursement is included in the recommendations section.

Universal availability to the fiber for the community will prove valuable but will take time to achieve.

The Task Force recommends that the Town adopt a long-term goal that the Fiber network should be universally available. Fiber construction is complicated and time-consuming. Only a consistent, long-term ongoing focus to complete the build will result in ultimate completion of the network. Generally, the areas that are not served by fiber today were omitted because of logistical issues at the time of initial construction. This report outlines a roadmap in the form of a Broadband Capital Program to planning and coordinating investments in ongoing construction. There are multiple potential approaches to funding the capital program. This report reviews them and concludes that a consistent level of effort which relies on the revenue of the broadband service is likely to be successful, so long as it is monitored and institutionalized.

If ARPA relief funds, or other grant funds, are allocated by the town, they could be used to initiate the Broadband Capital Program and accelerate the start of a consistent effort to complete the fiber network.

The value of achieving universal access to the fiber network through the town is that subsequent initiatives can be able to be quickly implemented. The Fiber network can support many community objectives at once. Sustainability, education, public safety, and economic development projects can all be enabled throughout the community once fiber is available.

The details of the Task Force recommendations are presented in the final section of this report. They can be summarized as follows:

1. Establish the goal of universal access to the municipal fiber network throughout the Town. Fund that goal through reinvestment of net income from the Broadband service. Measure the progress. Adding achievement of the goal to the portfolio of the Light Board, as the representatives of the citizens, should ensure success over time.

2. Focus on the Telecommunications enterprise business performance and growth to ensure that the Broadband service continues to be a net contributor to both the municipal finances and the community's economic vitality. By using metrics to track business performance, increasing in marketing activities, and performing periodic strategic planning, these outcomes can be achieved while enabling completion of the Fiber network.

3. Proactively establish programs that promote the Broadband service in multi-dwelling units, small businesses, and town centers, to further goals of economic inclusion and digital equity. CMLP has other successful programs in energy efficiency and strategic electrification which can serve as models for how to promote adoption of fiber and municipal Broadband.

Concord is among a relatively small number of communities that already have access to such a valuable resource. The construction and initial few years of operation have been successful. The fiber network has benefited the Town without creating any burden on scarce public funds. In fact, the project has contributed savings and income. It would be easy to let the status quo stand and assume success has been attained. That would be risky since Broadband service operates in a competitive landscape. A status quo approach also risks overlooking real opportunities for the future and omissions from the past that constrain the benefits that could ultimately be realized.

It is the Task Force's hope that this report serves to stimulate a commitment to action in the community that leads to forward progress on Fiber network completion. We believe that fiber network, when completed will offer even more benefits than it does now. By acting deliberately and consistently over time these goals can be achieved in a fiscally responsible way. Concord already has processes and institutions that can realize these aims. What is needed is to bring them into focus and establish the goals. It is our hope that we have contributed to that by bringing together the information in this report.

5. Current State of Fiber

Introduction – What is Fiber?

In 2014, Concord Light Broadband began offering broadband internet service and municipal communications through fiber optic cables. The term "broadband" refers to high-speed internet access that is always on, and carries multiple voice, video, and data channels simultaneously. Fiber optic cables accomplish this connectivity using glass strands contained in a protective tube. Fiber transmits data using light pulses. The Town has placed about 120 miles of Fiber [this # as of Feb 2017] along telephone poles or in underground conduit. It can be helpful to think of the Fiber system as a network of roads, which allows connections to be made between any points throughout the network.

Customers can receive broadband through Fiber with Ethernet cables for a wired connection, or use their router's wireless radio for Wi-Fi connectivity. Businesses and schools can use Fiber to set up private networks. All of Concord's municipal buildings are connected via Fiber. The Fiber network is used by police and emergency responders, and drinking water reservoirs and waste treatment facilities are monitored using Fiber. Concord's Smart Grid network was overlaid on the Town's Fiber, allowing some electric meters to communicate with the utilities.

Throughout this report, the terms "Fiber network" and "Broadband service" are frequently used. It is important to keep in mind that the Fiber network–the overhead and underground miles of glass fiber connecting much of our community- is more than just Broadband service-the Town's subscription-based access to High-Speed Internet via fiber. Article 41 directed this Task Force to explore ways to increase Fiber availability and study barriers to Broadband service growth. As discussed in this report, Broadband service revenue provides financial resources to support installation of more Fiber. Fiber optic technology has been called "future proof." It is expected to outlast the current generation of wireless devices, and will enable technologies that are presently unknown.

Benefits of Fiber

Fiber can transmit an almost unlimited amount of data, at unlimited speeds. Speed and capacity are controlled by the optical networking hardware and service configuration chosen by the Internet Service Provider, such as Concord Light Broadband (for example, a subscription for a higher speed connection costs more).

Any number of devices may be connected to Fiber broadband with no reduction in data transfer speeds or signal strength. This scalability feature contrasts with broadband provided via radio waves (such as 4G, 5G, or Wi-fi). With wireless broadband, data transfer speeds will slow when more users or more devices are simultaneously connected to the same wireless signal.

Fiber offers superior reliability. Wireless signals can be adversely affected by weather, physical obstructions such as buildings and trees, and distance from the broadcast point; Fiber has none of these limitations. Optical fibers are immune to electromagnetic interference and emit no radiation.

Internet connections via Fiber are also private, more secure, and less prone to hacking than other broadband transmission technologies. For example, businesses and other groups (schools, medical facilities) within Concord can set up private networks using the Town's Fiber.

Fiber is closely aligned with Concord's Sustainability Principles:

1. Reduce dependence on fossil fuels, underground metals, and minerals
2. Reduce dependence upon synthetic chemicals and other manufactured substances
3. Reduce encroachment on nature
4. Meet human needs fairly and efficiently

Fiber conducts broadband signals with glass. In contrast to coaxial cables, which are made using copper, and wireless transmitters, which are built with metals, Fiber reduces dependence on underground metals and minerals (Sustainability Principle #1). Fiber is usually located concurrently with electric utility lines on existing poles or underground. In contrast to radio towers and small cells, which compete with trees and vegetation, Fiber does not require placement of towers or cells. Some studies claim the electromagnetic fields (EMFs) constantly emanating from wireless towers and small cells harm plants and wildlife. Fiber thus reduces encroachment on nature (Principle #3). Finally, as a non-EMF solution to broadband, a wired solution like Fiber is preferred by people who suffer from electrohypersensitivity. Because Fiber allows broadband connectivity without the need to broadcast wireless signals, in contrast with towers and small cells that require power sources, it is more efficient. For these two reasons, Fiber can be viewed as meeting human needs more fairly and efficiently than wireless broadband (Principle #4).

Broadband Alternatives and Competition

Broadband technologies include both wireline (such as Fiber) and wireless infrastructure. Wireline choices include Digital Subscriber Line (DSL) and cable modem. Some Concord residents subscribe to cable modem service for cable television, and also subscribe to Concord Light Broadband for internet service. Many businesses subscribe to both cable modem-based internet and Concord's Fiber internet to have redundancy in the event of an outage.

Wireless broadband connects to the Internet using a radio frequency link between your device and the service provider's facility. Common kinds of wireless broadband include mobile (3G/4G/5G) wireless, fixed wireless and satellite services. (Source: Massachusetts Broadband Institute, https://broadband.masstech.org/what-we-do/what-broadband/broadband-transmission-technologies, visited March 26, 2022.) Fixed wireless requires equipment installed at the customer location. One satellite broadband provider, Starlink, has begun offering service in Concord. Some wireless technologies require a direct line of sight between the transmitter and receiver.

While far-reaching Fiber infrastructure can have many benefits beyond the provision of internet access, it is generally accepted that customers benefit from having competitive internet service providers. In Hamilton County, Tennessee, home of Chattanooga, the municipal electric distribution and broadband company EPB made a massive investment in Fiber beginning in

2010. By 2015, EPB made the "world's first 10 gigabit (10 Gig) internet service...available for access by every home and business in a 600 square mile area." (Source: Ten Years of Fiber Optic and Smart Grid Infrastructure in Hamilton County, Tennessee, Bento J. Lobo, Ph.D., CFA, 2020.) There are at least half a dozen non-municipal internet service providers (ISPs) in the Chattanooga area.

The "Last Mile"

In the telecommunications industry, "last mile" refers to the distance between Fiber in public rights of way and the end user. Achieving Fiber-to-the-home (FTTH) and Fiber-to-the-business (FTTB) can be as simple as running a Fiber cable from a telephone pole to a home or building, or it can be complicated, such as when third parties are involved or when cables are required to be buried underground. Third parties like landlords and condominium associations may not want to incur the expense of providing connections over their private property. In neighborhoods where power and telephone lines are required to be placed underground, Fiber must also be buried. The Task Force has spent a significant amount discussing possible solutions for these challenging situations. Recommendations are summarized in the final section of this Report.

Geographic Analysis

In October 2021, Concord's Geographic Information System staff provided the Task Force with spreadsheets with data for streets (StreetStatus.xls), properties or "parcels" (ParcelStatus.xls), and "addresses" (MATstatus.xls). The address data were the most numerous because there is one entry for each unique address or customer. MATstatus.xls includes both residential and business addresses; further analysis focused on the residential and business sectors is warranted to better understand availability in these subgroups.

- There are 9,000 address points in Concord's GIS system.
- Fiber is "Available" at 6,131 of these.
- "Available" means Fiber is present (overhead or in underground conduit) in streets where customers are located.

The 9000 unique address records in MATstatus.xls were each assigned a "Broadband Status" indicating if Fiber is "Available" at the address. If Fiber is not available, the assigned category describes in general terms why Fiber is not available. The categories and the counts (addresses in each category) are summarized in the table below.

Broadband Status	*Count of Status*	*% of total*
Available	6,131	68%
Fiber in Street but Address Noted as Not Available	1,175	13%
N/A Undeveloped	602	7%

NoAccessFrmConc	368	4%
N/A Open Space	245	3%
Condo Main/SubM	199	2%
Apt Main/SubM	150	2%
No Fiber in Street	130	1%
Grand Total	**9,000**	**100%**

Four categories of addresses can be excluded from an analysis of Fiber service availability because a broadband subscription is not possible: Undeveloped, Open Space, Apartment Main/Submain and Condo Main/Submain. Main/submain refers to the initial fiber connection point of an apartment or condominium, which point has no mailing address. Address points associated with apartment or condominium dwellers, whether residential or commercial, are the important ones for analyzing Fiber availability. (As discussed below, many residents of apartments and condominiums do have access to Fiber.)

The Task Force asked the question: How many addresses could not subscribe to Concord Light Broadband if they wanted it?

> Undeveloped Land and Open Space comprise 847 of the 9000 addresses. Apartment and Condo Mains and Submains comprise another 349 addresses. This leaves 7,804 possible customers. Fiber is available to 6,131 addresses, leaving 1,673 Master Address Table points without access. These are potential customers who cannot subscribe. The problem statement for this Task Force is: why do 1,673 residents lack access to Fiber? GIS data allowed us to analyze these unserved customers geographically (by streets and parcels, see Appendix 4) and by type of dwelling.

A. Streets Analysis

Concord has 135 miles of streets, which are the typical rights of way for electric utilities and Fiber. If there are 100 miles of Fiber, then there are 35 miles of streets without Fiber. Concord's GIS department provided a spreadsheet with relevant data by street ("StreetStatus.xls," attached in Appendix 4). Data included whether Fiber is in the street, how many Parcels and Multi Dwelling Units (MDUs) are located along each street, and the length of the street in feet. Of the 395 streets in Concord, 326 have Fiber (313 complete streets and 13 partial streets). The remaining streets either have no Fiber or it is listed as "In Street but Not Available." While it was beyond this Task Force's scope and resources to research each street to understand why Fiber was considered "Not Available," we were able to get more details on some of them, and also to group them geographically.

By grouping streets without Fiber geographically, we identified 52 distinct areas in town that lack Fiber. This list of 52 geographic groups (streets or combinations of streets) can be used by the Town in planning how and when to place Fiber. These 52 groups comprise 600 multi-dwelling units and 909 total units. Thus, 909 potential Broadband customers, or about half of

the 1,673 unserved customers, are one of these geographic groups. The streets in these 52 groups cover 81,001 feet (15.3 miles). Note that certain streets with few or no homes were excluded from the study area, such as State Highway Route 2 from the Town total of highway miles.

We reviewed a cost estimate for Fiber installation released by the Schools, Health & Libraries Broadband (SHLB) Coalition in February 2018 for Fiber installation in a right-of-way. (This does not include the cost to reach homes (FTTH) or businesses (FTTB)). The nationwide study attributed the Concord area to the Eastern Rural and Metro Area typologies. (Fig 2). New aerial Fiber construction, meaning putting Fiber on overhead poles where there is presently no existing communications attachment to poles or space on the poles, costs about $51,188 per mile. (Table 4: New Aerial Construction Cost) Undergrounding is more expensive, as new underground construction of Fiber was estimated to cost $86,000 per mile. (Table 7: New Underground Construction Cost) According to the SHLB report, "This cost assumes that most construction is directional boring, with a minimal amount of hand-digging if needed to avoid existing utilities. It is an average over a wide range of projects, assuming that some projects near roads or existing utilities will cost more, and that long straight stretches will be cheaper." These costs are significantly lower than estimates that have been voiced at Light Board meetings, which were on the order of $1 million per mile to place electric utility lines underground. Note that the cost of undergrounding Fiber alone is lower than the cost of undergrounding electric utility lines. Taking the higher estimate for undergrounding rather than aerial installation, it would cost $1,315,800, or slightly more than $1 million, to install Fiber in the streets of all of the 52 unserved geographic groups we identified.

There is a long-term benefit to the Town when Fiber is extended, either into new streets or to homes and businesses. Fiber is generally expected to remain functional for thirty to fifty years. If a home or business subscribes to Concord Light Broadband, the Town would receive $16,820 over 20 years for an average subscription of seventy dollars a month.

Relevant Recommendations:

- Costs can be reduced by incurring them at the same time a street or property is being connected to other services, such as electric service or road paving.
- Equipment that allows directional boring or microtrenching can bury Fiber at relatively low cost compared to traditional excavating equipment. The Ditch Witch® company sells directional drills, vibratory plows and other tools to specifically support Fiber installation.
- For residents who wish to move forward with Fiber installation, but find the costs prohibitive, the Town should consider offering financing, or the ability for costs to be paid over time, as is commonly done with expensive sewer construction.

Of the 52 areas where Fiber is not available, some observations could be made:

1. Many of these areas were developed a few years *before* Fiber service began, and the ways were subject to Concord's utility undergrounding bylaw. (See the bylaw in on the Town's web site here; No New Construction of Utility Poles and Overhead Wires

Bylaw (PDF).) Unless conduit was supplied for future utilities during construction, it is not possible to add Fiber service without digging.

2. Many of these areas have densely-developed multi-dwelling units. At the beginning of the Fiber construction project, a decision was made not to enter MDUs, possibly because of the complexity of reaching the subscribers within the buildings. In contrast to a single family home or stand-alone business, where the fiber only needs to get through an exterior wall that might be near a street to serve the customer, MDUs present a variety of configurations where the customer is not always close to the Fiber. For example, Fiber might have to run through a building or an attic, or require splits at an interior wall, before the Broadband subscriber's premises are reached.

   While MDUs are challenging to serve, they also offer great economies of scale. A large number of customers can potentially be connected without additional digging or aerial utility-line work. Concord Greene is one such area, with 3,867 feet of roads and 220 units. If the Town were to make an investment to connect each of these potential customers, and assuming the take rate of 25%, or 55 customers at the average price of $70.00 per month would provide $462,000 in revenue to the Broadband business, over a period of 10 years. Given the traditionally low "churn" rate, or The Task Force has high confidence in these estimates.

3. The Town's roadway paving program could be coordinated with Fiber installation. The Task Force heard from residents of Stacey Circle, where a re-paving project is planned for the near future. The residents suggested that re-paving would be a good opportunity to install Fiber, or at least conduits where Fiber could be laid in the future. The Task Force got in touch with the Roads Program to understand the [coordination or lack thereof] between Town Departments.

The Town has a process for maintaining the roadways based on their condition. This determines when they might need some level of repair or replacement. The Task Force recommends that the Telecommunications Department regularly check in with the Roads Department to understand when work may be planned for certain streets or neighborhoods, and make an effort to coordinate a "dig-once" policy. This process is particularly important for streets that already have underground electric service but lack conduit of space for fiber. These will not be addressed in the foreseeable future without a focus from the Telecommunications side. Several roads are scheduled for reconstruction on the 2022 Roadway that lack fiber. They include; Alford Circle, Ayrshire Lane, Mattison Dr., Old Mill Rd. and Stacey Circle. Once reconstructed, it could be many years before it is feasible to install a fiber system under these areas.

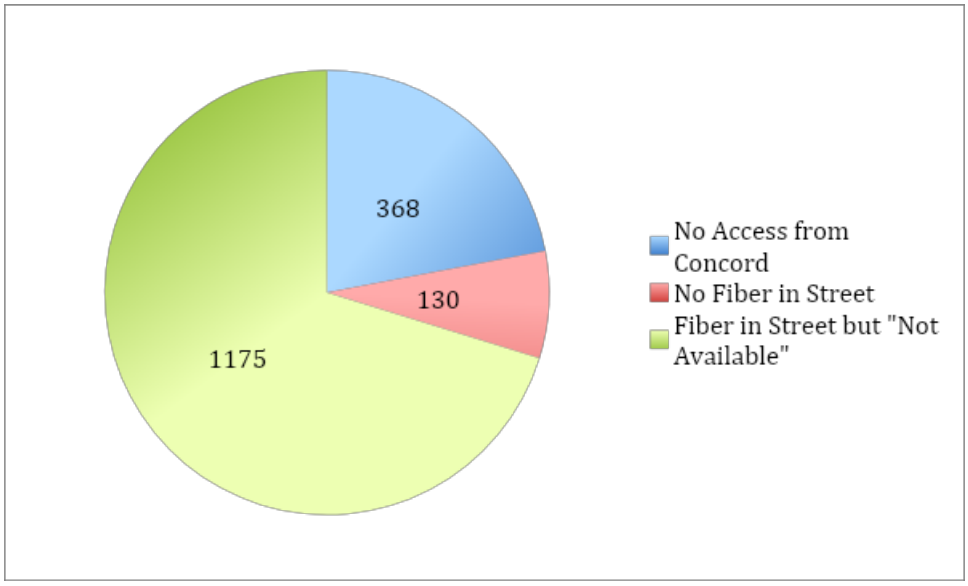
RULES FOR BURYING FIBER –

Concord Light Broadband has published Conduit Requirements regarding installation of fiber optic cable to residences when the electrical service is already underground. The requirements are included in References section of this report. The Fiber must be buried a

minimum depth of 24 inches, and PVC conduit must be 1.5" diameter or larger. Research into the practices of other Fiber network implementations suggests that these requirements may be unnecessarily conservative and expensive. There seem to be more cost-effective alternatives that should be explored for appropriateness in Concord.

B. Addresses without Fiber -

No Access from Concord – 368 (350 of these are Nathan Pratt Drive)
No fiber in Street - 130
Fiber in Street but "Not Available" at 1175 addresses.



Over half of the addresses that lack Fiber access are listed in the Master Address Table spreadsheet as having "Fiber in their street," however, there is some reason that the Fiber is "not available" to connect that address. Two examples are Everett Gardens and Warner Woods (247 Laws Brook Road). Everett Gardens is the Concord Housing Authority's (CHA) senior housing facility at 115 Stow Street. The spreadsheet lists 25 addresses here; the CHA web page says there are 52 units. It would be helpful to do some additional research to better understand why these 1175 addresses are not served, and break down this category into more discrete parts.

The second largest slice of the unserved segment of the pie is addresses with No Access from Concord. Ninety-five percent of these addresses are located on Nathan Pratt Drive, in the apartment complex currently known as The Prescott and formerly known as The Mews. While access from the roadway may be an issue for this property, it happens to abut as CMLP owned parcel with fiber. A unique project to address this particular premise seems possible and given the large number of housing units that are represented by it, more investigation into the feasibility is recommended.

Equity Analysis

A. Affordable/Subsidized Housing and Fiber

The Regional Housing Service Office has a list of the 713 affordable housing units available in Concord: https://www.rhsohousing.org/node/76/housing-inventory
Some locations offer both affordable and market housing, and they are a mix of rentals and owner-occupied dwellings. A sampling of these units suggests that more work needs to be done to make Concord Light Broadband available to affordable housing units.

1. Everett Gardens (34 Everett Street, 52 units) lacks fiber (even though Fiber is in the street)
2. Fairhaven Gardens (Abbot Lane, 42 units) lacks fiber
3. Warner Woods (247 Laws Brook Road, 80 units) lacks fiber

One existing Internet Service Provider (ISP) in Concord, Comcast, offers an inexpensive Internet Essential rate to lower income residents. At the time of this report, it was $9.95/month (https://www.internetessentials.com/). While there may be a perception that wiring affordable units with Fiber is not economically feasible because lower-income residents would obviously choose Comcast, a new subsidy from the Federal Government can help. The Emergency Broadband Benefit program, which began during the COVID-19 pandemic, offered ISPs who apply to the program a subsidy of $30 per month for connecting residents who qualify. That program has been permanently extended with the Affordable Connectivity Program.
A household is eligible for the Affordable Connectivity Program if a member of the household meets at least one of the criteria below:

- Has an income that is at or below 200 percent of the federal poverty guidelines;

- Participates in certain assistance programs, such as SNAP, Medicaid, Federal Public Housing Assistance, SSI, WIC, or Lifeline;
- Participates in tribal specific programs, such as Bureau of Indian Affairs General Assistance, Tribal TANF, or Food Distribution Program on Indian reservations;
- Is approved to receive benefits under the free and reduced-price school lunch program or the school breakfast program, including through the USDA Community Eligibility Provision in the 2019-2020, 2020-2021, or 2021-2022 school year;
- Received a Federal Pell Grant during the current award year; or
- Meets the eligibility criteria for a participating provider's existing low-income program.

Source: https://insidetowers.com/cell-tower-news-affordable-connectivity-program-is-open, visited Jan. 6, 2022.
The subsidy is payable to the ISP, not the resident. Thus, if Concord were to connect affordable housing units to Fiber, the Town could receive a guaranteed $30 per month for each customer.

If all 731 of Concord's affordable units had Fiber access, and assuming all of the residents chose to connect, this would provide $21,930 *per month* to the Fiber enterprise. Over a typical minimum contract period of two years, this translates to $526,320. Another consideration is that market rate units in the affordable inventory of buildings could be charged higher rates, thus providing even more revenue.

B. Multi-Dwelling Units

As mentioned previously, the initial focus of the Fiber network was on easier-to-reach, single family homes and stand-alone businesses. Concord's Broadband web page FAQs reports: "At this time, the fiber is not in place to support existing multi-unit dwellings with more than three residences. Also, there are frequently contracts with other providers that grant exclusive right of conduit inside these buildings that we are not allowed to use. We will be addressing multi-unit dwellings after the initial roll out is complete." According to the MATStatus.xls list of addresses, Concord has 2756 multi-dwelling units, with the inventory distributed as follows:

- 1673 Apartments
  Broadband "Available" at 856 Apartments

  Fiber in Street but Not Available at 380 Apartments
  No fiber in Street at 84 Apartments
  No Access from Concord at 351 Apartments
  Total Apartments without Fiber = 835

- 1040 Condo Units
  Broadband "Available" at 519 "Condo Units"

Fiber in Street but Not Available at 514 "Condo Units"
No Fiber in Street at 7 "Condo Units"
Total Condo Units without Fiber = 521

- 20 Duplexes
  Broadband "Available" at 19 Duplexes
  No Fiber in Street at 1 Duplex

- Biz Leases - 23 total
  Broadband "Available" at 18 Biz Leases
  Fiber in Street but Not Available at 3 Biz Leases
  No Fiber in Street at 2 Biz Leases

  Total: 2756
  Total without Fiber: 1362

About half of the MDUs have Fiber (close to half of all Apartments and half of all Condos). Yet, MDUs make up 81.4% of Concord addresses without access to Fiber (1362/1673). While some apartment buildings with fewer units do not have Fiber, it appears that buildings with a large number of apartments are less likely to have Fiber. The Task Force was not able to cross-check each of these MDUs where Fiber is noted as Available to confirm whether these are indeed just the apartments with three or fewer residences. For the Condos, the largest condo complexes do not have Fiber, including Concord Greene, 100 Keyes Road, 95 Conant. Some of the MDUs with Fiber are one-story units or stand-alone homes in dense "single family" neighborhoods with homeowners associations. Before decisions are made about targeting Fiber installations, a closer look at the actual availability and access to Fiber at MDUs is warranted.

C. Underground Utility Requirements Create Inequity

Many neighborhoods that lack Fiber were developed 15 years or more ago, just prior to the launching of Concord Light Broadband. When these neighborhoods were constructed, conduit was installed for electric power lines underground, but no conduit was made available for Fiber. Sometimes power lines were installed under streets and sidewalks. The result is that installing Fiber, which must be placed underground, involves digging and usually repaving. In contrast to neighborhoods where Fiber can–at much lower cost–be hung on utility poles and attached to the exterior of a building, these neighborhoods are at a major disadvantage. The Task Force recommends that these neighborhoods be identified and closely examined, so that plans (cost estimates, possible schedules) can be developed to connect these neighborhoods to the Fiber network.

According to CMLP history on the Town's web site, in 1966 "the Board agreed to use $40,000 to establish an underground wiring fund and to add to the fund annually, subject to Town Meeting approval. A comprehensive plan for undergrounding the Town, showing areas and priorities in increments of $50,000, was begun in 1968." The Task Force recommends that undergrounding efforts be closely reviewed to see where Fiber installation can be accomplished. As discussed elsewhere in this report, some methods for Fiber installation are orders of

magnitude cheaper than electric utility installation. Another avenue for increasing Fiber installation at relatively low cost is to coordinate it with re-paving efforts.

Fiber was initially installed in streets where customers would be easy to reach. This resulted in certain types of dwellings not being connected:

- Large multi-dwelling units–apartments and condominiums—where the connection from street to customers passes privately-owned common area
- Neighborhoods where utilities must be placed underground

https://www.youtube.com/watch?v=GBRaspRkwaA [link to meeting on 2-20 when this was discussed]

PROBLEM STATEMENT:

1. Why do 1,673 residents lack access to Fiber?
2. There is no defined plan to connect multi-dwelling units and neighborhoods with undergrounded utilities to the Town's Fiber network.
3. Assuming that MDUs are less expensive than single family dwellings, more less expensive housing (81.4% of total) is unserved than expensive housing. This creates an inequitable distribution of Fiber access.
4. There are approximately 15 miles of streets without Fiber. [See Appendix 4]

RECOMMENDATIONS:

With the additional barriers that MDU dwellers face, namely, not having control over common areas, it is much more logistically difficult for MDU dwellers to bring Fiber connections to their homes and businesses.

The inequities faced by MDUs suggests that the Town should have a special focus on ways to include MDUs in Fiber network extensions. Economies of scale make these investments more worthwhile than, say, connecting a single family home down a long driveway.

Neighborhoods with underground utility requirements should be closely examined for opportunities that would allow fiber installation. Re-paving plans should be coordinated with CMLP Telecommunications so that Fiber could be installed during re-paving. Alternative, less costly methods of burying Fiber should also be considered in these locations.

6. Current State of Finances – Telecommunications

Operating Structure:

Telecommunication is operating as a division of the Concord Municipal Light Plant (CMLP). It maintains segregated financial reporting from the electric operations and is not subject to Department of Public Utilities (DPU) regulation. In the FY22 Budget positive net income is projected and a return to normal subscriber growth assumed. There is a modest capital program planned as well.

The primary revenue generating activity of the telecommunication division is providing high-speed Internet services to residential and business subscribers in CMLP's territory. The division does have additional responsibilities as well. They included, support for the CMLP's Advanced Metering Infrastructure, support to municipal IT operations, maintaining the Fiber optic network which is used by Concord Public Schools and maintaining a small number of commercial dark fiber leasing arrangements. Except for the commercial dark fiber leases, these activities are accounted for on a cost recovery of internal cost transfer basis.

A PILOF, Payment in lieu of Franchise, was added to the Telecommunications budget for the first time in FY21. The Town Manager at the time authorized the transfer. It is reported to be in anticipation of a decline the Comcast franchise fee revenue for the Minuteman Media Network operating budget. Minuteman Media Network (MMN) is the current instantiation of the Town's PEG (Public, Educational, Government) access network. This optional expense represents a drag on telecommunication net income.

Historical Performance

Current Concord Broadband Installed Base and Growth

The following table shows the growth over time of Concord Broadband. It should be noted that growth in 2020 and 2021 was adversely affected by Covid-19 and may or may not represent an overall saturation of potential subscribers. The right column calculates the percentage of subscribers relative to the served (cable passing the property) base on the GIS evaluation found in this report (Table 3: 6,131 residences available to existing fiber infrastructure). This value is referred to as the "take rate".

Additional detail information on subscribers and growth can be found in Appendix 1 and 2.

		Residential	Commercial	Total	Growth % Y/Y	% of possible 6,131
2021	September	1,416	109	1,525	3%	25%
2020	December	1,390	94	1,484	5%	24%
2019	December	1,314	99	1,413	14%	23%
2018	December	1,107	129	1,236	22%	20%
2017	December	915	100	1,015	35%	17%
2016				750	67%	12%
2015				450	138%	7%
2014				189	~ %	3%

Table 2: Concord Broadband Subscriber Growth History

Recent Financial Performance

Calendar Year End	Broadband Additional Borrowing	Broadband Loan Service Payment	Broadband Net Loan note 1.	Broadband Revenue	Broadband Expense	Broadband Net Income / Loss	Broadband Annualized Revenue (Dec to Dec)	Broadband Net Position	Connections note 2.	Connections Change
2021 (3)				$1,579,985	$1,211,730	$ 368,255				
2020				$1,262,597	$1,096,838	$ 165,759	$ 1,262,587	$ 83,404	1,484	
2019	$ 338,000	$ 100,000	$ 913,000	$1,175,471	$ 775,618	$ 399,853	$ 1,175,471	$(316,449)	1,556	341
2018		$ 125,000	$ 675,000	$ 963,439	$ 892,280	$ 71,159	$ 957,671	$(358,664)	1,215	225
2017		$ 125,000	$ 800,000	$ 764,996	$ 692,102	$ 72,894	$ 884,138	$(429,823)	990	240
2016	$ 500,000	$ 50,000	$ 925,000	$ 571,690	$ 662,282	$ (90,592)	$ 556,248	$(414,749)	750	300
2015	$ 400,000	$ 25,000	$ 475,000	$ 357,013	$ 451,951	$ (94,938)	$ 353,000	$(374,157)	450	261
2014	$ 100,000		$ 100,000	$ 160,000					189	
2013										

Table 7: Concord Broadband P&L Financial Summary

Note 1: As of this writing the loan profile of concord broadband has yet to be reconciled based on various reports from CMLP.

Note 2: As of this writing exact subscriber numbers has yet to be reconciled based on various reports from CMLP.

Note 3: Data taken from enterprise budget books for respective years (see: https://concordma.gov/244/Budget-Books)

Note 4: Policy#: 2022-02: Nov 13, 2020 - Telecom Enterprise Fund shall transfer from the Electric Enterprise Fund to the Telecom Enterprise fund the amount of $1.9M.

The following table summarizes the Concord Broadband Financial performance over the years 2014 to 2020 with current outlook for 2021 through 2023.

Broadband Multi-Year Financial Plan

Original - Feb 2017

updated April 2022

Line	Description	2015 Actual	2015 Actual	2016 Actual	2017 Actual	2018 Actual / Budget	2019 Actual / Forecas	2020 COVID Actual / Plan	2021 COVID Actual / Plan	2022 Plan / Est.	2023 Plan / Est.
A	Subscribers (Avg Monthly Billed)		450	750	1,015	1,236	1,413	1,484	1,525	1,775	2,075
B	Revenue Per Subscriber		$ 66.11	$ 61.81	$ 61.33	$ 68.50	$ 68.00	$ 59.00	$ 58.00	$ 58.00	$ 57.00
C	Average Monthly Billings		$ 24,561	$ 46,481	$ 62,246	$ 84,666	$ 96,084	$ 87,556	$ 88,450	$ 102,950	$ 118,275
	Operating Margin										
D	Residential & Commerical Revenue		$ 357,005	$ 556,248	$ 746,352	$ 1,015,392	$ 1,153,008	$ 1,050,672	$ 1,061,400	$ 1,235,400	$ 1,419,300
E	Municipal Revenue		$ 63,600	$ 38,500	$ 3,465	$ 5,000	$ 6,000	$ 9,000	$ 9,000	$ 10,000	$ 10,000
F	Total Revenue		$ 420,605	$ 594,748	$ 750,417	$ 1,020,392	$ 1,159,008	$ 1,059,672	$ 1,070,400	$ 1,245,400	$ 1,429,300
G	LESS Operating Expenses		$ 412,000	$ 611,488	$ 664,000	$ 750,000	$ 825,000	$ 900,000	$ 990,000	$ 1,100,000	$ 1,100,000
H	Operating Margin		$ 8,605	$ (16,740)	$ 86,417	$ 270,392	$ 334,008	$ 159,672	$ 80,400	$ 145,400	$ 329,300
	Monthly Averages										
I	Revenue		$ 35,050	$ 49,562	$ 62,535	$ 85,083	$ 96,584	$ 88,306	$ 89,200	$ 103,783	$ 119,108
J	Expenses		$ 34,333	$ 50,957	$ 55,333	$ 62,500	$ 68,750	$ 75,000	$ 82,500	$ 91,667	$ 91,667
	New Installations							COVID	COVID		
K	Net New Installations (Billed)		-	300	265	221	177	71	41	250	300
L	Average Cost of Installation		$ -	$ 2,000	$ 1,800	$ 1,750	$ 1,700	$ 1,500	$ 1,300	$ 1,300	$ 1,300
M	Installation Expenses		$ -	$ 600,000	$ 477,000	$ 386,750	$ 300,900	$ 106,500	$ 53,300	$ 325,000	$ 390,000
N	Margin with Installations (+I-J-M)		$ 8,605	$ (616,740)	$ (390,583)	$ (115,758)	$ 33,108	$ 53,172	$ 27,100	$ (179,600)	$ (60,700)
	Debt										
O	Borrowing per year	$ 100,000	$ 400,000	$ 500,000			$ 338,000	$ -	$ -	$ -	$ -
P	Annual Principal Payments		$ 25,000	$ 25,000	$ 125,000	$ 140,000	$ 190,000	$ 175,000	$ 100,000	$ 75,000	$ 75,000
Q	Cummulative Debt	$ 100,000	$ 500,000	$ 1,000,000	$ 1,000,000	$ 1,000,000	$ 1,338,000	$ 1,338,000	$ 1,338,000	$ 1,338,000	$ 1,338,000
R	Cummulative Repayment		$ 25,000	$ 50,000	$ 175,000	$ 315,000	$ 505,000	$ 680,000	$ 780,000	$ 855,000	$ 930,000
S	Outstanding Debt	$ 100,000	$ 475,000	$ 950,000	$ 825,000	$ 685,000	$ 833,000	$ 658,000	$ 558,000	$ 483,000	$ 408,000

V Capital Value of Broadand Connections (equipment + ONT)
W Capital Value of Broadand Equipment (e.g. Trucks)
X Capital Value of Broadand Business

Table 8: Concord Broadband Financial Model Updated

Successful startup and repayment of startup expense, most of the debt yet to be retired. In 2020 CMLP policy number 2022-02 stated the following.

The table above represents the financials are reported for Broadband service over time. In 2020, as the result of a financial audit. A new policy was put in place that requires the Broadband Service to repay "startup costs" to its parent the electric utility.

This policy reflects a drag on future revenues of the Broadband service. Further study of the long term impact of this expense should be performed.

Policy#: 2022-02: Nov 13, 2020

"The Light Plant shall transfer funds from the Electric Enterprise to the Telecom Enterprise in the amount of $1.9 million. The Telecom Enterprise of the Light Plant shall payback the Electric Enterprise in the amounts prescribed below in the Telecom Startup Loan Payback Schedule. The amounts in the schedule below can be amended based on operating results. If more funds are determined necessary by the Director of the Light Plant, the loan can be increased and the schedule below amended. " Source: CMLP Finance Department

Telecom Startup Loan Payback Schedule	
Year	Amount
2022	$ 75,000
2023	$ 75,000
2024	$ 100,000
2025	$ 100,000
2026	$ 150,000
2027	$ 150,000
2028	$ 200,000
2029	$ 200,000
2030	$ 300,000
2031	$ 300,000
2032	$ 250,000
Total:	**$ 1,900,000**

#Edit Table 9: Concord Broadband Telecom Startup Loan Payback Schedule

Town Meeting approved borrowings:

There have been two town meeting articles to approve borrowing for the Concord Broadband:

Article 48, 2013 Town meeting authorized $1,000,000 borrowing.
Article 24, 2017 Town meeting authorized and additional $1,000,000 borrowing.

Growth Investment Analysis

The initial operating plan for Concord Broadband service was appropriately conservative. There was a focus on keeping costs low and achieving net positive cash flow. Policies related to investments in customer acquisition stressed this faster payback. The experience has been that the subscriber turnover rate, "churn", is low. Customer satisfaction as reported in surveys is high. Very little has been expended on market and sales since the demand for subscriptions consistently outpaced the ability to make connections over the first few years.

Typical customer acquisition costs have been below $1,900 per subscriber. Experience with the customer bases suggests that Concord Broadband could safely expend more to acquire subscribers. The expenses would involved a combination of sales and marketing or direct installation expenses. The lifetime value of a subscription can be estimated based on the annual subscription turn-over rate or "churn". Concord's experience implies a churn rate of less than five percent.

The table below indicates the total revenue based on a $70.00 monthly average revenue per user (ARPU), which is less than Concord's historical average:

Lifetime Subscriber Revenue - based on ARPU=$70.00		
Years	Churn Rate/year	Revenue
5	20%	$ 4,200
10	10%	$ 8,400
20	5%	$ 16,800
33.3	3%	$ 28,000

The least expensive way to drive growth is to increase the take rate through marketing and sales to subscribers occupying premises that are already "passed". There is a natural as yet unknown limit to the market share that will be achieved. After that, expanding to market by completing the Fiber network will increase subscriptions. By relaxing constraints on the cost of acquisition increases in revenue can be achieved.

Churn is expensive, so a focus on customer retention is also appropriate. The pricing policies, fixed rate, that do not adjust upward that are in place can be credited with the high retention rate. Other programs that recognize the value of long-term commitment also be considered in the future if competition or churn appear to be increasing.

Capital Investment Analysis

The return on capital invested to expand the pool of potential of premises served can be calculated using the following model: Incremental revenue will equal the premises passed times the take rate times the ARPU. The return will be the premises passed time the take rate times the Lifetime Subscriber Value.

The Broadband Capital Program outlines a systematic way to make investments over time toward completing the network. The model described above enables the enterprise to plan the financial return on those investments. Details of the Broadband Capital Program are presented in the recommendations section of this report.

External Funding Opportunities:

The Town of Concord has had success attracting grant funding in many areas over the years. Efforts to secure such funding for the Fiber network and Broadband services are not currently active. However, there is a great deal of activity in this space, particularly in the past two years. The Task Force suggests that the Town more actively pursue such funding. Below are a few examples of available resources.

I. Municipal Grants Reference links:

https://www.mass.gov/info-details/community-compact-it-grant-recipients#fiscal-year-2021-

Lists awardees, including those who are using funds to expand their muni fiber optic networks. Sudbury is one such awardee.

https://www.mass.gov/municipal-fiber-grant-program

The grant funding application period is March 15 - April 15, 2022.

II. Dept of Treasury - Capital Projects Fund

https://home.treasury.gov/policy-issues/coronavirus/assistance-for-state-local-and-tribal-governments/capital-projects-fund

The Capital Projects Fund aims to "Enable investments in capital assets designed to address inequities in access to critical services."

Reference article on the Treasury Departments Guidance on municipal broadband: https://www.fiercetelecom.com/regulatory/u-s-treasury-favors-fiber-guidance-for-10b-capital-projects-fund:

“The U.S. government issued guidance detailing how states should use money from a $10 billion Capital Projects Fund created earlier this year and the news is all good for fiber.

Launched as part of the American Rescue Plan Act of 2021, the Capital Projects Fund is designed to help states complete projects “that directly enable work, education and health monitoring. … Though not a competitive grant program, states are required to submit an application and grant plan for the work they want to pursue. Once they have the money in hand, they are then permitted to award funding to local governments, non-profits or private entities such as co-operatives, electric utilities or broadband operators.

The Department of Treasury is set to open its application portal for states on September 24, with funding requests due by December 27. All funds must be expended by December 31, 2026."

The guidelines also urge states to pursue "projects that involve broadband networks owned, operated by or affiliated with local governments, non-profits and co-operatives — providers with less pressure to generate profits and with a commitment to serving entire communities."

III. ARPA Funding

The Town has already received $5.654 Million in direct fiscal recovery funds from the Federal government's American Rescue Plan Act of 2021. It is directed to be spent on infrastructure and similar investments, and must be obligated by 2024 and spent by 2026. Lost Revenue and Broadband Infrastructure are two of the eight named categories of eligible use. The Select Board has begun the process of identifying projects that could potentially receive these funds. In addition to these already-received funds, the Town may apply for more ARPA funding.

Financial Recommendations:

1. Make balanced investment in marketing including additional focus on grouping installations near each other in order to minimize overhead of installations.

2. Consider longer term amortization of customer premises installation capital expenses (e.g. 20 years) in order to increase the amount of expense available to reaching harder to reach customers.

3. Consider bundled solutions for multi-dwelling units or similar. For example an example home owners association of 220 residences with an assumed take rate of 20% (conservative) and allocating $3,500 per paying customer yields a total of $154,000 which might be applied to providing available access to all 220 units.

4. Consider lowering the cost of installation of fiber by using direct buried fiber (see Appendix 3) where the costs are on the order of $1.50 to $2.00 per foot in contrast to buried conduit which cost on the order of $189.00 per foot ($1M/Mile).

5. Plan for a leveling off of the installation rate by complementing direct hired staff with contingent (contractor) workers. Divide the work between inside residence and outside residence with contractor work focused on outside residence.

6. Plan for seasonal variation in the ability to do installations, for example April to March are much more difficult for certain types of installations, plan for this utilizing both planning, grouping of installations and use of contractors.

7. Report with clarity and high fidelity with monthly resolution (report can be performed quarterly) showing for both residential and commercial customers additions and cancellations for both new locations and existing locations (such as when someone moves out and another individual moves in and takes the service.

This report should show exact and accurate total subscribers for each period (month) as well as revenue profile for those customers.

8. Report breakdown of operational costs partitioned by continued support and new installations.

9. Focus growth for locations and residences where fiber is already passing the location, this growth supports additional funding to extend the reach of the Concord Broadband to harder to reach locations.

10. Eliminate the PILOF to provide additional investment capability in the short term. Revisit the rationale for PILOF in the future, if and when, the franchise fee receipts actually decline and support for MMN is needed.

11. Pursue additional sources of fiber expansion funding as available to increase the premises passed while preserving financial security.

7. Service Growth

This section will look at the historical growth of the service. Suggest ways to understand the addressable market. Review what options exist to increase the growth of subscriber base.

History and Analysis of the current approach

Concord Broadband was launched in 2013 and in 2022 serves approximately 1500 or 1600 subscribers, growing at a rate determined by the number of new installations, minus a small number of quits. Residents or businesses wanting to enroll in the service are currently waiting for many weeks as of 2022-01-01. During COVID, the installation backlog grew to over 150, and is reported to now be about 100 requests. With the addition of a fourth technician, the wait is likely to become shorter. Currently, new subscribers can be added as quickly as crews can install new services, recently as many as 30 new subscribers per month, and possibly higher with additional staff.

The steady subscriber growth is creating the financial stability that is a prerequisite for extending the service universally to all who want it. Universal access will create additional revenue opportunities as new neighborhoods and buildings subscribe and add to revenues. Universal access will also create opportunities for "network effects" that specifically arise when all who want the service can get it, with benefits including cost, resilience, security, and redundancy.

Concord Broadband currently prioritizes installations in areas and neighborhoods where it can install services quickly and easily to a maximum number of people or businesses. Prioritizing installations in this way has helped the telecom division provide service across 80% of the streets in the town and to quickly achieve financial stability. *This is a good thing*. However, prioritizing the easiest to reach places also tends to neglect residents of harder to reach areas and of multi-dwelling units, where lower income populations are more likely to reside.

At some point, subscriber growth may require that Concord Broadband find solutions to more difficult installation settings, such as in multiple dwelling units (MDU) or more rural settings with large distances between subscribers. If universal access is to be provided to all residents who want it, including these more difficult locations, it is important to start planning toward that goal now. Unfortunately, not planning to do so effectively excludes those streets and buildings for the foreseeable future.

If the broadband service is to achieve the ability to provide universal service to all who want it, it will eventually need to figure out how to install service in such challenging situations, particularly in the MDUs. This is a long-term challenge and may take several years. Since providing service to these hard-to-reach places and the MDUs will require learning, creative negotiation approaches, process improvements and trial and error, and possible additional funding, it makes sense to start acquiring such knowhow sooner rather than later, so that lessons learned can be developed and improved upon continually, rather than in a rush at the end and potential eventual abandonment of universal access as a goal. It may be possible to implement a mix of easy and hard projects along parallel tracks, so that the more challenging ones do not block progress in other areas, or unduly impact the financial status of the division.

Capacity for growth – Computation of the opportunity

Some Concord residents may ultimately prefer to use Comcast for their broadband, cable television, phone, mobile and security services. This proportion of residents represent an upper limit on the number of people who are likely to subscribe to Concord Broadband. Other towns with competitive municipal broadband service have experienced various take rates. It may be useful for Concord to estimate the expected take rate, and track subscriptions relative to that expected limit. It may be possible to design surveys or other means to estimate limits on the take rate.

About 52 streets and groups of streets currently do not have access to Concord Broadband service, and this lack of access poses an upper limit on the capacity for growth, unless ways are found to extend coverage to these unserved streets and MDUs. For argument, suppose the upper limit of the take rate is about a third of all residents. With 2010 census data indicating 6500 total households in Concord, this take rate suggests 2166 potential subscribers. This potential number is reduced by the inaccessibility of service, perhaps by 20%, to about 1733. This number is higher than the current subscriber count and suggests that there continues to be room for subscriptions to grow. Estimated take rate and percentage unserved.

Appendix Census Data for Concord.

Provides insight to possible customer base and number of homes.

US Census 2010 results (key metrics for study)	Source: U.S. Census Bureau, 2010 Census.
http://factfinder2.census.gov/	
SEX AND AGE	**Quantity**	**Per Cent %**
Total population	17,726	100
In group quarters	1,698	9.6
Institutionalized population	1,672	9.4
HOUSEHOLDS BY TYPE		
Total households	6,500	100
Family households (families) [7]	4,505	69.3
With own children under 18 years	2,082	32
Average household size	2.47	N/A
Average family size [7]	3.02	N/A
HOUSING OCCUPANCY		
Total housing units	6,964	100
Occupied housing units	6,500	93.3
Vacant housing units	464	6.7
For rent	155	2.2
Rented, not occupied	18	0.3
For sale only	47	0.7
Sold, not occupied	23	0.3
For seasonal, recreational, or occasional use	97	1.4
All other vacants	124	1.8
Homeowner vacancy rate (percent) [8]	0.9	N/A
Rental vacancy rate (percent) [9]	9.3	N/A
HOUSING TENURE		
Occupied housing units	6,500	100
Owner-occupied housing units	5,002	77
Population in owner-occupied housing units	13,270	N/A
Average household size of owner-occupied units	2.65	N/A
Renter-occupied housing units	1,498	23
Population in renter-occupied housing units	2,758	N/A
Average household size of renter-occupied units	1.84	N/A

i. Realization of growth – potential programs and approaches

The phrase "Flywheel of Growth" conveys the simple idea that as the number of subscribers increase, Concord Broadband will experience higher revenues which then can support higher levels of spending to sustain growth. For instance, now that Concord Broadband is larger and financially stable, it can support a fourth technician. that a more robust subscription revenue stream can drive growth.

ii. What sorts of programs could be put in place?

The "Flywheel of Growth" may drive growth by making it possible to provide additional services or programs such as the following:

- Bringing service to currently underserved populations, such as low income or MDU settings
- Adding differentiated services, such as redundant internet access
- Providing commercial customers with leased line services.
- Barriers to Subscription Growth

Factors inhibiting adoption of service by potential customers may include:

- Potential customers lack knowledge of the offerings
- Competitive cost or value of the offerings
- Inhibitors to Installation (other than there being no fiber in the street).
- Impacts of underground by law – individual subscribers must pay for conduit installation. This can be expensive and complex to do. – CMLP could consider providing assistance that is similar to programs and assistance offered for EV chargers, solar panels, home energy renovations (e.g., Green-Your-Heat) and heat pumps.
- Challenges involving access, cost and governance issues at apartments, condominiums, and Multi-Dweller Units (MDUs)

Metrics in this area will include take rates, subscriber levels, new installations performed, cycle times associated with installations, reason for cancellation or incomplete orders, percentage of successfully completed orders.

8. Recommendations

This section will provide recommendations for approaches to establish and accomplish objectives related to fiber completion. The resulting roadmap should suggest a long-term approach to achieving results over time. (Specific and ancillary recommendations).

A. Policies

The Task Force recommends that specific policy objectives be established with respect to Universal Access to the Fiber Network. Closely related to this concept is the decision about the specific territory for Concord's operations and expectation of involvement with other initiatives. All three of these policy areas are in the domain of the citizen owners of the municipal light plant to determine. The Task Force encourages a public dialog and integration of these questions into the long range planning process for the Town.

i. Universal Access:

It shall be the policy objective of CMLP to provide the opportunity to receive telecommunication services to every premise that is also served by the electric service. This recognizes that the Fiber network is a community asset and that there is a commitment to equalize access to the asset for all residents and businesses with the Town.

1. The goal may have been expressed by Article 41 from 2021 Town Meeting.
2. However, further clarification and another authorization should be sought, because the Town Meeting action was not sufficient explicit about to this goal.
3. The Task Force recognizes that universal access makes financial sense and addresses digital equity. It can be justified on economic reason alone.

ii. Expansion outside the 2022 service territory:

While CMLP can potentially expand the fiber network outside the electric service territory. There may be valid public service or economic goals that support such an investment.
The Task Force recommends that:

1. A process for evaluating such opportunities should be defined.
2. A strategic business plan for telecommunication be updated periodically, at least every five years. It should consider expansion among other options in light of the business fundamentals and long-range goals.
3. The Task Force does not recommend considering expansion of the service territory until a more rigorous assessment of the business opportunity and sustainability is completed for the current territory.
4. Consider removing all together or subjugate to general planning.
5. Potentially this is outside the scope all together.

iii. Support for Economic Vitality, Sustainability, Equity, and Inclusion

1. Additional benefits will accrue from successfully accomplishing the primary mission of universal access, fiber everywhere.

2. Establish specific program linkages to Human Services and other programs within the Town's mission, Some examples:
    a. *Affordable Housing – Task Force Recommends that fiber is connected all Town owned affordable units as they are built. This would enable an Internet essentials like program to be offered to those residents*
    b. *Sustainability –Task Force recommends follow up to establish strategic plan integrations. (linkage to AMI Advanced Metering Infrastructure project for example).*
    c. *Public Safety – Communications Network – continue to support and explore options to expanse fiber use to improve resilience, climate mitigation and other.*
    d. *Education – Explore School to residents – expand on the support the fiber provides to school buildings to include options to connect students directly to schools.*
    e. *Economic support for the businesses in Concord*
        i. Fiber access in the Town centers can be challenging. Investment in fiber will support the vitality of the Town centers.
        ii. Professional offices in Concord have been among the early successes. Additional marketing and support should lead to more adoption.
    f. *Government access (PEG)*
        i. The Task Force notes that beginning in 2021 a Payment in Lieu of Franchise (PILOF) has been included in the Broadband budget. This payment supports PEG access. It's origin and parameters are not clearly established by citizen governance bodies. The Task Force recommends this be eliminated. If it is not, a rationale for this cross-subsidy should be clearly documented and adopted.

B. Recommended Metrics for tracking.

The Task Force recommends that the follow metrics be established and tracked for the Fiber network and the Broadband service. The Light Board is the logical place for this reporting to take place.

1. Parcels Served
    a. *Defined as the count of Residential and Business Parcels with fiber access as documented in the Town's GIS.*
        i. Currently 6131 MAT (Master Address Table) entries are served, as denoted by a Broadband Status of 'Available'
        ii. Task Force recommends a standardized published definition and regular reporting process for parcels served.

2. Premises Served - Served rate

   a. *Defined as the Number of Master Address Table (MAT) entries listed as 'Available' divided by total MAT Entries excluding entries of open space and undeveloped parcels.*
      i. Refinement of the denominator is needed.
      ii. For example, the 349 "Apt Main" and "Condo Main" entries, may just represent groups of other entries. Should they be counted?
      iii. Currently 6131/8023 or 76.4% (1902 unserved, 23.6%)
      iv. Task Force recommends standardized published definition and regular reporting process.
      v. The Task Force suggests that a survey of a statistically valid subset of the 1902 unserved premises to determine their likelihood of subscribing in order to estimate the take rate of this subset. It should be noted that these premises may in fact represent a different market compared to those that are served. Primarily because the group is dominated by multi-dwelling units and smaller properties compared to the premises which are already served.
3. Road Miles served
   a. *Sum of road miles with fiber divided by total road miles*
      i. Task Force recommends standardized published definition and regular reporting process.
      ii. Integrated planning with the Town's road program will result in cost effective extensions of the network.
4. Subscribers
   a. *Monthly billed subscriptions as reported in the billing system.*
      i. Subscriber growth should be reported as net of installations and cancellations.
      ii. The Task Force recommends monthly internal reporting and inclusion in Light Board packet.

5. Take rate:

   Defined as subscribers/Premises Served

   a. *This is a metric for internet service providers used industry wide. It is a measure of the efficiency of the capital investment in fiber constructions since it denotes the number of actual customers compared to the number of customers that the service is currently able to serve. Higher take rate is typically correlated with better business return on investment. Take rate can reasonably be thought of as market share.*
      i. As of November 2021, 25.3% (1552/6131)
      ii. The task force recommends that the strategic business plan for the telecommunications business establish a maximum take rate assumption and use this expectation for planning marketing and capital construction expenses to ensure that there is business justification for

investment as well as forecasted return on investment that can be assessed and refined.

iii. The difference between the current take rate and the assumed maximum represents that growth opportunity for any given service. It is important to recognize and address these potential limits within the tactical and strategic business plans.

iv. Take rate should be tracked over time and reported to the Light Board at least annually.

v. The Task Force suggests a survey of a statistically valid subset of the 6131 served premises to determine their likelihood of subscribing to estimate the maximum take rate.

6. Churn:

Subscription cancellations as a percentage of total

a. This is an industry metric that tends to indicate the customer loyalty and stability of the expected revenue stream.

i. Calculated as the count of subscriptions that are terminated in a given time period divided by total subscriptions for the same period.

ii. Analyzing churn can provide insight to customer satisfaction and customer value. Understanding customer value can help to guide the level of investment to be made in marketing and installation expense by helping to establish a return on investment period.

7. Installations

New connections to the fiber network of customer end points.

i. Currently installations are frequently represented by new subscriptions in the billing system. However, there is a subtle difference that is important to delineate for the purpose of fiber completion. It involves the difference between reconnections of previously installed premises and a first-time installation of fiber service at a premise.

ii. The Task Force recommends that:

1. Installations should be reported as new connections to the fiber plant.
2. Re-connections should be tracked separately. As either re-subscriptions (previously cancelled returns) or transfers (new customer at a previously served premise.
3. The distinction between these cases represents the underlying growth of the service and is reflected in the take rate.
4. Abandoned connections – are valuable, proactive attempts to connect new subscribers to existing drops should be prioritized.

C. Governance

The Task Force advises that the Light Board, with the assistance of the Select Board and the Finance Committee ensure that the policies outlined are adopted as operational goals by Town staff.

1. Track progress against completion of the fiber network:
   a. *Who: Telecom Staff (Responsible), Light Board (Informed),*
   b. *What: Premises served vs. Total Premises*
   c. *Target: 100% of premises served is Universal Access*
   d. *Frequency: quarterly and annually.*

2. Rate of Return Policy
   How might that guide investments in fiber construction?
   a. *A target rate established by agreement of the citizen boards would establish a way to evaluate the execution instead of just letting it float.*
   b. *Compare to the return rate objectives (requirements) of other enterprises, Electric, Water, Sewer or other.*

3. What are the financial goals for the broadband business? How are the goals established?
   a. *The business needs to sustain itself financially and operationally*
   b. *The Town may conclude that broadband should support other goals or needs, such as PEG (Public, Educational, Government) access. Also known as Minuteman Media Network.*

4. Policy for retained earnings and operating reserve.
   a. *See Business return below*

D. Process for setting Strategic Planning Goals

As a relatively new enterprise activity with unique elements of competition and financial positioning, it is important to continue to review the progress and refine the goals for the Telecommunications Business. The Task Force notes that this is very different industry from others in which the Town currently operates. There is substantial success in municipal broadband. But there are also projects which have struggled. The difference is typically the level of planning and recognition of the unique conditions and skills. Clear goal setting is necessary. We recommend that the following goals be set, tracked and revised at least every five years.

i. Marketing and Growth

1. Subscribers
   a. *Market study to establish the total opportunity represented by the served territory.*

b. Annual target for subscriber growth based on installation process capability

2. Premises Served
   a. Periodically the service territory coverage should be reviewed – every 5 years
   b. In-fill – ensure that all areas within the service territory are actually served.
   c. Expansion – Look at what opportunities for extend the service territory through partnership, intermunicipal agreements, or fiber construction

3. Services Offered
   a. Periodically review the service offerings, at least every 5 years
   b. Current Offerings:
      i. Residential Internet with optional routing & managed Wi-Fi
      ii. Small Business Internet with optional routing and managed Wi-Fi
      iii. Private Virtual Networks
      iv. Dark Fiber Leasing
   c. Discuss or investigate future or additional offerings.
      i. Security services
      ii. Redundant (High availability) dual connection
      iii. Wired meter services.
      iv. Local virtual networks
   d. Competitive and adjacent Offerings Review
      i. Wireless Internet
      ii. Wireless Tower backhaul
      iii. Voice
      iv. Video

ii. Business return

1. Establish an allocation policy based on the level of the return – Below is a strawman allocation approach for discussion:
   a. Any 0-5% return is directed to Operating Reserves (Up to a target level of reserves, establish by Policy)
   b. Returns >5-10% directed toward Marketing and Subscriber Growth
   c. Returns >10% Capital Expansion – Fiber Construction
   d. Returns in excess of 15% are considered for return to subscribers
2. Business Model Analysis to ensure adequate reserves for
   a. Depreciation and Maintenance
   b. Catastrophic events

E. Budgeting Process – for fiber expansion

The Task Force observes that the current budget will not achieve universal access in the foreseeable future. Expanding to fill in the Town's unserved areas will require establishing an ongoing capital plan. Resources to jump-start this could come from ARPA recovery funds or other sources. Resuming a growth rate such as was seen between 2016 and 2019 should provide sufficient resources to make progress assuming that unnecessary drags on the finances of Broadband can be removed.

i. Status Quo operation is unlikely to achieve universal access
ii. Expand to fill existing opportunities in the unserved areas creates additional resources
iii. Resume Growth of the business should fund expansion if drags are removed.
iv. What external sources of funds that could be accessed fiber expansion project?
    1. ARAP Funds
    2. Infrastructure Bill Funding

F. Capital Planning Process

i. Process for quantifying the cost of expanding the fiber network
    1. Develop a pro-forma cost model for construction planning (See Broadband Capital Planning below)
ii. Mechanisms are available to pay for expansion
iii. Revise/Refine methods for computing return on investment

G. Construction and Logistics:

Task force recommends that less expensive construction techniques be allowed in order to facilitate completion more quickly and at a lower cost.

i. Vibratory Plow – direct buried fiber cables
    1. Reference Mason Public Utility process.
    2. Could be delivered via a third party or in-house resources.
    3. Financing for customers could also be offered

H. Additional follow-on work

i. Anything out of scope of Article 41 that the Task Force wishes to identify as needed.
ii. Anything that Article 41 required that could not be accomplished within the available timeframe.

Request for ARPA reimbursement of lost Broadband Revenue

The Covid-19 pandemic has curtailed broadband operation during the period of March 2020 through March 2022. The specific impact on broadband revenue can be estimated by examining the number of subscribers and comparing the 24 months since March 2020 to the previous years.

The Fiber Broadband Completion Task Force has modeled this loss of revenue and respectfully requests that Town Manager consider including this in the request for allocation of ARPA recovery funds based on loss of revenue due to the pandemic. In March 2020 Covid-19 policies were put in place to protect town staff and customers which suspend installations except in special situations. That policy was in place for over a year.

The Broadband service is a relatively new enterprise activity and has enjoyed steady growth since it was started in 2014. Generally, it is acknowledged that the rate of new service additions has been constrained by the staff availability and external factors such as seasonal weather conditions. In the three-year period of 2017 to 2019, net new subscriptions were 188, 221 and 177 respectively, for an average of 195. In 2020 subscriptions grew by 71 and in 2021 just 80 through January of 2022. Using the average growth of subscriptions or the 2019 rate of subscriber growth as a guide it is estimated that there would have been between 239 and 283 more subscribers on the system by January of 2022 than are actually connected.

Based on historical average subscriber revenue of $70 per month. The revenue loss for resulting from the pandemic disruption is between $240,000 and $271,500 over two years. This is computed by assuming 18 months of average revenue for missing 2020 subscriptions and six months of 2021 lost subscriptions plus the one-time installation free for the missed subscriptions. It should be noted that the gap of 240 fewer subscriptions in March 2022 has an ongoing revenue impact of $16,800 per month.

The impact of this reduction will continue for an unknown time into the future because it is unclear when or if the system will make up those missed opportunities. However for the purpose of seeking relief from the immediate impact of pandemic reductions, the Task Force suggests that using the past two years is prudent as it is unknown if there might be a rebound in new connections 2022.

Broadband has a relatively small fund balance. The net position was $249,163 at the end of 2020 and is estimated to be $434,101 at the end of 2021. Should broadband receive

$240,000 of ARPA revenue loss relief it would enable significantly more resources to be available to support further recovery through marketing. Also, in early 2022, materials and supplies, particularly fiber optic cable are supply constrained and it is reasonable to assume that unusually high costs are likely. These funds could help shield the enterprise from that impact.

Multi-Dwelling Units and Third-Party Last Mile Enablement

The challenge that CMLP Broadband faces with Multi-Dwelling Units has a number of issues:

Unlike single family homes there are many decision makers as to whether Broadband will be wired to these type of communities:

a) Residents
b) HOA Boards
c) Landlords

Where there is ownership of condos in MDUs and a managing HOA Board, resident demand for fiber optic has to be significant enough for the HOA Board to consider the expense of trenching to each building or unit. These expenses are not insignificant and can run into the hundreds of thousands of dollars. The HOA Board has to determine if this expense, like all they consider, will benefit the majority of residents or just a small minority. Using a specific example, Concord Greene residents were surveyed about their opinions to spend over $100,000 in trenching to install CMLP Broadband in the community. Seventy percent of the votes were against this expense and the HOA Board took no action. It seems fair to assume that as long as trenching costs are not absorbed by CMLP, that most HOA Boards will not approve the installation of CMLP Broadband in their communities.

In other MDUs throughout Concord, where trenching is also an issue and may be significant, but where Broadband is not yet available, the question again is are the residents and the HOA Board willing to absorb this cost? Milldam Square with 58 units at 100 Keyes Road is an example.

CMLP has to consider the value of absorbing the trenching costs against the long term payment of customer acquisition. At $79.99 a month for Broadband service for 10 years, one customer will generate $9598.80. With MDUs the multiplier effect with a significant number of households would be much more income for CMLP in dollars to offset trenching costs.

Landlords

Generally landlords fall into the following categories:

1) Their buildings have been wired for Broadband and they offer the service to their residents at the CMLP published rates or as a part of the rental agreement.
2) Their buildings are not wired for Broadband and the owner has no interest in having the building wired.
3) Broadband is not available at the building location
4) The building is wired for Broadband but the owner has not informed the renters and/or CMLP has not provided marketing material to the building owner or occupants

Broadband Capital Program

Once there is an agreed upon goal for the construction of fiber to the premises within the service territory. It will be necessary to determine exactly how to make progress toward the goal. This section defines steps to accomplish the planning needed to initiate such a program.

The task force recognizes that the Telecommunications Enterprise will have other capital project beyond fiber construction. It is understood that these projects will need to be prioritized at times and may impact the available resources for fiber construction. This section is an outline for how to establish the fiber construction portion of the plan understanding that it will later be integrated with the overall program.

Review the unserved areas, enumerate, and categorize them. This builds on the groups that have been created by the Task Force as a first pass to enable the creation of a Broadband Capital program plan. The result of this step is a list of potential capital projects. It is useful to tag each project with specific planning parameters that will later be used to select and order them.

Develop a high-level method to create rough order of magnitude cost and schedule estimates for planning purposes for each identified capital project scope. Recognizing that projects may be added, combined, or broken down in the future as appropriate based on external factors such as coordination with other capital programs. The result of this step is simple a list of projects which each have a rough order of magnitude cost.

Engage in a strategic planning process that is informed by the program scope to determine a target annual funding. Use a roll up of the high-level estimates to quantify the cost the entire program. Equipped with that information a program budget and roadmap to accomplish the fiber construction goal can be set by the strategic planning process.

At this stage in the process, it will be useful to discuss options such as large capital projects, outside or in-house construction options, and multi-year vs single year project budgeting. Due to the nature of outside plant construction, there could be a wide variety in appropriate solutions.

Funding sources and target allocation of revenue should be established as part of the strategic planning process. Parameters impacting the ability to make these investments and decision rights regarding the prioritization of competing needs should be articulated

in terms of policies and goals. The Task Force recommends that the Light Board be empowered to take decision with the advice of the finance committee.

If certain specific projects or elements of the capital program exceed resource that are likely to be able to be available through an annual capital investment program. Identify them and engage in the Town's large-scale capital project planning process or other appropriate process to define the project and articulate the criteria which could be used to determine when or each project could be done.

The strategic planning process should articulate a desired timeframe to achieve the end state. Best practice would suggest that the division staff as part of an annual process update a 5 to 10 year plan that can is used to coordinate with other capital projects on a town-wide basis. This is consistent with the Town's road program and other ongoing construction and maintenance of infrastructure.

The choice to set up a specific revolving fund for fiber construction versus a target allocation from the enterprise capital budget should be discussed at the Light Board level. It depends on the degree to which accountability to achieve the construction goals are prioritized against flexibility to use capital funds for other enterprise priorities. Another consideration could be related to any expectation that funding sources other than telecommunication revenue might be directed toward this purpose.

9. Members of the Fiber Broadband Completion Task Force

- Gordon Brockway is a member of the Concord Municipal Light Plant Light Board with a background is in electrical engineering and business management.

- David Hesel is the member representing homeowners association (HOAs), as a resident of Concord Greene. He previously operated the Toy Shop.

- Gail Hire is large member with a background in environmental and mechanical engineering and law.

- Scott Hopkinson is a member of the PEG Access Advisory Committee. Scott wrote an early plan for Concord Broadband.

- Mark Howell is an at-large member. He worked at IBM for 32 years in telecommunications. He was Concord's Chief Information Officer for eight and a half years. He managed the start-up of the Town's Broadband service from 2013 to 2019, which involved studying other municipalities with community-based FTTH to create the business plan.

10. Reference Links and Materials

Task Force Web Page: https://concordma.gov/2958/Fiber-Broadband-Completion-Task-Force

Objectives Document: Focus Area Defintions (9/30/21 version)

GIS Data Analysis – Preliminary map link:
https://www.arcgis.com/home/webmap/viewer.html?webmap=33ab6e1bd086442994735c945614ae10&extent=-71.4463,42.4187,-71.2517,42.5013

Broadband Availability Map: Broadband Available ArcGIS Online tools from Concord Broadband to check for known availability.

Telecommunication Financials:

Enterprise Budget Books: https://concordma.gov/253/Enterprise-Fund-Budgets
FY23 Enterprise Budget Book (Telecom starts on page 40):
https://concordma.gov/DocumentCenter/View/35609/FY23-Enterprise-Budget-Book
FY22 CMLP Operating Forecast (Telecom starts on page 97):
https://concordma.gov/DocumentCenter/View/34364/2022-CMLP-Forecast---Final-Public
FY22 Enterprise Budget Book: Telecom on p.38 and following.
https://concordma.gov/DocumentCenter/View/29426/FY22-Enterprise-Budget-Book
2021 Telecommunication Budget:
July 2021 Telecomm Financial report:
2018 Enterprise Budget Hearing: Article 47 - Light Plant Expenditures and PILOT PH Pres 03-12-18

Underground Bylaw No New Construction of Utility Poles and Overhead Wires Bylaw (PDF) from Town Bylaws Page: Town Bylaws

Concord Light Broadband Conduit Requirements

The following summary explains the CMLP Policy regarding the installation of fiber optic cable to residences when the electrical service is already underground. This is designed to help ensure that a reliable service is safely installed.

1. Fiber is being installed in compliance with the Town's Under Ground By-law. The effect of this policy is to require that if a customer's electrical service is already underground, then the fiber must also be installed underground.

2. Fiber optic cable must be installed in a separate, dedicated conduit from all other utilities. This avoids potential damage to both the fiber and the other services.

3. If an underground customer does not have an available conduit that is appropriate for the installation of the fiber optic cable it is the customer's responsibility to pay for the installation of conduit. Customers are free to hire a private contractor and proceed to the next step. Once appropriate conduit is installed, CMLP will install fiber and connect the Internet service.

4. The following are guidelines for installing conduit for fiber optic cable:

   Search for a contractor: CMLP cannot recommend specific contractors. However a search on Google for "underground conduit installation in Concord MA" should yield results for a local construction, landscape, or electrical contractor that can provide the service.

   Obtain quotes: We recommend obtaining at least three competitive quotes to facilitate comparisons.

-Plan the installation-

- Once a contractor has been selected, contact CMLP Engineering at 978-318-3116 to coordinate the best conduit route.

- Typically 1.5" electrical PVC conduit is sufficient for fiber optic cable but larger sizes are acceptable.

- Minimum 24" depth for conduit.

- The customer should ensure that the contractor installs a pull cord to facilitate easy fiber installation.

- More than four 90 degree directional changes will require installation of a hand-hold.

- REMEMBER: Dig Safe (http://www.digsafe.com/ or Dial 811) notification is required PRIOR to any underground conduit installation!--

Appendix 1: Monthly Installations of Concord Broadband: 2017 to 2021

This information was provided based on inquiry of the broadband services.

		Residential	Commercial	Total	Y/Y Growth
2021	September	1416	109	1525	3%
	August	1410	105	1515	
	July	1403	102	1505	
	June	1413	104	1517	
	May	1413	97	1510	
	April	1398	95	1493	
	March	1395	96	1491	
	February	1392	96	1488	
	January	1393	95	1488	
2020	December	1390	94	1484	5%
	November	1385	94	1479	
	October	1376	95	1471	
	September	1365	95	1460	
	August	1363	96	1459	
	July	1354	96	1450	
	June	1343	98	1441	
	May	1335	101	1436	
	April	1334	101	1435	
	March	1331	102	1433	
	February	1334	101	1435	
	January	1322	97	1419	
2019	December	1314	99	1413	14%
	November	1312	98	1410	
	October	1302	100	1402	
	September	1273	102	1375	
	August	1259	103	1362	
	July	1242	105	1347	
	June	1223	104	1327	
	May	1241	105	1346	
	April	1193	106	1299	
	March	1177	107	1284	
	February	1167	105	1272	
	January	1139	108	1247	

		Residential	Commercial	Total	Y/Y Growth
2018	December	1107	129	1236	22%
	November	1092	128	1220	
	October	1086	123	1209	
	September	1067	121	1188	
	August	1039	118	1157	
	July	1025	116	1141	
	June	1017	115	1132	
	May	1000	113	1113	
	April	962	112	1074	
	March	949	110	1059	
	February	937	105	1042	
	January	926	101	1027	
2017	December	915	100	1015	30%
	November	891	97	988	
	October	880	96	976	
	September	863	93	956	
	August	848	91	939	
	July	806	89	895	
	June			0	
	May	761	88	849	
	April	739	87	826	
	March	722	86	808	
	February	705	82	787	
	January	701	80	781	

Appendix 2: Yearly Installations of Concord Broadband 2013 to 2021

This information was extracted from each yearly CMLP financial report posted on the town web site.

As of this writing, the totals have not been reconciled with other data provided by Concord Broadband.

Year	Total	Y/Y Growth
2020	1,484	-5%
2019	1,556	28%
2018	1,215	23%
2017	990	32%
2016	750	67%
2015	450	138%
2014	189	N/A

Appendix 3: Learning and insights from Other Municipalities Broadband Business:

Washington State PUD March 30, 2022
MASON COUNTY Public Utility District No. 3 Shelton, Mason County, Washington
Mason Public Utility District - Broadband Service Shelton, WA 98584

Summary: After a public records request for broadband financial statements and included request to collaborate on experience and insights a call was set up on March30 between Mr. Hopkinson and Kristin French Information Governance & Contracts Manager to discuss the request. When Mr. Hopkinson appeared via team meeting web meeting the following individuals from Mason County Washington were on the call:

Justin Holzgrove, Director of Engineering & Utility Services;
Mike Rientjes, Telecommunications Manager;
Terri Oberg, Telecommunications Services Coordinator;
Sherry Speaks, Finance Manager;
Kristin French Information Governance & Contracts Manager

Although Mason County folks could not accommodate the possibility of recording the call the following notes were captured from the approximately 30 minute conversation. Previous to the call Mr. Hopkinson had reviewed the web sites and information for Mason County and the Mason County folks had been provided links to the Concord MA broadband web site.

Introductions were provided by all the individuals on the call.

Scott provided a overview of the Concord MA broadband activity and explained that Concord was undertaking the evaluation of growth after operating the broadband for a number of years. Mason County had come to our attention first due to the use of the direct burry fiber cable (vibratory plow) and other aspects of the web site.

Justin Holzgrove provided a summary overview of Mason County's broadband system.
He complemented Concord on the live GIS broadband access map on our web page.
(note: this video describes the PUD network:
https://www.youtube.com/watch?v=9hWUrFVjkJQ)
White Space Wireless – un-used TV frequency is discussed.

Summary of Discussion the Mason County system:

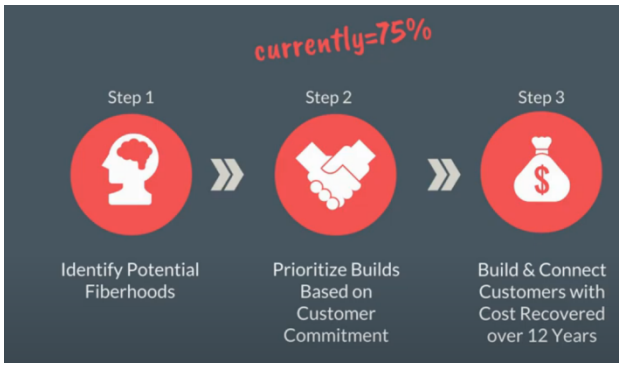
1) Most of the customers for Mason County are rural and economically depressed.
2) Many of the customers have few alternatives as neither Comcast nor Verizon FIOS service this area.
3) Broadband service can be connected either using overhead (poles) or underground.
    a. (there is no underground mandate as there is in Concord).
4) Broadband connections to end users averages $3,800 per user and is typically amortized over 12 plus years.
5) Washing State inhibits acting as a commercial entity.
6) Mason PUD3 leverages both loans and grants to build a financial basis for installing
    a. (see 2021 Mason County PUD3 financial report and discussion of broadband finances)
7) Mason County PUD3 creates "fiber hoods" to fund installations (see details below)
8) Program was initially started in 2000 however the growth programs were launched in 2017.
9) Construction Pipeline: Current backlog is 18-24 months out for lead. Currently 500-600 installs per year.
10) Fiber is brought to the outside of the house with an external ONT with Ethernet connections internally.
11) Currently subscribed 3,000 , 75% of these are in last 5 years
12) Staffing is currently 15 full time equivalent (see details below).
13) Financial Accounting: As PUD3 only provides lit fiber to ISP and charges them for the infrastructure the PUD3 has folded the service and staffing within their utility service. As such there is no separate accounting of the broadband business as in Concord MA.
14) Mason County PUD3 participates in a regional municipal non-profit for sharing ideas, insights and best practices: Northwest Open Access Network, Inc. The District, along with nine other Washington State public utility districts and EN, is a member of Northwest Open Access Network (NoaNet), a Washington nonprofit mutual corporation. NoaNet was incorporated in February 2000 to provide a broadband communications backbone over public.
15) Mason County Team interviewed strongly recommended that Concord MA Fiber Completion Task Force reach out to
16) Fiber optic cable used: durra line 18 x 14 mm micro conduit with locate wire .
17) Vibratory Plow Used: Ditch Witch 410 SX note: Vibratory Plow Depth setting: 18 inch depth
18) Muti-tenant buildings are often addressed with a local cabinet powered by 110VAC and ONT termination to an Ethernet switch that in turn services the tenants. Typical uplink for these installations is 10Gbit/Sec .
19) Financial information and reports can be found at: (significant details on funding, grants and matching can be found in these reports and should be considered by Concord MA Broadband).
    https://www.pud3.org/service/about-us/documents-archive

Fiber hood details:

Fiber hood – only fiber hood customers $25 per month
Passed form ISP to be applied for future installations
Fiber hood – amortization over 12 years to recover cost.
Fiber hood: easy to reach – proximity to PUD3
Underserved or unnerved
Underserved = federal definition of broadband
COS Software used to judge commitment levels.
Fiber to the curb vs. fiber to the house.
Advanced PUD equipment – vibratory plow.
Price for service (ISP) and cost adder of 12 years at $25 per month.
1G rate is $35 per month + $25 for construction adder.
Charge to retailer is then $60 per month

https://www.youtube.com/watch?v=Adw8tVlI4Nk

Process follows the following steps:



Staffing details for Mason County PUD3 Broadband:

2 customer / retailer interface folks
2 IS/IT folks - part time network (1 FTE)
6 engineers / outside plan
design residential
permits
design house to home
engineers go first - easement - permit
6 installers - communication tech.
2 person crews + supervisor
Only use fiber build and bring up poles

Total Staffing: 15 FTE

Additional related information can be found in the following links:

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Mason County PUD 3 - YouTube Channel
(many informative videos about the Mason County PUD3 - highly recommended)
https://www.youtube.com/channel/UCQYgNEHkqfum8T6RjUNeSMQ

Some customers who are interested in getting fiber optic service from Mason PUD 3 need to install a conduit to get the communication lines to their home. A vibratory plow might be a good solution. Please call the PUD 3 telecommunications department to learn more. (360) 426-8255 x. 5882.

https://www.pud3.org/
https://www.pud3.org/service/additional-services/pud-3-fiber-optic-network
https://www.pud3.org/service/additional-services/pud-3-fiber-optic-network/vibratory-plow

Mason County Video on Fiber Install
https://youtu.be/5LHObecYJwU?t=1

Rural Broadband Toolkit for Mason County
https://www.youtube.com/watch?v=9hWUrFVjkJQ

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Burying Fiber Optic with a Ditch Witch 100SX
https://www.youtube.com/watch?v=MhgVVZY2ojU

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Under sidewalk
https://youtu.be/MhgVVZY2ojU?t=233

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Installing Fiber Optic customer drops using the Ditch Witch R300 Vibratory Plow.
https://youtu.be/b5aAEclM26g?t=1

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BURYING A FIBER OPTIC CABLE! (FULL PROJECT) [4K]
https://www.youtube.com/watch?v=KuGHLFMxwb4

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City of Anacortes, Washington State Broadband

broadband@cityofanacortes.org

https://www.anacorteswa.gov/436/Fiber-Project-Background
https://www.anacorteswa.gov/984/Access---Anacortes-Fiber-Internet
https://www.anacorteswa.gov/1138/Internet-Install-Equipment
https://www.anacorteswa.gov/1104/ORDER-FORMS---Get-ACCESS
https://www.cityofanacortes.org/
https://en.wikipedia.org/wiki/Anacortes,_Washington

Fiber Project Background
The City of Anacortes is improving the reliability and speed of Internet services in town by constructing a fiber optic based internet network for commercial and residential useGreater accessibility and faster speeds translates into improved business performance which can lead to the creation of jobs, innovative business solutions, and business expansion as companies grow or relocate to Anacortes.

City Council budgeted funds for 2019 and 2020 to construct network infrastructure in three pilot areas. The City's experience in the pilot areas reasonably demonstrated the project's financial, technical & logistical feasibility. City Council funded continued expansion of the network into 2021 and beyond.

History (Anacortes, Washington)
City Council adopted Resolution 2013 outlining the City Council's desire to pursue a municipal fiber optic internet system and provides staff with the directive to prepare a business plan. The 2019-2020 biennial budget authorized a two year pilot project.

Business Plan Summary (Anacortes, Washington)
1. Build an in-house ISP
2. Outsource or partner for work that we can't do in-house
3. Focus on high-speed Internet service offering; investigate phone and TV partnerships
4. Dark Fiber leases for additional revenue
5. 1-year trial: 1000 buildings in low cost-to-construct neighborhoods
6. If successful, expand throughout the City (aim for 3 year construction schedule)
7. Staffing: 4 employees during trial, possibly expand to 6 or 7 after trial
8. Business Goals: cash flow positive in year 1 or 2, construction ROI in 15 years9. 35% market share is key

Business Plan Goals (Anacortes, Washington)
1. Deliver High Speed Residential and Business Internet Service at Competitive Prices Throughout the Community
2. Provide Excellent Customer Service
3. Achieve a Market Share of 35% or More

4. Pay for any Construction Liabilities (loans) with Subscriber Revenue
5. Achieve Payback On Construction Investment in 15-20 years
6. Become Cash Flow Positive in 2-3 years
7. Spur Local Business Development and Economic Growth

Appendix 4: Streets without Fiber Grouped Geographically

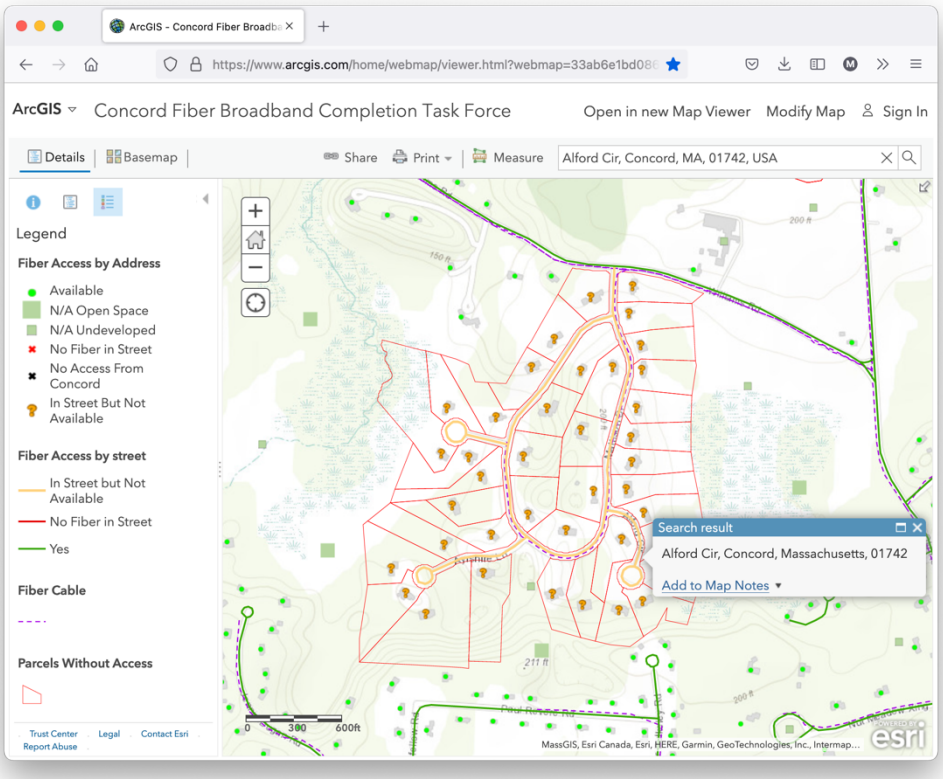
The table below includes a grouping of the neighborhoods throughout Concord that lack fiber access. This grouping was done by the Task Force based on the map data provided by the Town's Geographic Information System (GIS).

The Parcels, Number of MDU (multi-dwelling units) and length of the street as measured along the right-of-way center line are included.

Note there are other premises and individual parcels that are not served by the fiber system. This data only reflects groups of parcels that appear on the map.

The map that produced this data map be accessed here: https://www.arcgis.com/home/webmap/viewer.html?webmap=33ab6e1bd086442994735c945614ae10&extent=-71.4463,42.4187,-71.2517,42.5013

An example of a view of the map for group 2, Alford Circle is shown in this figure:



Data

Parcel Group	Street Name	Sum of Number of Parcels	Sum of MDU Units	Sum of Total Units	Sum of Feet
1	ABBOTT LN	2	42	42	1095
1 Total		**2**	**42**	**42**	**1095**
2	ALFORD CIR	6	0	6	882
	AYRSHIRE LN	5	0	5	987
	MACMILLAN DR	3	0	3	683
	MATTISON DR	25	0	25	4024
2 Total		**39**	**0**	**39**	**6576**
3	AUTUMN LN	9	0	9	1088
3 Total		**9**	**0**	**9**	**1088**
4	BAKER AVENUE EXT	1	14	14	1569
4 Total		**1**	**14**	**14**	**1569**
5	BALDWIN RD	0	38	38	391
	CORTLAND AVE	1	80	80	1624
	MACINTOSH LN	0	18	18	367
	RUSSET RD	0	16	16	491
	SPARTAN DR	0	60	60	993
5 Total		**1**	**212**	**212**	**3867**
6	BARTKUS FARM	1	12	12	2293
6 Total		**1**	**12**	**12**	**2293**
7	BARTONS WAY	3	0	3	1247
7 Total		**3**	**0**	**3**	**1247**
8	BRIDGECOURT LN	9	0	9	696
8 Total		**9**	**0**	**9**	**696**
9	BUTTRICKS HILL RD	4	0	4	1574
9 Total		**4**	**0**	**4**	**1574**
10	CEDAR WAY	3	0	3	783
10 Total		**3**	**0**	**3**	**783**
11	COMMONWEALTH AVE	4	20	20	420
11 Total		**4**	**20**	**20**	**420**
12	CONCORD XING	1	32	32	453
12 Total		**1**	**32**	**32**	**453**
13	CRANBERRY LN	1	15	15	528
13 Total		**1**	**15**	**15**	**528**
14	CRANEFIELD RD	2	0	2	278
14 Total		**2**	**0**	**2**	**278**
15	DUNBAR WAY	7	0	7	230
	FULLER LN	6	0	6	539
	PEABODY CT	6	0	6	348
15 Total		**19**	**0**	**19**	**1116**

16	EMERSON RD	7	0	7	609
	OLD MARLBORO RD	23	0	23	1767
16 Total		**30**	**0**	**30**	**2377**
17	FAR AFIELD	3	0	3	1407
17 Total		**3**	**0**	**3**	**1407**
18	GREAT MEADOWS RD	8	0	8	3859
18 Total		**8**	**0**	**8**	**3859**
19	GREENFIELD LN	1	9	9	557
19 Total		**1**	**9**	**9**	**557**
20	HEMLOCK ST	5	0	5	478
20 Total		**5**	**0**	**5**	**478**
21	INDEPENDENCE CT	1	5	5	116
21 Total		**1**	**5**	**5**	**116**
22	KENNEY LN	24	0	24	1533
	PHILIP FARM RD	14	0	14	1267
22 Total		**38**	**0**	**38**	**2800**
23	LEE DR	14	0	14	1610
23 Total		**14**	**0**	**14**	**1610**
24	LOVE LN	2	4	4	416
24 Total		**2**	**4**	**4**	**416**
25	MACONE FARM LN	3	0	3	837
25 Total		**3**	**0**	**3**	**837**
26	MIDDLESEX RD	1	14	14	3765
	PRATT LN	0	2	2	1235
	SHELDON LN	0	3	3	895
	WINSOR LN	0	6	6	761
26 Total		**1**	**25**	**25**	**6656**
27	MONUMENT SQ	2	2	4	392
27 Total		**2**	**2**	**4**	**392**
28	MUSTERFIELD RD	9	0	9	960
28 Total		**9**	**0**	**9**	**960**
29	OFF HARRINGTON AVE	5	0	5	679
	STACEY CIR	8	0	8	862
29 Total		**13**	**0**	**13**	**1540**
30	OLD MARLBORO RD	6	0	6	447
30 Total		**6**	**0**	**6**	**447**
31	OLD MILL RD	1	0	1	2463
31 Total		**1**	**0**	**1**	**2463**
32	PARTRIDGE LN	31	0	31	2567
32 Total		**31**	**0**	**31**	**2567**
33	PHEASANT LN	3	2	4	378
33 Total		**3**	**2**	**4**	**378**

34	QUAIL RUN DR	5	0	5	770
	SAW MILL RD	10	0	10	722
34 Total		**15**	**0**	**15**	**1492**
35	SOUTH MEADOW RDG	1	21	21	1202
35 Total		**1**	**21**	**21**	**1202**
36	STAFFORDSHIRE LN	1	26	26	287
36 Total		**1**	**26**	**26**	**287**
37	TANGLEWOOD DR	5	3	7	1804
37 Total		**5**	**3**	**7**	**1804**
38	THOREAU CT	3	0	3	260
38 Total		**3**	**0**	**3**	**260**
39	THOREAU ST	9	19	22	540
39 Total		**9**	**19**	**22**	**540**
40	THORNTON LN	1	7	7	560
40 Total		**1**	**7**	**7**	**560**
41	TRACEY ST	2	0	0	248
41 Total		**2**	**0**	**0**	**248**
42	UNION TPKE	0	0	0	3019
42 Total		**0**	**0**	**0**	**3019**
43	URSULA DR	1	5	5	273
43 Total		**1**	**5**	**5**	**273**
44	VIRGINIA RD	28	1	28	6971
44 Total		**28**	**1**	**28**	**6971**
45	VIRGINIA RD	1	1	1	681
45 Total		**1**	**1**	**1**	**681**
46	WALDEN ST	2	2	3	2739
46 Total		**2**	**2**	**3**	**2739**
47	WATER ST	5	6	8	402
47 Total		**5**	**6**	**8**	**402**
48	WAYSIDE RD	1	6	6	830
48 Total		**1**	**6**	**6**	**830**
49	WEDGEWOOD CMN	3	69	69	1934
49 Total		**3**	**69**	**69**	**1934**
50	WESTGATE PARK	1	0	1	488
50 Total		**1**	**0**	**1**	**488**
51	WESTVALE MDW	1	16	16	492
51 Total		**1**	**16**	**16**	**492**
52	WRIGHT FARM	1	24	24	3337
52 Total		**1**	**24**	**24**	**3337**
(blank)	(blank)				
(blank) Total					
Grand Total		**351**	**600**	**909**	**81001**

The grand total of 81,000 feet from this analysis implies there are at least 15 miles of roads remaining to complete the Fiber network in Concord.